



***FOREIGN EXCHANGE RISK EXPOSURE, HEDGING BEHAVIOUR,  
AND CORPORATE VALUATIONS:  
EVIDENCE FROM SOUTH AFRICA***

by

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## **DECLARATION**

I, the undersigned, hereby declare that this thesis is submitted by me for the award of a PhD degree at the University of Cape Town, Graduate School of Business. I further declare that this is my own independent work and has not been previously submitted in part or its entirety to any other university.

Signed by candidate

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April, 2018

## **ABSTRACT**

The international business and finance literature documents a so-called exchange rate exposure puzzle. The exchange rate exposure puzzle refers to the apparent lack of empirical support for theories posited in the finance literature which predict that in the advent of an increasingly globalising world economy, nonfinancial firms should report high levels of foreign exchange risk exposure. The majority of the studies are based on the developed market context and the emerging markets of the ASEAN region.

However, there is scant literature in the context of the emerging markets of the African continent. Considering that the estimation of foreign exchange risk exposure is based on the application of asset pricing models, and the fact that emerging markets are generally found to be partially segmented, the so-called exchange rate exposure puzzle cannot be generalised to the emerging markets of Africa.

The general aim of the study was to examine the level of foreign exchange exposure of nonfinancial firms in South Africa, hedging behaviour and their effect on corporate value, taking into account idiosyncratic factors. Foreign exchange risk exposure were estimated at more than 40% for all for proxy currencies on the basis of the standard augmented market model. However, after controlling for idiosyncratic factors exposure levels were found to range between 6.5% and 12%. These results indicate the importance of controlling for the effects of idiosyncratic factors in the estimation of foreign exchange risk exposure in the context of emerging markets. Furthermore, the study found exposure levels to be time-varying with respect to the trade-weighted exchange rate. An indirect test of asymmetric exposure revealed results that are similar to those estimated on the basis of a more direct test in the form of a Nonlinear ARDL model and these were found to be higher than those estimated on the basis of the standard model.

The study established that South African nonfinancial firms are likely to hedge using foreign currency derivatives when they have foreign sales, have lower interest coverage, have access to capital markets, are highly liquid, have higher gearing, and whose management have equity stakes in the firm. In contrast, South African nonfinancial firms were found to be more likely to hedge using foreign currency denominated debt when they are small in size, have foreign sales, are highly leveraged, have less growth opportunities, are highly liquid. The magnitude of the marginal effects show that foreign sales is the single most important determinant of the decision to hedge using foreign currency denominated debt. In contrast, managerial incentives play no role in the decision to hedge using foreign currency denominated debt.

Corporate currency risk management using foreign currency derivatives and foreign currency denominated debt was found to have no beneficial effects on corporate value. However, foreign currency denominated debt use was found to be much more effective than the use of foreign currency derivatives. The study identified the need for South African firms to adopt a more strategic approach in the management of economic foreign exchange risk exposure.

## DEDICATION

*“We are like dwarfs sitting on the shoulders of giants. We see more, and things that are more distant, than they did, not because our sight is superior or because we are taller than they, but because they raise us up, and by their great stature add to ours.”*

(John of Salisbury)

I dedicate this PhD thesis to:

- My late paternal grandfather, Moruti Maphalle Arnold Molele.
- My late paternal grandmother, Mmakhotlo Roseleah Molele.
- My late maternal grandfather, Moruti Motinki Alpheus Mangena.
- My maternal grandmother, “Mmane” Mante Mangena.
- My father, Moruti Matome Gabriel Molele.
- My mother, Mammoga Stephelina Molele.

To my children, may you draw courage and strength from this accomplishment. My wish is that you appreciate that with determination, dedication, discipline and consistency, you too can reach your dreams.

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*“The fear of the LORD is the beginning of wisdom: and the knowledge of the holy is understanding.”  
(Proverbs 9:10 KJV)*

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# CHAPTER 1

## INTRODUCTION

*“All firms involved in international trade, and conceptually even purely domestic firms, are affected by changes in currency values. Hence, persistent exchange rate volatility and the increasing globalization of business activity make foreign exchange exposure management a key component of corporate strategy”* (Booth & Rotenberg, 1990).

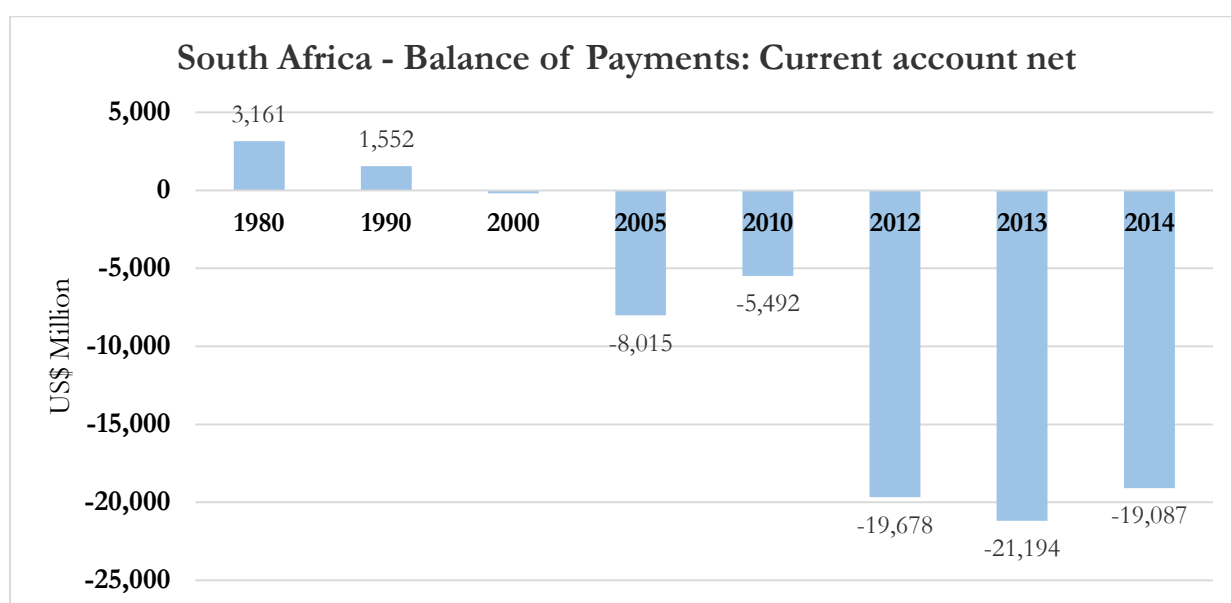
### 1.1 Background

#### ***1.1.1 Developments in foreign exchange markets***

The unravelling of a breakdown of the gold standard under the Bretton-Woods system in the period between 1971 and 1973 led many countries to remove official barriers to alternative exchange rate arrangements. Alternative exchange rate arrangements that have since emerged include a) currency board, b) conventional fixed peg, c) pegged exchange rates within horizon bands, d) crawling pegs, e) exchange rates within crawling bands, f) managed float, and g) independent float (IMF, 2016). The adoption of the fixed exchange regime has to a large extent helped to accelerate the pace of globalisation (Klein & Shambaugh, 2006).

Subsequent to the changes of the 1970s in relation to the foreign exchange market, many countries liberalised their trade and financial markets. Reform packages under the so-called Washington Consensus, encouraged developing countries in particular, to adopt a number of policy reforms including the liberalisation of trade and investment. The accession of many countries to the global trading system under the Marrakesh Agreement of 1994 establishing the World Trade Organisation (WTO) also helped accelerate the pace of globalisation in respect of global trade.

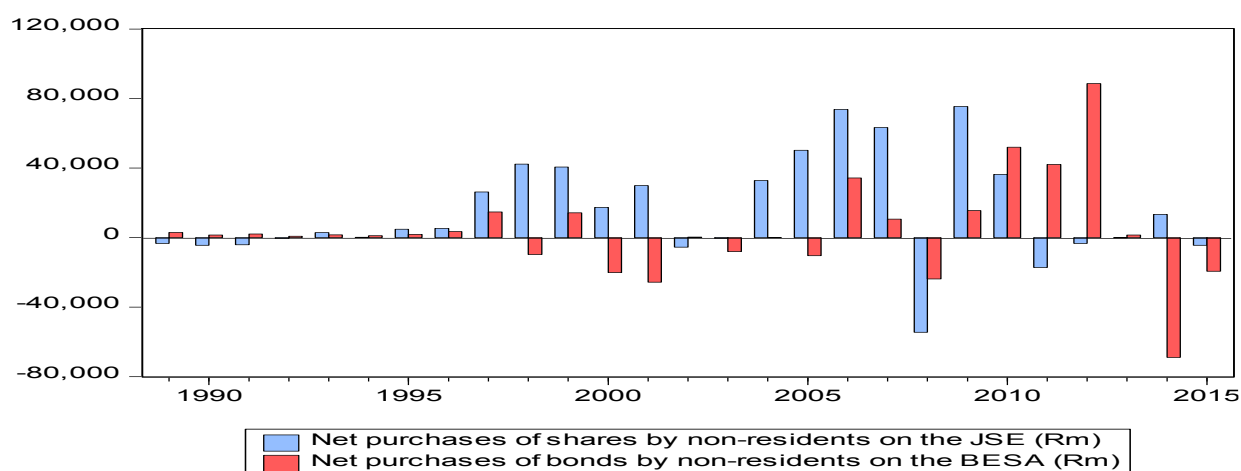
Figure 1 shows that since South Africa's accession to the WTO in the mid-nineties, the country's current account position has largely been in a net deficit position and has worsened with the passage of time. In 1994, the country adopted the so-called Growth Employment and Redistribution (GEAR) policy, which was primarily outward-focused in its orientation. The main thrust of this policy position was to put international trade at the center of the country's growth strategy with the aim of creating employment, particularly in the export-oriented manufacturing sector (Golub & Ceglowski, 2002).



**Figure 1: South Africa's Current Account Net Position; UNCTAD, 2015**

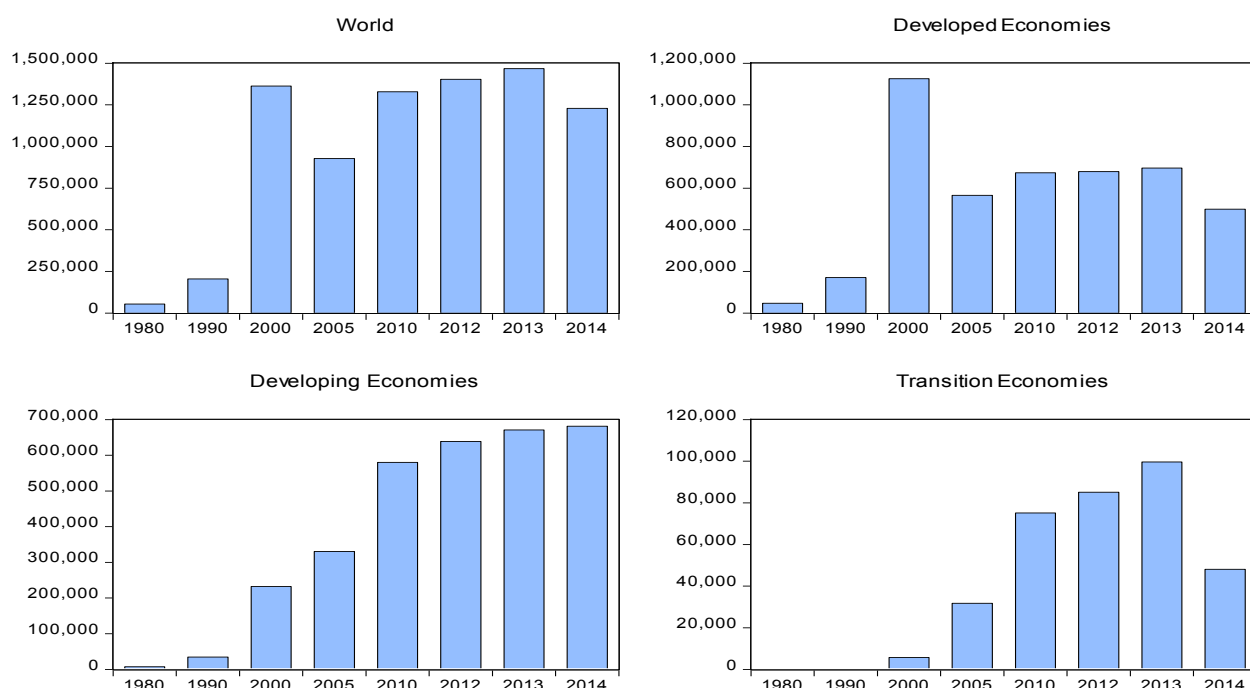
The capital account position of the country improved significantly from 1994 around the time of the accession into the WTO system. The improvement was largely due to the relaxation of exchange controls, allowing domestic residents access to international capital markets along with the availability of relatively cheap foreign trade financing (Gidlow, 2002). Institutional investors were allowed to seek diversification of their portfolios by investing in foreign markets through the use of asset swaps (Farrell & Todani, 2006).

Figure 2 illustrates that while exchange controls allowed for domestic investors to invest in foreign markets, the net result of the financial liberalisation process was that there have been net inflows of capital seeking higher returns both on the domestic equities and bond markets. It is also apparent however that this type of capital is volatile. The role of foreign capital in South Africa's equity market has been growing in prominence to the extent that by the year 2007, before the global financial crises, foreign capital accounted for 50% to 60% of daily turnover on the Johannesburg Stock Exchange (Gidlow, 2009).



**Figure 2: South Africa's Portfolio Flows, SARB**

The international integration of its domestic financial markets was not unique to South Africa. We have also witnessed an increase in international capital flows, both in the form of foreign direct investment (FDI) and portfolio flows. Global FDI rose from USD\$ 55 billion in 1985 to US\$ 628 billion in 2002, and US\$ 17 trillion in 2010 (Hommel & Prokesch, 2013). Figure 3 illustrates the fact that there has been a step change in the level of FDI inflows globally. It further demonstrates that developing economies (otherwise referred to as emerging markets) have experienced the biggest step change in FDI Inflows.



**Figure 3: Trends in Global FDI Inflows (US\$ Millions); UNCTAD, 2015**

It is thus evident that the increasing trend towards economic integration and financial integration has driven demand for foreign exchange by facilitating cross-border transactions. The free float system has however been characterised by volatile exchange rates and in those instances where benchmarks were identified, exchange rates under the floating system have proven to be excessively volatile (Hallwood & MacDonald, 2000).

By 2007, turnover on the global foreign exchange markets amounted to US\$ 3 080 989 million. It is also interesting to note that the spot market only accounted for 33% of the turnover (Eun & Resnick, 2009). The fact that there is more activity in the foreign exchange derivatives and forwards markets than in the spot market, implies that foreign exchange market participants are largely preoccupied with getting protection from the risk that comes about because of volatility, while others are speculating on the future path of exchange rates.

Long-run volatility of real exchange rates for developing countries has been found to be between 2 and 2.5 times, higher than in developed countries (Hausmann,

Panizza, & Rigobon, 2006). (Hausmann et al., 2006) show that the level of sophistication<sup>1</sup> of an economy also explains differences in volatility across countries.

In the context of developing countries, nominal exchange rate volatility is largely found to be explained by macroeconomic fundamentals (Canales, Kriljenko & Habermeier, 2004). In a study of a cross-section of eighty-five developing and transition economies, Canales et al., (2004) find that “*the volatility of nominal exchange rates is higher in countries with higher inflation and higher fiscal deficits, and lower in countries with faster real GDP growth and more open economies*”. The key message from Canales et al., (2004) is that even though external factors affect nominal exchange rate volatility, a greater proportion of the differences in the volatility of nominal exchange rates can be attributed to domestic factors.

In an increasingly integrating global economy the volatility of exchange rates poses a risk to both multinational firms and domestic firms. Much research has been dedicated to the study of the so-called foreign exchange exposure of nonfinancial firms. This area of research emerged around the same time when the Bretton-Woods system was falling apart and the period immediately thereafter and includes ((Dufey, 1972), (Heckerman, 1972), (Shapiro, 1975)).

### ***1.1.2 The role of foreign currency risk in international business***

“In the presence of deviations from parity conditions such as purchasing power parity and the international Fisher effect, nonfinancial corporations are confronted with risks stemming from the impact of unexpected exchange rate changes on the value of the firm, especially in the short- and the medium-term” (Bartram, Dufey, & Frenkel, 2005).

---

<sup>1</sup> Defined by a country's level of development and diversification of its export base

If markets were perfectly efficient, “parity conditions such as Purchasing Power Parity (PPP) and the international Fischer effect (IFE) would hold” and there would be no need for active management of foreign exchange exposure of nonfinancial firms (Aggarwal, 2011). A number of studies have been conducted which reveal limited support for the validity of both IFE and PPP (Papell, 2002; Rogoff, 1996; Frankel & Froot, 1985)

Akinboade & Makina (2006) investigated the validity of PPP between the South African Rand and the US\$ and the British £. The study spans the period between 1978 and 2003 and uses cointegration methods. The study finds that PPP is valid in the long-term. A Vector Autoregressive Model, however, revealed very weak relations in the short-term, and that only the Rand/£ exchange rate responds positively to short-term deviations in PPP relations. Thus PPP was found to hold in the short-term only with respect to Rand/£ and not the Rand/US\$ exchange rate.

More recently (Su, Chang, & Liu, 2012) conducted a study on the validity of PPP covering 15 African countries, including South Africa spanning the period between December 1994 and July 2008. Using univariate unit root and panel unit root tests they find no support for PPP in South Africa.

Aron & Ayogu (1997) found that IFE does not hold in the South African context by testing for weak form efficiency of foreign exchange markets in South Africa.

Given that empirical evidence does not support the validity of parity conditions such as IFE and PPP in the South African context, it stands to reason that South African nonfinancial companies should actively manage their foreign exchange exposure. In theory, however, there are other incentives that support the case for active management of foreign exchange exposure such as the potential to increase firm value by reducing taxes and other costs such political risk and bankruptcy costs (Aggarwal, 2011).

### ***1.1.3 Exchange rate regimes and foreign exchange risk exposure***

(IMF, 2016) provides definitions of alternative exchange rate arrangements and further provides data confirming that the majority of countries follow the floating regime (such as floating and free floating). Under the float regime exchange rates are determined by demand and supply forces in the foreign exchange market. South Africa is among the 71 countries in the world that follow the floating exchange rate regime (IMF, 2016).

(Ye, Hutson, & Muckley, 2014) investigate the effect of exchange rate regimes on firms' foreign exchange risk exposure. Out of a sample of 1523 firms across 20 countries, 94 firms are sampled from South Africa. They find that "non-floating regimes fail to protect firms from exchange rate exposure" in line with the findings of (Parsley & Popper, 2006). However, out of a total of 11 countries in the sample which follow the floating exchange regime, only South Africa and the Czech Republic reported a negative average foreign exchange exposure of firms. The negative foreign exchange exposure of South African firms despite the fact that South Africa follows the floating exchange rate regime warrants a more detailed study of foreign exchange exposure in the emerging market context of South Africa. It necessitates an investigation of firm-specific factors that may be the cause of the negative foreign exchange exposure of South African firms.

## **1.2 Problem Statement**

The study seeks to assess the extent of foreign exchange risk exposure of nonfinancial firms from an emerging market perspective. The asset pricing literature in the emerging market context of the African continent points to the idea that equity capital markets are partially segmented (Kodongo, 2011). Thus, empirical evidence based on the application of the standard market model in the developed market context may not be generalised to the emerging market context.

It is therefore necessary to account for idiosyncratic factors in the study of foreign exchange risk exposure of firms in the emerging market context of Africa. The study applies a variety of asset pricing theories in the determination of foreign exchange exposure of nonfinancial firms of the African continent, and the South African market in particular. The study is necessitated by the fact that there is scant literature on foreign exchange exposure in the emerging market context of Africa (Abor, 2005; Asaolu, 2011; Chen, Naylor, & Lu, 2004; Salifu, Osei, & Adjasi, 2007). Idiosyncratic factors affecting the pricing assets are unique to each emerging market. Thus, the body of knowledge will be enhanced by providing empirical evidence from the emerging market context of the South African context. The peculiarities of the South African market make this study interesting for both theory and practice of foreign currency risk management of nonfinancial firms. (Gossel, 2011) characterises the nominal exchange rate of the Rand in the post 1995 period as an “equity currency”, as opposed to the pre 1995 period, when the currency was more of a commodity currency. To our knowledge, this is the only currency on the African continent, which can be said to be an equity currency, since the South African financial system is not dominated by the banking system, as is the case for many other countries on the African continent. The study also models asymmetric exposure by applying a regime-switching model in the form of the Smooth Transition Autoregressive Model, a Markov-Switching Regime Model, and a Nonlinear Autoregressive Distributed Lag Model. The literature is mixed on the determinants of foreign exchange exposure in the developed market context (Bartram & Bodnar, 2007). The study fills the gap by identifying key determinants of foreign exchange exposure from an emerging market perspective, in particular, South Africa.

The hedging behaviour of nonfinancial firms in respect of their exposure to foreign exchange risk is also investigated by this study. (Bartram, Brown, & Minton, 2010) argue that hedging behaviour explains the low percentages of firms with foreign exchange exposure in the developed market context. The study further

fills the gap by providing empirical evidence of firm-specific factors affecting hedging behaviour of South African firms and how hedging behaviour in the South African context affects the nature and degree of foreign exchange exposure. Furthermore, corporate value effects of the use of foreign currency derivative instruments and foreign currency denominated debt are investigated by the study. The study concludes by recommending corporate financial policy in the measurement and management of foreign exchange risk in the emerging market context of South Africa.

To the best of my knowledge, this is the first study of its kind in the emerging market context of Africa, and more specifically the South African context.

### **1.3 Research aims and objectives**

The general aim of the study is to examine the level of foreign exchange exposure of nonfinancial firms in South Africa, hedging behaviour and their effect on corporate value, taking into account idiosyncratic factors.

#### ***1.3.1 Specific aims***

*Aim 1:* To determine the nature and degree of foreign exchange exposure of nonfinancial firms.

*Aim 2:* To establish the determinants of foreign exchange exposure.

*Aim 3:* To identify firm-specific factors affecting firm hedging behaviour.

*Aim 4:* To determine the extent of hedging activity of nonfinancial firms in South Africa.

*Aim 5:* To determine if the use of foreign currency derivatives affects firm value.

*Aim 6:* To inform corporate financial policy with regards to the management of foreign currency risk in South Africa and other emerging markets.

### **1.3.2 Objectives of the study**

*Objective 1:* To apply econometric models in the assessment of the nature and degree of foreign exchange exposure. In the first instance in the assessment of the degree of foreign exchange exposure, Seemingly Unrelated Regression (SUR) methods will be applied in the estimation of the augmented market model of (Jorion, 1990). The augmented market model will be further augmented with Fama-French type factors. In order to estimate the asymmetric exposure model of (Koutmos & Martin, 2003), nonlinear methods in the form of the Smooth Transition Autoregressive (STAR) model will be applied, Markov-Switching Regime Methods, and Nonlinear Autoregressive Distributed Lag Model (Non Linear ARDL).

*Objective 2:* To establish the determinants of foreign exchange exposure using panel regression methods in the form of the Pooled Model and a choice between the Fixed Effects and Random Effects Models.

*Objective 3:* To study the extent of hedging behaviour of nonfinancial firms in South Africa by applying Logit model.

*Objective 4:* To identify firm-specific factors affecting hedging behaviour of nonfinancial firms in South Africa by applying the Logit Model.

*Objective 5:* To determine if the use of foreign currency derivatives affects firm value through the application of panel regression methods such as the Pooled Model and a choice between Fixed Effects and Random Effects Models.

## **1.4 Research questions**

*Question 1:* What is the nature and degree of foreign exchange exposure of nonfinancial firms?

*Question 2:* What are the determinants of foreign exchange exposure?

*Question 3:* Which firm-specific factors affect the hedging behaviour of nonfinancial firms in South Africa?

*Question 4:* Which firm-specific factors affect the extent of hedging activity of nonfinancial firms in South Africa?

*Question 5:* What are the corporate value effects of corporate hedging in respect of foreign currency risk exposure?

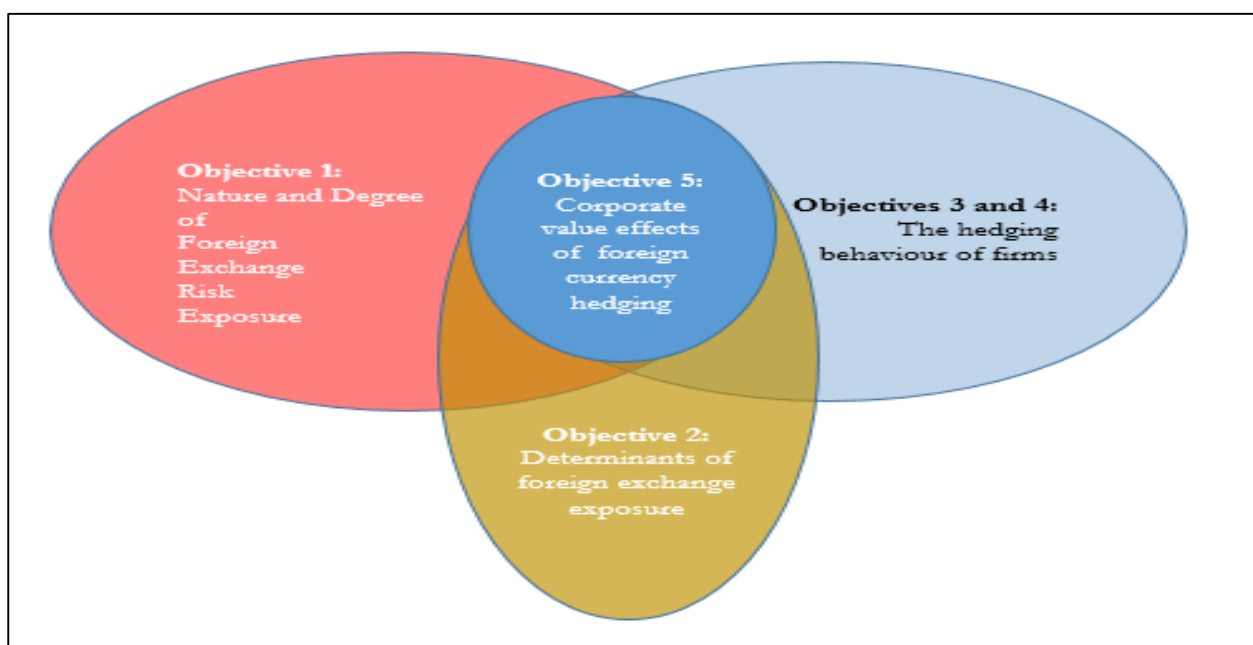
*Question 6:* How should firms measure and manage foreign exchange risk exposure in the South Africa context?

## CHAPTER 2

### THEORETICAL FRAMEWORK AND LITERATURE REVIEW

*“In the presence of deviations from parity conditions such as purchasing power parity and the international Fisher effect, nonfinancial corporations are confronted with risks stemming from the impact of unexpected exchange rate changes on the value of the firm, especially in the short- and the medium-term” (Bartram, Dufey, & Frenkel, 2005).*

#### 2.1. Theoretical Framework.



**Figure 4: A framework to assess foreign exchange risk exposure of nonfinancial firms**

In order to address the general aim of the study, the theoretical framework outlined in Figure 4 is adopted by the study. (Bartram et al., 2010; Bartram & Bodnar, 2007) outline the theoretical foundations underpinning the so-called exchange rate exposure puzzle. The exchange rate exposure puzzle refers to the apparent lack of empirical support for theories posited in the finance literature

which predict that in the advent of an increasingly globalising world economy, nonfinancial firms should report high levels of foreign exchange risk exposure. Theoretical papers in this regard include (Adler & Dumas, 1984; Dufey, 1972; Hekman, 1985). The study seeks to explore key aspects of the theories outlined in (Bartram et al., 2010; Bartram & Bodnar, 2007), which in their view explain the apparent low levels of foreign exchange risk exposure.

The literature distinguishes between three alternative definitions of foreign exchange exposure as follows: a) economic exposure, b) transaction exposure, and c) translation Exposure.

The working definition of this study is the economic foreign exchange exposure approach. Economic exposure is defined as “the sensitivity of firm value to unanticipated changes in exchange rates as reflected in stock prices” (Adler & Dumas, 1984).

## **2.2. Foreign exchange exposure of firms**

### **2.2.1 Theory**

Foreign exchange risk exposure of firms began to gain prominence in finance scholarship around the time of the breakdown of the Bretton-Woods system in the period between 1971 and 1973 (Bartram et al., 2005). Seminal works of (Dufey, 1972) and (Heckerman, 1972) are among the most cited in this strand of literature (Bartram & Bodnar, 2007; Bartram et al., 2005; Bartram & Karolyi, 2006; Booth, 1982; Chen & So, 2002; Dhanani, 2003; Glaum, 1990; Hekman, 1985; Jorion, 1990, 1991; Muller & Verschoor, 2006b).

The work of (Dufey, 1972) describes corporate financial policy contradictions that arise in the context of a multinational company/firm (MNC) that has to contend with multiple dimensions through which exchange rate variations can affect the

value of the firm. The specific case that is dealt with in the paper is now technically referred to as translation exposure or accounting exposure. (Eun & Resnick, 2009) gives a much more updated characterisation of the details outlined by (Dufey, 1972) as follows:

“Translation exposure, sometimes also called accounting exposure, refers to the effect that an unanticipated change in exchange rates will have on the consolidated financial reports of a MNC. When exchange rates change, the value of a foreign subsidiary's assets and liabilities denominated in a foreign currency change when they are viewed from the perspective of the parent firm. Consequently, there must be a mechanical means for handling the consolidation process for MNCs that logically deals with exchange rate changes”.

(Dufey, 1972) provided the first reasoned qualitative description of the likely firm-level effect of the uncertainties around exchange rates in the post-Bretton-Woods system. (Heckerman, 1972) on the other hand was a first attempt at providing a quantitative model of the effect of changes in exchange rates on firm value. The model sought to provide a technical definition of the effect of changes in the price level and exchange rates on the value of foreign operations of a MNC. The model is referred to as the present discount value (PDV) technique. The PDV technique contributed to the literature by demonstrating that the accounting approach misstated the exchange rate risk exposure by not taking into account the effects of terms of trade. According to the accounting approach of the day, the exchange rate exposure of the MNC was thought to be limited to the firm's financial assets denominated in foreign currency. The formulation of the relationship between firm value and changes in exchange rates under the PDV technique makes the fundamental assumption that sales and production quantities are constant (Hekman, 1985). This is in contrast to (Shapiro, 1975) who extends the PDV technique by relaxing the assumption of constant quantities and also working with nominal firm profits. (Shapiro, 1975) shows that pricing dynamics in the

sector within which the MNC's foreign entity operates, have a demonstrable impact on the exposure levels of the MNC.

While (Dufey, 1972; Heckerman, 1972; Shapiro, 1975) considered foreign exchange exposure from the perspective of an MNC with foreign operations, (Hodder, 1982) drew attention to the role of domestic factors such as domestic prices and the domestic inflation rate etc.

(Dumas, 1977) focuses on the impact of flexible exchange rates on the value of the trading firm. Instead of focusing on MNCs, (Dumas, 1977) investigates the effect of changes in exchange rates on the value of the trading firm in the presence of inflation. The model found that trading decisions of firms were independent of exchange and inflation risks. However, the author did point out a number of weaknesses in his study including the fact that his study was a single period study. Firms are now known to make very different strategic choices in the multi-period case when compared to the single period case. However, the paper still evoked interest in the study of the exchange risk exposure of the trading firm.

### ***2.2.1 Empirical evidence***

(Bodnar & Wong, 2003) study issues related to model structure in relation to their influence on the precision of the estimates of exchange rate exposure. They focus on US firms, and find that the return measurement horizon and model specification affect the exposure estimates in a reasonably meaningful way. Of major significance is their finding that issues related to model specification play a much more influential role than return horizon. In support of the augmented market model of (Jorion, 1990), they show that the inclusion of the market return index has significant influence over the exposure estimate. However, they go further to contribute to our understanding of the dynamics at play, by demonstrating that the type of market index chosen has a dramatic influence on the "sign and size of the exposure estimate". They attribute this finding to the

particular construction of the market index. The value-weighted market index is dominated by larger firms, which are known to engage in hedging activities, and thus exposure levels tend to be lower than in the case of the equally-weighted market index which allows for smaller firms to have better representation in the index, and since most smaller firms don't have the capability to hedge, exposure levels tend to be higher.

(Koutmos & Martin, 2003) investigate exposure levels at the industry level over two distinct periods of currency appreciation and depreciations. In particular, they sought to test the hypothesis that currency exposure is asymmetric over these two distinct periods. They find asymmetric exposure in the financial and non-cyclical sectors. They explain asymmetric exposure by relying on a number of theories such as asymmetric pricing-to-market behaviour (PTM) (Froot & Klemperer, 1989; Knetter, 1994; Marston, 1990), hysteretic behaviour (Baba & Fukao, 2000; Baldwin & Krugman, 1989; Baldwin, 1988; Christophe, 1997), and asymmetric hedging behaviour. Many other studies have been conducted at the industry level seeking to identify industry level dynamics (G. Allayannis & Ihrig, 2001; Griffin & Stulz, 2001; He & Ng, 1998).

(Muller & Verschoor, 2006c) provide yet another survey of the empirical literature on foreign exchange exposure of firms. It must, however, be pointed out that the literature reviewed in their survey is exclusively focused on studies conducted in the developed markets context. The survey synthesises the many studies that have been conducted, extracting key lessons, and identifying key questions that remain unanswered. (Muller & Verschoor, 2006c) show that despite the arguments demonstrated in the theoretical literature, demonstrating the link between firm value and exchange rate changes, there has been very limited support in the empirical literature for the exchange rate exposure hypothesis in the developed market context. The survey concludes by observing that consensus regarding the factors influencing the foreign exchange risk exposure of firms is yet to be established. However, they argue that the theoretical literature has

enhanced our appreciation of the dynamics at play in relation to the issue of exchange risk exposure. With regard to the empirical literature they conclude that the findings of the empirical literature are mixed, and that “the bulk of the evidence suggests that exchange rate fluctuations affect, to a certain extent, shareholder wealth”. “In this sense, the literature has demonstrated that exchange risk exposure does matter in both a practical and academic sense” (Muller & Verschoor, 2006c).

(Bartram & Bodnar, 2007) conducted a much more in-depth review of the empirical literature and found that in many studies conducted in the developed markets context, only 10 - 25% of the firms in the samples revealed evidence of foreign exchange exposure. This apparent contradiction between the hypothesis stated in the theoretical literature and the low exposure levels reported in the empirical literature is referred to as the exchange rate exposure puzzle (Bartram & Bodnar, 2007). Based on their review of the literature the authors suggest that the exchange rate exposure puzzle is not a consequence of the poor specification of the empirical methodology or sample selection as demonstrated by the many alternative model specifications in the literature summarised by (Muller & Verschoor, 2006c). Instead, the authors contend that the exchange rate exposure puzzle is attributed to firm level endogeneity with respect to hedging behaviour.

The empirical literature on exchange rate exposure in the emerging market context is scant and has mostly been conducted for major emerging markets such as Brazil, China, and India (Chue & Cook, 2008; Lin, 2011; Luiz & Júnior, 2012). Theory suggests that exposure levels must be higher in emerging markets due to the fact that their financial markets are known to be partially segmented, thus implying that PPP will be violated. In the African context, it has been proven that a number of markets are partially segmented (Kodongo, 2011).

The empirical literature covering emerging markets is inconclusive on the extent of exposure. It can be argued that the situation is even worse for the African context where a literature search only revealed a few papers that deal with

exchange rate exposure (Abor, 2005; Asaolu, 2011; Barr, Kantor, & Holdsworth, 2007; Molele, 2014; Salifu et al., 2007). With regards to the African context, the few studies that have been conducted have applied at best, methodologies characterising the first of three waves in the empirical literature on exchange rate exposure as characterised by (Muller & Verschoor, 2006c). This part of the literature review confirms the need to fill the gap in our understanding of the level of foreign exchange risk exposure taking into account both model specification issues as well as firm level issues with respect to hedging behaviour.

## **2.3. Determinants of foreign exchange exposure**

### ***2.3.1 Theory and evidence***

(Choi & Prasad, 1995) study firm-level and industry-level determinants of foreign exchange exposure. Their study focuses on 409 firms in the United States' manufacturing sector over the period 1978-1989. The authors examine the sensitivity of firm-level exposure to a number of factors that serve as proxies for measuring the extent of a firm's international operations. The study uses three proxies, namely: a) foreign sales revenue, b) foreign identifiable assets, and c) foreign operating profit. The study finds a positive association between firm-level exchange rate exposure and the firm's extent of foreign operations for all three proxies. The modelling approach adopted is similar to that of (Fama & French, 1992) who follow a two-step procedure. In his study on currency risk pricing at the firm-level for South Africa, (Kodongo, 2011) recommends that further work be conducted using (Fama & French, 1993).

(Aggarwal & Harper, 2010) focus on a sample of nonfinancial firms with the common characteristic of not engaging in international transactions. They define these firms as being as "domestic" firms. The study had the primary goal of measuring exchange rate exposure for domestic firms, and the secondary goal of

examining their exposure. They argue a priori, that such exposure will be similar to that of MNCs. The chosen methodology in the estimation of currency exposure is that of (Fama & French, 1992, 1993). The findings of the study report exposure levels for domestic firms that are similar to those of MNCs. They also find that exposure levels at the firm level are negatively associated with firm size and asset turnover, and “positively associated with the market to book ratio and financial leverage”. (Aggarwal & Harper, 2010) use the (Fama & French, 1993) model to examine the determinants of foreign exchange exposure.

(Agyei-Ampomah, Mazouz, & Yin, 2013) use panel regression methods to examine determinants of exposure of UK nonfinancial firms. Variables in this regard include market capitalisation of each firm (MV), the debt-to-asset ratio (DA), market-to-book ratio (MTB), and the quick ratio (QR). The study finds a positive association between DA and currency exposure, in other words, firms that are highly leveraged report higher currency exposure. MTB is found to be negatively associated with currency exposure. Given that MTB is a proxy for the firm’s growth opportunities, the results imply that such firms are likely to report currency exposure. The results for QR as a determinant are not very clear since the results vary depending on the representative exchange rate. The authors find a negative association between MV and currency exposure. In essence, the results suggest that smaller firms are more likely to be exposed to currency risk than larger firms. The authors attribute this finding to the view that larger firms are more likely to exhibit hedging behaviour (Pantzalis, Simkins, & Laux, 2001)

Many other studies have been conducted that sought to investigate the determinants of foreign exchange risk exposure, however, there is no evidence of similar studies being conducted in the South African context (Chow & Chen, 1998; Faff & Marshall, 2005; He & Ng, 1989).

## **2.4. Hedging behaviour of firms**

### **2.4.1 Theory and evidence**

Many studies have attributed the low levels of foreign exchange exposure to hedging activities of firms (Bartram & Bodnar, 2007; Bartram, Brown, & Conrad, 2011; Bartram et al., 2010). (Bartram et al., 2010) attempt to resolve the exposure puzzle by assessing the role of hedging behaviour in explaining the empirical evidence of low foreign exchange rate exposure in the developed market context.

The traditional view advanced by the Modigliani and Miller framework, which assumes perfect capital markets, asserts that risk management is irrelevant for corporate valuations (Allayannis & Weston, 2001a; Jin & Jorion, 2006; Modigliani & Miller, 1958). The assumption of a perfect capital market implies that there are no taxes, financial distress costs, transaction costs, and information costs (Charumathi & Kota, 2012).

However, there are a number of theories which have been advanced, which suggest that financial risk management through hedging activities can increase corporate value (Bessembinder, 1991; Froot, Scharfstein, & Stein, 1993; Smith & Stulz, 1985).

(Smith & Stulz, 1985) develop what they refer to as a “positive theory of hedging behaviour of value-maximising firms”. They attribute the hedging behaviour of value-maximising firms to three fundamental issues: a) taxes, b) costs of financial distress, and c) managerial risk aversion.

Bessembinder (1991) advances a theory which proposes two channels by which risk hedging by firms contribute to the creation of firm value. In the first instance, the author demonstrates that hedging activities by firms creates value by reducing agency costs. Many empirical studies have been conducted which sought to assess the effect of hedging on corporate value as well the determinants

of corporate hedging (Bartram, 2004; Belghitar, Clark, & Mefteh, 2013; Bessembinder, 1991; Géczy, Minton, & Schrand, 1997; Guay & Kothari, 2003; Jin & Jorion, 2006; Judge, 2006; Mackay & Moeller, 2007; Nance et al., 1993; Nguyen & Faff, 2002; Yong, Faff, & Nguyen, 2006).

(Géczy et al., 1997) empirically tests alternative theories of hedging behaviour of firms. They find that “firms with greater growth opportunities and financial constraints are more likely to use derivatives to reduce cash flow variation that might otherwise preclude firms from investing in valuable growth opportunities”.

(Nguyen & Faff, 2002) sought to ascertain the determinants of corporate hedging behaviour and also to establish the extent of derivatives use. The study focuses on a sample of Australian firms over two financial years i.e. the year 1999 and the year 2002. They find that “financial leverage (a proxy for financial distress costs), firm size (a proxy for financial distress cost together with the cost of setting up a corporate hedging programme), and liquidity (a proxy for the role of financial constraints in the underinvestment hypothesis) are the most important factors in affecting the likelihood that a firm will use derivatives”. Liquidity is further found to be the most influential determinant of the extent to which a company will use derivatives followed by the dividend payout ratio (a proxy for hedging substitutes). However, the study fails to find evidence of managerial incentives affecting hedging behaviour. The study further provided evidence that hedging does contribute to the creation of corporate value. The findings of the study are further corroborated by later empirical evidence such as that of (Yong et al., 2006).

## **2.5. Research questions emerging from the literature Review**

Based on the literature review, the following research questions require further investigation in the emerging market context:

- *What is the nature and degree of foreign exchange exposure of nonfinancial firms?*

- What are the determinants of foreign exchange exposure?
- Which firm-specific factors affect the hedging behaviour of nonfinancial firms in South Africa?
- Which firm-specific factors affect the extent of hedging activity of nonfinancial firms in South Africa?
- What are the corporate value effects of corporate hedging in respect of foreign currency risk exposure?
- How should firms measure and manage foreign exchange risk exposure in the South Africa context?

## **CHAPTER 3**

# **CURRENCY RISK EXPOSURE OF FIRMS IN SOUTH AFRICA**

*“The estimation of exchange rate exposure is a relatively recent area of research in international finance.’ In response to the onset of fluctuating exchange rates in 1973, managers became concerned about the impact of exchange rate fluctuations on firms”  
(Bodnar & Wong, 2003)*

*“Theory predicts sizeable exchange rate (FX) exposure for many firms. However, empirical research has not documented such exposures” (Bartram et al., 2010)*

### **3.1 Introduction**

This chapter presents an analysis of the degree of foreign exchange exposure from an emerging market perspective. The first subsection presents statistics describing key variables, the second subsection presents results of unconditional FX exposure based on alternative asset pricing models. The third subsection provides results of measures of time-varying FX exposure based on Rolling Window Regression, whilst subsection four provides empirical evidence of asymmetric FX exposure, and the fifth subsection provides evidence of firm-specific determinants of firm-level FX exposure. The last subsection provides a synthesis of the results and conclusion.

### **3.2 Foreign exchange measurement and hypothesis**

#### ***3.2.1 Asset pricing models and foreign exchange exposure measurement***

### 3.2.1.1 *The CAPM MODEL and the APT model*

The seminal paper of (Adler & Dumas, 1984) developed a simple regression model that sought to estimate in quantitative terms, the effect of exchange rate changes on firm value. (Adler & Dumas, 1984) specified the following Model:

$$R_i = \beta_{i,0} + \beta_{i,XR}XR + \varepsilon_{i,t} \quad (1)$$

where  $R_i$  refers to the equity return on firm  $i$  in period  $t$ ,  $XR_t$  refers to the change in exchange rate in period  $t$ ,  $\beta_{i,XR}$  is the measure of firm  $i$ 's sensitivity to changes in exchange rates,  $\beta_{i,0}$  is the constant term, and  $\varepsilon_{i,t}$  is the error term.

The model described in equation (1) above was criticised because it was thought that use of a single factor results in the overestimation of the effect of exchange rate changes due to the fact that the total exposure estimate was thought to also incorporate the influence of other macroeconomic factors.

(Jorion, 1990) improved on the work of (Adler & Dumas, 1984) by augmenting equation (1) with a factor that controls for the effect of other macroeconomic factors. Equation (2) describes what has come to be known as the augmented market model.

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \varepsilon_{i,t} + t \quad (2)$$

$\beta_{i,M}$  in equation (2) is the firm's market beta and measures the systemic risk of the firm.  $R_{Mkt,t}$  represents the market index. The meaning of  $\beta_{i,XR}$  changes somewhat under equation (2) because it now only measures the residual exposure in excess of the total exposure after taking out the systemic risk component. Equation (2) follows the framework outlined in the Capital Asset Pricing Model as

outlined in (Sharpe, 1964) and has subsequently been applied to studies of foreign exchange exposure in many other studies in this strand of literature (Aggarwal, Chen, & Yur-Austin, 2011; Agyei-Ampomah et al., 2013; Bartram & Bodnar, 2007; Muller & Verschoor, 2006). Equation (2) is the standard model in the study of foreign exchange exposure (Agyei-Ampomah et al., 2013). The augmentation of the CAPM by incorporating the exchange rate risk factor results in a multifactor model (otherwise known as the Arbitrage Pricing Theory (APT)) as outlined in (Ross, 1976).

(Molele, 2014) applied the SUR method in a study which sought to establish the level foreign exchange exposure on nonfinancial firm in the South African Market on the basis of the standard market model. The study spans the period July 2002 and July 2003 and a sample of 90 firms. The current study will differ from the method applied by (Molele, 2014) for the South African context, in that the exchange rate return factor  $XR_t$  will be orthogonalised in order to address the multicollinearity that may exist between the two risk factors,  $R_{Mkt,t}$  and  $XR_t$  in line with (Barr et al., 2007; Choi & Prasad, 1995; Jorion, 1991). The study will orthogonalise  $XR_t$  as follows:

$$XR_t = \mathcal{G}_m R_{Mkt,t} + \tau_{mt} \quad (4)$$

The residual in equation (3),  $\tau_{mt}$  replaces  $R_{Mkt,t}$  in the augmented market model.  $\mathcal{G}_m$  is the coefficient of  $R_{Mkt,t}$  and refers to the effect elasticity of exchange rate  $XR_t$  with respect to changes in macroeconomic factor, here represented by the market index which serves as a proxy.

### 3.2.1.2 The Fama-French 3-factor model

“Based on the prior empirical studies that analysed numerous potential risk factors, (Fama & French, 1993) proposed a three-factor model for equity stock returns, which has since become the industry standard” (Flint, Seymour, & Chikurunhe, 2016).

(Fama & French, 1993) have demonstrated that equity returns can be sensitive to size and value factors, and not just the market index. (Basiewicz & Auret, 2010; Strugnell, Gilbert, & Kruger, 2011) show that size and value effects do help to explain the variation in equity returns of firms listed on the Johannesburg Stock Exchange (JSE). (Kodongo & Ojah, 2014) and (Kodongo, 2011) apply the International Capital Asset Pricing Model (ICAPM) and Arbitrage Pricing Theory (APT) respectively, and in both cases, find that Africa’s equity markets, including South Africa are partially segmented. (Kodongo, 2011) recommends the use of (Fama & French, 1993) in order to take into account idiosyncratic factors. Thus, the study will apply the following model:

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \varepsilon_{i,t} \quad (4)$$

Where *SMB* and *HML* in equation (4) refer to the return on a portfolio of small firms minus large firms, and the return of value firms minus growth firms respectively, thus capturing size and value effects that are unique to the South African context. The use of (Fama & French, 1993) in the study of foreign exchange exposure is line with the work of (Huffman, Makar, & Beyer, 2010; Kolari, Moorman, & Sorescu, 2008). To our knowledge, this approach to the study of foreign exchange exposure has not been applied in the context of African equity markets, and this will add to the body of knowledge as recommended by (Kodongo, 2011).

### 3.2.1.3 The Carhart 4-factor model

The study will further estimate foreign exchange exposure based on the (Carhart, 1997) asset pricing model in line with the work of (Kolari et al., 2008). As stated in (Flint et al., 2016), the model is an extension of the (Fama & French, 1993) and was originally motivated by the evidence presented in the work of (Jegadeesh & Titman, 1993).

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,UMD}R_{UMD,t} + \varepsilon_{i,t} \quad (5)$$

Equation (5) augments equation (4) with an additional momentum factor,  $R_{UMD,t}$ , which is “the return on a portfolio of past winner stocks minus a portfolio of past US loser stocks” (Kolari et al., 2008). (Moskowitz, Ooi, & Pedersen, 2012) find evidence of time series momentum in a study that covers 58 indices across equity, currency, bond, and commodity markets. They find persistence in returns in the period spanning one to twelve months. The momentum factor is generally regarded as a measure of cognitive bias with regards to investor sentiment.

### 3.2.1.4 The Fama-French 5-factor model

Through the use of the (Fama & French, 2015) the study will augment equation (4) by incorporating two additional factors as follows:

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,CMA}R_{CMA,t} + \beta_{i,RMW}R_{RMW,t} + \varepsilon_{i,t} \quad (6)$$

Where  $R_{CMA,t}$  (Conservative – Minus – Aggressive) and  $R_{RMW,t}$  (Robust – Minus – Weak) are proxies for the investment and profitability factors, respectively. The inclusion of these factors is motivated by the evidence that highly profitable firms attract a significant and consistent premium, beyond the risk premium attributable to the other risk factors (Flint et al., 2016). However, the economic interpretation of the

$R_{RMW}$  is not without controversy as evidenced by the work of (Lin, 2017; Ülkü, 2017).

### **3.2.1.5 Conclusion and testable hypothesis**

In conclusion, the reader is reminded that the use of alternative asset pricing models is not meant to test the validity of the alternative models themselves in the South African context. On the contrary, the use of alternative asset pricing models is meant to assess the robustness of the estimated parameter that is meant to measure the degree of foreign exchange exposure in the South African context.

This study will therefore make important methodological contributions to the study of foreign exchange exposure in that all selected asset pricing models, with the exception of the CAPM based model of (Jorion, 1990) have never been applied in the African context, and to our knowledge, the (Fama & French, 2015) model has not been applied in the study of foreign exchange exposure even in the developed market context.

Testable hypothesis in this regard are as follows:

$H_0$  = Changes in the exchange rate have no effect on returns nonfinancial firms in South Africa.

$H_1$  = Changes in the exchange rate have no effect on returns nonfinancial firms in South Africa.

## **3.3 Econometric methods and estimation procedures**

Part of the contribution of the study is the applications of latest advances econometric methodologies in the context of emerging markets of Africa.

### 3.3.1 Estimation of conditional exposure

The study will apply the Seemingly Unrelated Regression (SUR) model of (Zellner, 1962) which takes the following form:

$$R_{it} = \alpha_i + x'_{i,t} \gamma_i + u_{i,t} \quad (7)$$

where  $E[u_{i,t} u_{j,t}] = \sigma_{i,j}$ ,  $E[u_{i,t} u_{j,s}] = 0$  for all  $i, j$  and  $t \neq s$

Equation (7) can be represented in matrix form as follows:

$$\begin{bmatrix} \mathbf{R}_1 \\ \mathbf{R}_2 \\ \vdots \\ \mathbf{R}_m \end{bmatrix} = \begin{bmatrix} X_1 & & & 0 \\ & X_2 & & \\ & & \ddots & \\ 0 & & & X_m \end{bmatrix} \begin{bmatrix} \boldsymbol{\beta}_1 \\ \boldsymbol{\beta}_2 \\ \vdots \\ \boldsymbol{\beta}_m \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_m \end{bmatrix} \quad (8)$$

where  $E[u] = 0$ ,

where  $R_{it}$ , the return on firm  $i$ , is the dependent variable, and  $X'_{it}$  is a  $1 \times k_m$  - vector of independent variables, and  $u_{it}$  are the error terms for,  $i=1,2,\dots,108$  cross-section of firms, observed in periods  $t=2003M01, 2003M02, \dots, 2015M11$ . The  $X'_{it}$  vector will comprise of  $XR_t, R_{Mkt,t}, R_{SMB,t}, R_{HML,t}, R_{UMD,t}, R_{CMA,t}$ , and  $R_{RMW,t}$  depending on the asset pricing model specified.  $\boldsymbol{\beta}_i$  in equation (8) is equivalent  $(\alpha_i \gamma_i)'$  from equation (7).

When independent variables are the same for each equation as is the case for this study, the SUR model is equivalent to equation by equation OLS regression modelling. The estimation of parameters in equation (2) through the use of the SUR model has been practiced quite extensively in the literature (Allayannis & Ihrig, 2001; Bae, Kwon, & Li, 2008; Bodnar & Gentry, 1993; Dominguez, 1998;

Khoo, 1994; Muller & Verschoor, 2006b; Priestley & Ødegaard, 2007; Williamson, 2001; Wong, Wong, & Leung, 2009)

### **3.3.2 Estimation of time-varying exposure and asymmetric exposure**

Equations (1), (2), (4), and (5) assume that firm-level currency exposure remains constant over time. However, there is the possibility that firm-level currency exposure may be time-varying due to firm-specific factors such as firm size and hedging behaviour changing over time (Agyei-Ampomah et al., 2013; Patro, Wald, & Wu, 2002). In this study, the percentage of firms which are found to be exposed to foreign exchange movements is plotted against the time dimension to observe if there is variation in foreign exchange exposure of nonfinancial firms in South Africa. The estimation is based on ordinary least squares (OLS) rolling window regression with a fixed window size of 31 observations and a step size of 1. Rolling window regression methods have been used quite extensively in the estimation of time-varying betas within the CAPM framework (Da, Guo, & Jagannathan, 2012; Fama & Macbeth, 1973; J. Lewellen & Nagel, 2006; Petkova & Zhang, 2005).

Furthermore, the literature review has demonstrated that there are theoretical grounds to expect foreign exchange exposure to be asymmetric over currency appreciation and depreciation episodes. Following (Koutmos & Martin, 2003), the study will extend the augmented market model in equation (2) by decomposing the vector  $XR_t$  into its positive and negative components, namely  $XR_t^+ = \text{Max}(XR_t, 0)$  and  $XR_t^- = \text{Max}(0, XR_t)$  and restating equation (2) as follows:

$$R_t = \alpha_i + \beta_i R_{m,t} + \theta_i^+ XR_t^+ + \theta_i^- XR_t^- + \varepsilon_{i,t} \quad (9)$$

Equation (9) “can be used to test the null hypothesis that exchange rate exposure is symmetric, i.e.,  $H_0 = \theta^+ = \theta^- = \theta$  against the alternative hypothesis that exposure is asymmetric, i.e.,  $H_1 = \theta^+ \neq \theta^-$ ” (Koutmos & Martin, 2003; Lin, 2011).

In the first instance we follow the approach of (Belghitar et al., 2013). The study applies equation (10) to indirectly assess the extent of asymmetric exposure of South African firms to the appreciation and depreciation of the South African currency relative to the US\$ i.e. USDZAR.

$$R_i = \beta_0 + \beta_{i,m} R_{mkt,t} + \beta_{i,USDZAR}^+ XR_{i,USDZAR}^+ + \beta_{i,USDZAR}^- XR_{i,USDZAR}^- + \varepsilon_{i,t} \quad (10)$$

where:

$XR_{i,USDZAR}^+$  and  $XR_{i,USDZAR}^-$  are determined by decomposing the  $XR$  factor in equation (2) into its negative and positive components; and

$\beta_{i,USDZAR}^+$  represents  $firm_i$  exposure to the appreciation of the South African Rand relative to the US\$.

$\beta_{i,USDZAR}^-$  represents  $firm_i$  exposure to the depreciation of the South African Rand relative to the US\$.

$XR_{i,USDZAR}^+$  is a vector of positive changes in the exchange rate of the South African Rand relative to the US\$.

$XR_{i,USDZAR}^-$  is a vector of negative changes in the exchange rate of the South African Rand relative to the US\$.

It must however be indicated that the indirect test provided above is not sufficient to provide conclusive evidence of asymmetric foreign exchange exposure. The study therefore conducts a direct test of asymmetric exposure based on the Nonlinear Autoregressive Distributed Lag model of (Shin, Yu, & Greenwood-Nimmo, 2014). This approach has the advantage of being able to distinguish between long-run and short-run dynamics, thus allowing us to make inferences

regarding both long-run and short-run asymmetry. The Nonlinear ARDL model in our context is represented as follows:

$$y_t = \sum_{j=1}^p \phi_j y_{t-j} + \sum_{j=1}^p (\theta_j^+ x_{t-j}^+ + x_{t-j}^-) + \varepsilon_t \quad (11)$$

An error correction model can be derived from equation (11) by following the approach of (Pesaran, Shin, & Smith, 2001):

$$\begin{aligned} \Delta y_t &= \rho y_{t-1} + \theta^+ x_{t-1}^+ + \theta^- x_{t-1}^- + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=1}^{q-1} (\phi_j^+ \Delta x_{t-j}^+ + \phi_j^- \Delta x_{t-j}^-) + \varepsilon_t \\ &= \rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=1}^{q-1} (\phi_j^+ \Delta x_{t-j}^+ + \phi_j^- \Delta x_{t-j}^-) + \varepsilon_t \end{aligned} \quad (12)$$

Where,

$$\rho = \sum_{j=1}^{p-1} \phi_j - 1, \quad y_j = -\sum_{i=j+1}^p \phi_i \quad \text{for } j=1, \dots, p-1, \quad \theta^+ = \sum_{j=0}^q \theta_j^+, \quad \theta^- = \sum_{j=0}^q \theta_j^-, \quad \phi_0^+ = \theta_0^+,$$

$$\phi_j^+ = -\sum_{i=j+1}^q \theta_i^+ \quad \text{for } j=1, \dots, q-1, \quad \phi_0^- = \theta_0^-, \quad \phi_j^- = -\sum_{i=j+1}^q \theta_i^- \quad \text{for } j=1, \dots, q-1 \quad \text{and} \quad \xi_t = y_t - \beta^+ x_t^+ -$$

$\beta^- x_t^-$  is the nonlinear error correction term where  $\beta^+ = -\theta^+ / \rho$  and  $\beta^- = -\theta^- / \rho$  are

the associated asymmetric long-run parameters" (Shin et al., 2014). (Shin et al., 2014) further show that equation (12) can be manipulated through algebra to arrive at a conditional nonlinear error correction model as follows:

$$\Delta y_t = \rho \xi_{t-1} + \sum_{j=1}^{p-1} \gamma_j \Delta y_{t-j} + \sum_{j=1}^{q-1} (\pi_j^+ \Delta x_{t-j}^+ + \pi_j^- \Delta x_{t-j}^-) + e_t \quad (13)$$

where,  $\pi_0^+ = \theta_0^+ + \omega$ ,  $\pi_0^- = \theta_0^- + \omega$ ,  $\pi_j^+ = \phi_j^+ - \omega' \Lambda_j$ ,  $\pi_j^- = \phi_j^- - \omega' \Lambda_j$  for  $j=1, \dots, q-1$ .

Thus, the study will apply the following NARDL model:

$$\Delta R_t = c + \theta_1^+ MKt_{t-1}^+ + \theta_1^- MKt_{t-1}^- + \theta_2^+ USDZAR_{t-1}^+ + \theta_2^- USDZAR_{t-1}^- +$$

$$\sum_{j=1}^{p-1} \psi_j \Delta R_{t-j} + \sum_{i=0}^q \pi_{1,i}^+ \Delta MKt_{t-i}^+ + \sum_{i=0}^q \pi_{1,i}^- \Delta MKt_{t-i}^- + \sum_{i=0}^q \pi_{2,i}^+ \Delta USDZAR_{t-i}^+ + \sum_{i=0}^q \pi_{2,i}^- \Delta USDZAR_{t-i}^- + e_t \quad (14)$$

To estimate equation (14) for each of the firms in the sample we conduct Stepwise Least Squares regression using EViews 9.5 software. We specify the equation for each firm by listing the first difference of the return (R) of firm  $i$  as the dependent variable, denoted by D(R), followed by five (5) regressors as follows: the intercept, denoted by C, the first lagged term of the return of firm  $i$ , denoted by R(-1), the first lagged term of the partial sum of positive change in the market return, denoted by Mkt\_P(-1), the first lagged term of the partial sum of negative change in the market return, denoted by Mkt\_N(-1), the first lagged term of the partial sum of positive change in the exchange rate, denoted by USDZAR\_P(-1), the first lagged term of the partial sum of negative change in the exchange rate, denoted by USDZAR\_N(-1). Search regressors are the lagged differenced terms of each of the independent regressors up to lag 12 in line with the suggestion of (Shin et al., 2014). The final model is specified by searching for appropriate lagged terms on the basis of the backward selection method with the p-value serving as the stopping criteria. This is the so-called general-to-specific model specification approach.

The study will further apply the Smooth Transition Autoregression (STAR) model in the estimation of foreign exchange exposure as suggested by (Teräsvirta, 1994; Van Dijk, Teräsvirta, & Franses, 2002). This model is particularly appealing because it incorporates regime-switching behaviour into the modelling framework. Following (Luiz & Júnior, 2012), the study will model regime-switching behaviour based on the following alternate equation:

$$R_{i,t} = \alpha_i + \beta_{i,mkt} * R_{mkt,t} + \left\{ \beta_{i,USDZAR} + \beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d}) \right\} * XR + \varepsilon_{i,t} \quad (15)$$

Where  $\{\beta_{i,USDZAR} + \beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d})\}$  is a measure of foreign exchange exposure, comprising of two components.  $\beta_{i,USDZAR}$  represents the linear component, and  $\beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d})$  represents the nonlinear component. In this sense  $G_i(\gamma, c, z_{t-d})$  is a bounded, continuous, and smooth transition function, where  $\gamma$  is a slope parameter that determines the velocity of the transition,  $c$  is a vector of location parameters which determines the location of the switch in regime. The particular functional form adopted in the study will vary between the following two cases and will be determined on the basis of objective criteria which will be set out below:

$$\text{Logistic function: } G(\gamma, c, z_{t-d}) = \{1 + \exp[-\gamma(z_t^i - c)]\}^{-1}, \gamma > 0 \quad (16)$$

$$\text{Exponential function: } G(\gamma, c, z_{t-d}) = 1 - \exp[-\gamma(z_t^i - c)^2] \quad (17)$$

The study will follow the modelling cycle of the STAR model as outlined in (Teräsvirta, 1994; Van Dijk et al., 2002) which proceeds by specifying the model, estimating the parameters, and lastly the evaluation of the model. The specification of the STAR model comprises of two stages. In the first instance, linearity tests are conducted in order to assess the appropriateness of specifying a nonlinear model in the form of the STAR model, and in the second stage, a choice is made between the particular functional form of  $G(\gamma, c, z_{t-d})$  in the STAR model i.e. a choice between the Logistic STAR (LSTAR) model and the Exponential STAR (ESTAR) Model.

Tests of linearity against both the LSTAR and ESTAR model are set out in (Van Dijk et al., 2002). The choice between LSTAR and ESTAR model is made on the basis of a sequential test of null hypotheses as set out in (Teräsvirta, 1994).

Enders (2015) provides a more precise and simpler outline of the problem of testing for linearity on the basis of traditional LM tests as follows:

Assume a LSTAR model as follows:

$$y_t = \alpha_i + \alpha_1 y_{t-1} + (\beta_0 + \beta_1 y_{t-1}) [1 + \exp(-\gamma(y_{t-1} - c))]^{-1} + \varepsilon_t \quad (18)$$

$$\theta = [1 + \exp(-\gamma(y_{t-1} - c))]^{-1} \equiv [1 + \exp(-h_{t-d})]^{-1} \quad (19)$$

so that  $h_{t-d} = (-\gamma(y_{t-1} - c))$

A third-order Taylor series expansion of  $\theta$  with respect to  $h_{t-d}$  evaluated around  $h_{t-d} = 0 =$

$$\theta \cong \theta(0) + \theta'(0)h_{t-d} + \frac{\theta''(0)h_{t-d}^2}{2} + \frac{\theta'''(0)h_{t-d}^3}{6} \dots \dots \dots (20)$$

where  $\theta(0)$ ,  $\theta'(0)$ ,  $\theta''(0)$ , and  $\theta'''(0)$  are the derivatives of evaluated at  $h_{t-d} = 0$

Enders (2015) illustrates that with more elaborate algebra, it is possible to obtain the following partial derivatives:

$$\begin{aligned} \frac{\partial \theta}{\partial h_{t-d}} &= \frac{e^{-h_{t-d}}}{(1 + e^{-h_{t-d}})^2} && \text{equals } 1/4 \text{ at } h_{t-d} = 0 \\ \frac{\partial^2 \theta}{\partial h_{t-d}^2} &= \frac{-e^{-h_{t-d}}(1 - e^{-h_{t-d}})}{(1 + e^{-h_{t-d}})^3} && \text{equals } 0 \text{ at } h_{t-d} = 0 \\ \frac{\partial^3 \theta}{\partial h_{t-d}^3} &= \frac{e^{-h_{t-d}}(1 + e^{-2h_{t-d}} - 4e^{-h_{t-d}})}{(1 + e^{-h_{t-d}})^4} && \text{equals } -1/8 \text{ at } h_{t-d} = 0 \end{aligned}$$

The above partial derivatives point to the ideal expansion of  $\theta$  taking the following form Enders (2015):

$$\theta = h_{t-d}/4 - h_{t-d}^3/48 \quad (21)$$

Such that

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + (\beta_0 + \beta_1 y_{t-1} + \dots + \beta_p y_{t-p}) + \left( h_{t-d}/4 - h_{t-d}^3/48 \right) + \varepsilon_t \quad (22)$$

Given that  $h_{t-d}$  is linear in  $y_{t-d}$ , [i.e.,  $h_{t-d} = (-\gamma(y_{t-d} - c))$ ], the LSTAR model can be written in the following form:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + \alpha_{11} y_{t-1} y_{t-d} + \dots + \alpha_{1p} y_{t-p} y_{t-d} + \alpha_{21} y_{t-1} y_{t-d}^2 + \dots + \alpha_{2p} y_{t-p} y_{t-d}^2 + \alpha_{31} y_{t-1} y_{t-d}^3 + \dots + \alpha_{3p} y_{t-p} y_{t-d}^3 + \dot{\alpha}_t \quad (23)$$

Enders (2015) finally concludes that in the final analysis the presence of nonlinear behaviour in the form of a LSTAR model can be tested on the basis of the following regression model

$$e_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_p y_{t-p} + \alpha_{11} y_{t-1} y_{t-d} + \dots + \alpha_{1p} y_{t-p} y_{t-d} + \alpha_{21} y_{t-1} y_{t-d}^2 + \dots + \alpha_{2p} y_{t-p} y_{t-d}^2 + \alpha_{31} y_{t-1} y_{t-d}^3 + \dots + \alpha_{3p} y_{t-p} y_{t-d}^3 + \dot{\alpha}_t \quad (24)$$

A hypothesis test of linearity of the model is therefore conducted through the standard F-test is as follows:

$$\alpha_{11} = \dots = \alpha_{1p} = \alpha_{21} = \dots = \alpha_{2p} = \alpha_{31} = \dots = \alpha_{3p} = 0$$

The estimation of the parameters of the STAR Model will be made with the aid of EViews 10 Beta Version which applies Conditional Maximum Likelihood methods in the estimation of the STAR as set out in (Teräsvirta, 1994).

The study will adopt the “two-regime” interpretation of the STAR model as outlined in (Van Dijk et al., 2002), where  $G(\gamma, c, z_{t-d}) = 0$   $G(\gamma, c, z_{t-d}) = 1$  can be associated with currency depreciation (currency appreciation) at each extreme, and the transition between the regimes occurs in a smooth fashion. This model is appropriate because it assumes that foreign exchange exposure of firms will not be sudden, but will change smoothly in accordance with the size of the change in exchange rates (Luiz & Júnior, 2012). Thus, to assess asymmetric exposure in the South African context the following hypothesis is tested for each firm in the sample:

$H_0$  = Firm returns of nonfinancial firms respond symmetrically to changes in the exchange rates.

$H_1$  = Firm returns of nonfinancial firms respond asymmetrically to changes in the exchange rates.

### 3.3.2 Panel regression model assessing determinants of exposure

This part of the study will apply two panel regression models i.e. the pooled model and a choice between the random effects model and the fixed effects model as follows. Table 1 provides a description of alternative panel regression models.

**Table 1: Alternative Panel Regression Models**

	The Pooled Model	Fixed Effects Model	Random Effects Model
The Model	$y_{it} = \alpha + x'_{it}\beta + u_{it}$	$y_{it} = \alpha_i + x'_{it}\beta + u_{it}$	$\frac{\partial E(y_i / x_i, \beta)}{\partial x_{ij}} = f(-x'_i\beta)\beta_j$ where $\varepsilon_{it} = \alpha_i + e_{it}$ $var(\varepsilon_{it}) = \sigma_\alpha^2 + \sigma_e^2$ and $cov(\varepsilon_{it}, \varepsilon_{is}) = \sigma_\alpha^2$
Assumptions	constant coefficients	Heterogeneity across firms modelled by $\alpha_i$ , assumed to be correlated with explanatory variables.	Heterogeneity across firms modelled by $\alpha_i$ , assumed to be uncorrelated with explanatory variables.

$y_{it}$  refers to currency exposure for firm  $i$  at time  $t$ .  $x'_{it}$  is a vector of explanatory factors limited to the following firm-specific factors, “market capitalisation ( $MV$ ), debt-to-assets ratio ( $DTA$ ), market-to-book ratio ( $MTB$ ), and quick-ratio ( $QR$ ) which serve as proxies for firm size, financial distress, growth opportunities, and asset liquidity” (Agyei-Ampomah et al., 2013).

It must, however, be noted that the issue of endogeneity in the model means that the application of the pooled model might result in biased estimates. The pooled model produces biased estimates because, despite its consistence, it still lacks efficiency when compared to the fixed effects and random effects model. To ensure comparability with previous studies, the study will continue to apply the pooled

model. The study will further rely on the fixed effects and random effects model. The Hausman Test will be utilised to determine if the fixed effects or the random effects model is appropriate. The Hausman test statistic is given as follows:

$$H = (\hat{\beta}_{RE} - \hat{\beta}_{FE})' (V(\hat{\beta}_{RE}) - V(\hat{\beta}_{FE})) (\hat{\beta}_{RE} - \hat{\beta}_{FE})$$

and follows a chi-squared distribution.

The random effects model is chosen if the Hausman test statistic is proven to be insignificant, otherwise, the fixed effects model is appropriate.

### **3.4 Data and descriptive statistics**

The study examines FX exposure of nonfinancial firms listed on the JSE in the period 2002 and 2015. The original sample of JSE listed nonfinancial firms comprised of 309 firms, however, the final sample comprises of 108 nonfinancial firms. The criteria for inclusion in the final sample is that a firm should have no missing values of monthly share prices in the period January 2002 and 2015 November. Share prices for each firm are collected from INETBFA.

The Trade-Weighted Exchange rate of the Rand (TWC) in nominal terms is collected from the Bank of International Settlements (BIS). Foreign exchange rate data for the USDZAR, EURZAR, and GBPZAR are obtained from INETBFA. Asset pricing risk factors based on (Carhart, 1997; Fama & French, 1993, 2015) are collected from Peregrine Quantitative Research. Key risk factors in this regard are the Mkt, Size, Value, Momentum, Profitability, and Investment risk factors.

Table 3 presents summary statistics for exchange rates, orthogonalised exchange rates, and asset pricing risk factors in monthly frequencies. Panel A shows that mean values for TWC, USDZAR, EURZAR, and GBPZAR are -0.0034, 0.0033, 0.0034, and 0.0029 respectively. The USDZAR has the highest maximum return

whilst TWC has the lowest minimum return over the period. The standard deviation of the USDZAR is highest when compared to the other exchange rates.

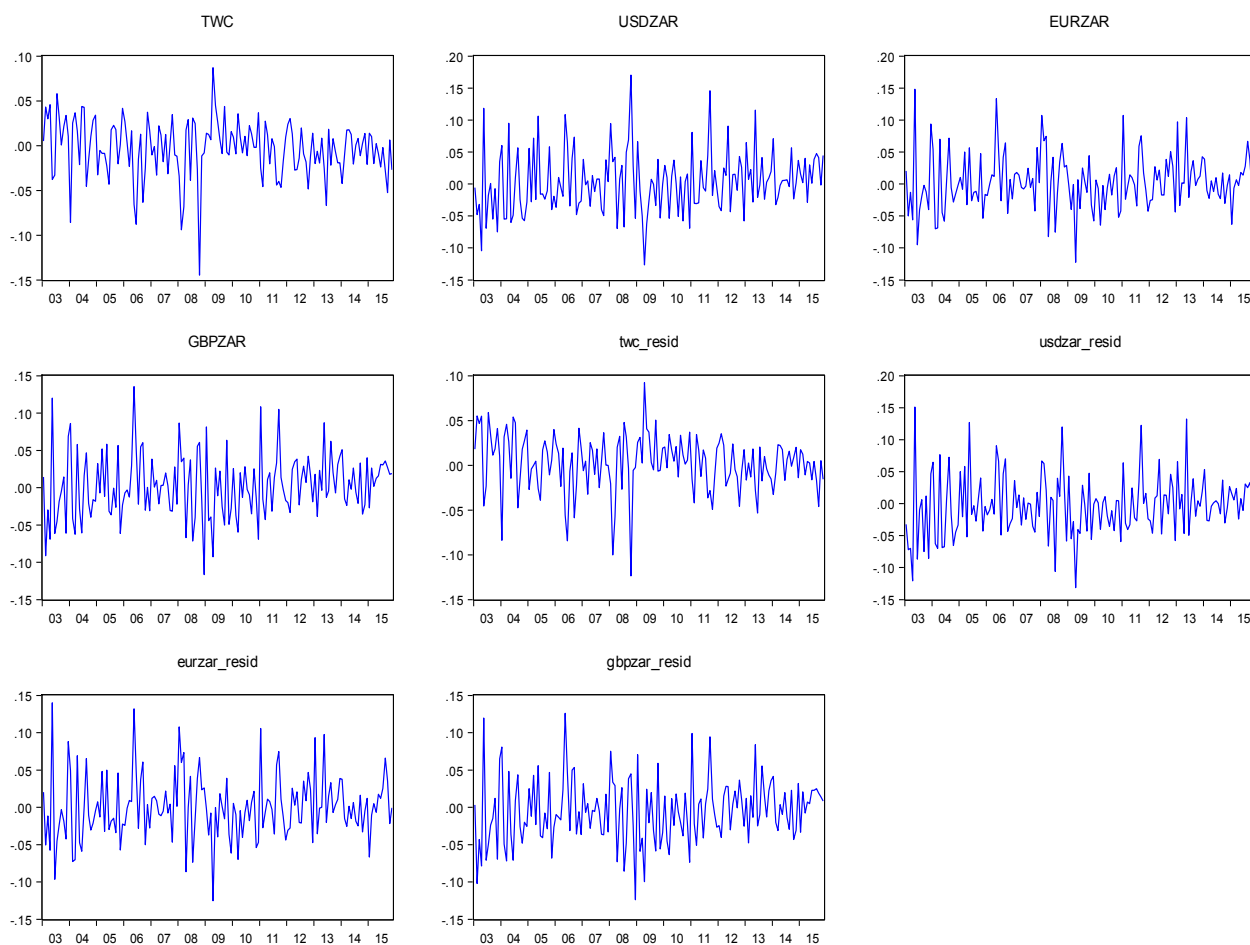
### **3.4.1 Returns of nonfinancial firms in South Africa**

The sample for the study comprises of 108 nonfinancial firms listed on the Johannesburg Stock Exchange (JSE). The study spans the period February 2002 and November 2015. Share price data of nonfinancial firms and the 3-month T-Bill data ( $R_{0t}$ ) used to compute excess returns were collected from INET-BFA. Excess returns (ER) of nonfinancial firms were computed as follows:

$$ER_{it} = R_{it} - R_{0t}$$

Figure 4 illustrates the evolution of excess returns of listed nonfinancial firms in South Africa. It is clear that excess returns exhibit volatility clustering and that most of the cases of extreme volatility are common to all firms and tend to be related to some macroeconomic factors. For example, the period between June 2007 and January 2010 is characterised by sharp spikes in the returns of most of the nonfinancial firms in South Africa. The period between June 2007 and January is generally known having been characterised by a global financial crises which affected most capital markets, including equity and currency markets.

### 3.4.2 Evolution of changes in exchange rates of the South African Rand



**Figure 4: Exchange rates of the Rand and orthogonalised exchange rates**

Figure 5 illustrates the evolution of exchange rates of the South African Rand relative to the US\$ (USDZAR), the Euro (€) (EURZAR), the British Pound (£) (GBPZAR), and the trade-weighted exchange rate (TWC). The orthogonalised exchange rates, computed in line with equation (3). The differences are not that much apparent when one observes the evolution of the two exchange rate measure.

Panel A and Panel B in Table (2) provides summary statistics which allow for the understanding of the distribution of the four alternative exchange rate proxies considered in the study.

**Table 2: Summary statistics for exchange rates and orthogonalised exchange**

<b>Panel A:</b> Summary statistics for exchange rates					
	Mean	Median	Maximum	Minimum	Std. Dev.
TWC	-0.0034	-0.0009	0.0870	-0.1444	0.0316
USDZAR	0.0033	0.0007	0.1702	-0.1264	0.0480
EURZAR	0.0034	-0.0010	0.1483	-0.1223	0.0430
GBPZAR	0.0029	0.0005	0.1356	-0.1166	0.0426

<b>Panel B:</b> Summary statistics for orthogonalised exchange rates. Obtained by regressing the exchange rate factor as a function of MKT factor and obtaining residuals.					
	Mean	Median	Maximum	Minimum	Std. Dev.
TWC_RESID	0.002	0.004	0.092	-0.124	0.031
USDZAR_RESID	-0.002	-0.001	0.151	-0.131	0.048
EURZAR_RESID	0.0004	-0.002	0.140	-0.125	0.043
GBPZAR_RESID	-0.005	-0.007	0.126	-0.124	0.043

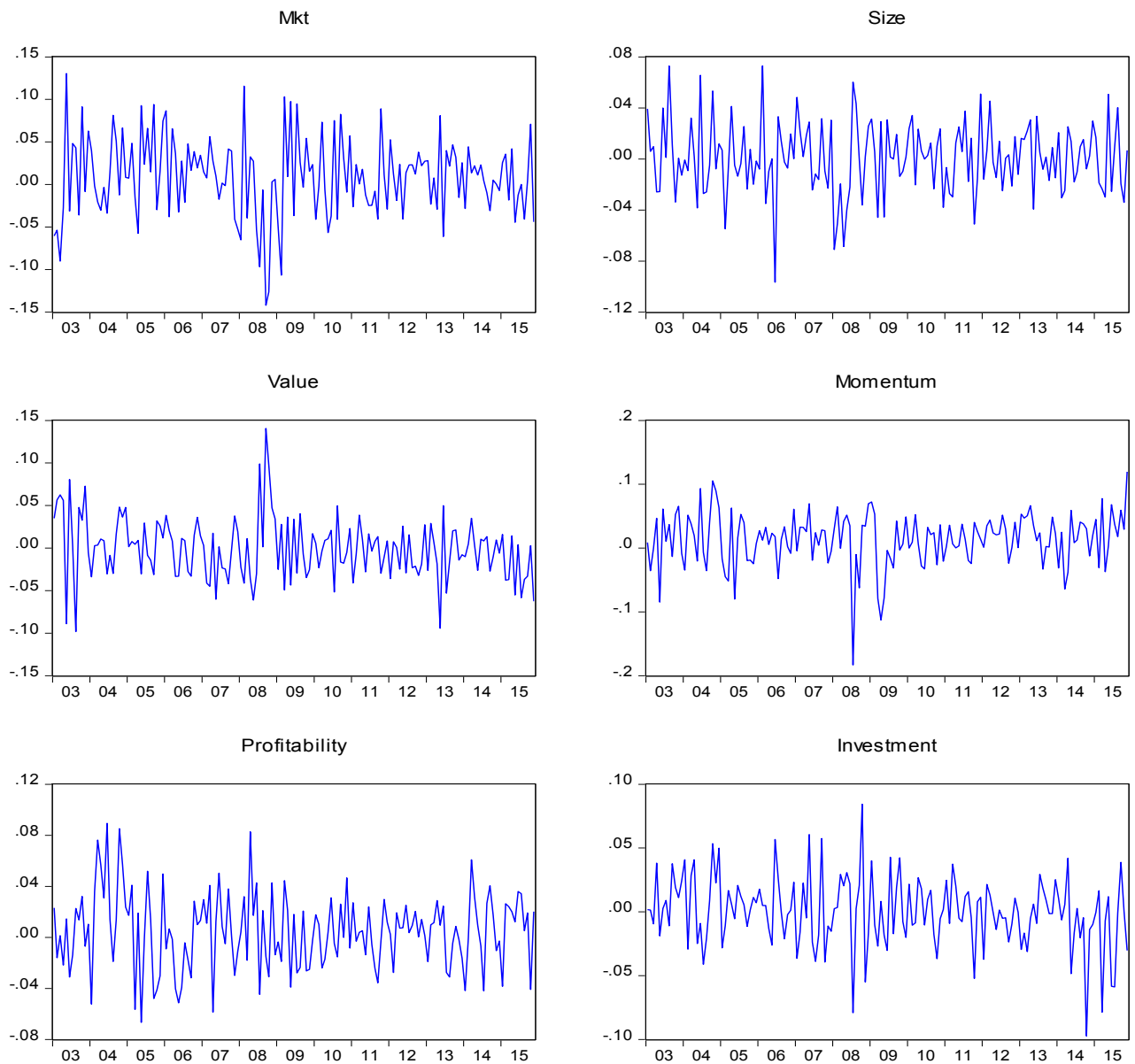
### 3.4.3 Asset pricing idiosyncratic risk factors

Data on idiosyncratic factors applied in the study was collected from Peregrine Factor Data Library<sup>2</sup>. The construction of the risk factors covered in the database is detailed in (Flint et al., 2016)

**Table 3: Summary statistics of asset pricing risk factors**

<b>Panel C:</b> Summary statistics for asset pricing risk factors					
	Mean	Median	Maximum	Minimum	Std. Dev.
MKT	0.009	0.010	0.130	-0.142	0.047
SIZE	0.001	0.001	0.073	-0.097	0.028
VALUE	-0.001	0.003	0.141	-0.098	0.036
MOMENTUM	0.014	0.019	0.119	-0.183	0.042
PROFITABILITY	0.005	0.007	0.089	-0.067	0.030
INVESTMENT	0.0002	0.0005	0.084	-0.097	0.027

<sup>2</sup> This is an open-source library providing a growing database of South African equity risk factors constructed as per international asset pricing literature.



**Figure 5: Asset Pricing Risk Factors**

### 3.5 Empirical results of unconditional exposure

In this section, we present the results of estimates of foreign exchange exposure based on the standard CAPM framework of (Sharpe, 1964) in line with (Jorion, 1990), the three-factor asset pricing model of (Fama & French, 1993), the four-

factor asset pricing model of (Carhart, 1997), and the five-factor asset pricing model of (Fama & French, 2015). The study applies the SUR model under the feasible GLS specification, which as outlined in section 3.3.1 is equivalent to equation by equation ordinary least squares regression modelling, given the fact that regressors are identical across the system of equations. The SUR model executed through the EViews 9.5 software. The presentation of the results will be done separately for each asset pricing model to ensure ease of comparison of the results across the asset pricing models. We also compare and contrast total foreign exchange exposure to residual foreign exchange exposure as defined in equation (3).

### **3.5.1 Empirical tests based on the CAPM framework**

Table (4) provides a summary of the results of estimates of both total foreign exchange exposure and residual foreign exchange exposure of nonfinancial firms in South Africa in respect of the trade-weighted currency (TWC), USDZAR, EURZAR, and GBPZAR. The estimation is on the basis of the standard (Jorion, 1990). Exposure to the market risk factor is provided for the sake of completeness, however, given the fact that the focus of the study is on foreign exchange exposure, more depth and rigour in analyses will be done in respect of the exchange rate risk factor.

**Table 4: Pooled Feasible GLS regression results for the 2-factor model of foreign exchange exposure**

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \varepsilon_{i,t}$$

		Total Exposure				Residual Exposure			
		TWC	USDZAR	EURZAR	GBPZAR	TWC	USDZAR	EURZAR	GBPZAR
Mkt Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Mean	0.68	0.68	0.72	0.71	0.72	0.75	0.73	0.73
	Minimum	-0.44	-0.53	-0.33	-0.38	-0.36	-0.40	-0.38	-0.35
	Maximum	2.09	2.08	2.14	2.14	2.17	2.21	2.14	2.16
	Percentage of firms with Significant Market Risk Exposure	<b>76.9%</b>	<b>76.9%</b>	<b>78.7%</b>	<b>77.8%</b>	<b>79.6%</b>	<b>79.6%</b>	<b>78.7%</b>	<b>78.7%</b>
FX Exposure Coefficient ( $\beta_{i,XR}$ ) $\beta_i$ :	Mean	0.37	-0.17	-0.19	-0.19	0.37	-0.17	-0.20	-0.19
	Minimum	-0.99	-0.83	-0.81	-0.87	-0.99	-0.83	-0.81	-0.87
	Maximum	1.25	1.42	1.35	1.28	1.26	1.41	1.35	1.27
	Percentage of firms with Significant FX Exposure	<b>43.5%</b>	<b>40.7%</b>	<b>43.5%</b>	<b>41.7%</b>	<b>42.6%</b>	<b>40.7%</b>	<b>41.7%</b>	<b>38.9%</b>
R <sup>2</sup>	Positive	88	29	27	31	89	28	27	31
	Negative	20	79	81	77	19	80	81	77
F-stat		10.59** (0.00)	10.69** (0.00)	10.96** (0.00)	10.97** (0.00)	10.94** (0.00)	10.71** (0.00)	10.95** (0.00)	10.97** (0.00)

The estimation of foreign exchange exposure is based on a sample spanning the period 2003M01 to 2015M11. This table shows a summary of the hypothesis test results of foreign exchange exposure of a sample of 108 nonfinancial firms listed on the JSE, as set out in section 3.2.1.5. The results are presented across four different proxies of the exchange rate  $XR_t$ , i.e. TWC, USDZAR, EURZAR, and GBPZAR. The Pooled Feasible GLS Model implemented through EViews 9.5 package corrects for cross-section heteroscedasticity, thus resulting in robust standard errors and t-statistics. By definition, the residual exposure reported in this study is estimated on the basis of an orthogonalised exchange rate factor as defined in equation (3).  $R^2$  is the coefficient of determination. The figures in the parenthesis are the p-values applied along with the F-stat in a hypothesis test of overall model fit i.e. that  $(\beta_{i,M})\beta_i = (\beta_{i,XR}) = 0$ . (\*\*) and (\*) represent significance at the 5% and 10% respectively. Detailed firm level exposure coefficients and p-values which were used in conducting hypothesis tests as specified in section 3.2.1.5 are provided in Appendix A, under Panel A and Panel B in (6).

Table 4 reports systematic risk exposure of nonfinancial firms as 76.9%, 76.9%, 78.7%, and 77.8% for specifications of equation (2) involving TWC, USDZAR, EURZAR, and, GBPZAR exchanges rate as alternative proxies, respectively. After correcting for possible multicollinearity between the exchange rate risk factor and the market risk factor as defined in equation (3), systematic risk exposure is reported as 79.6%, 79.6%, 78.7%, and 78.7% for the TWC, USDZAR, EURZAR, and GBPZAR exchange rate proxies, respectively.

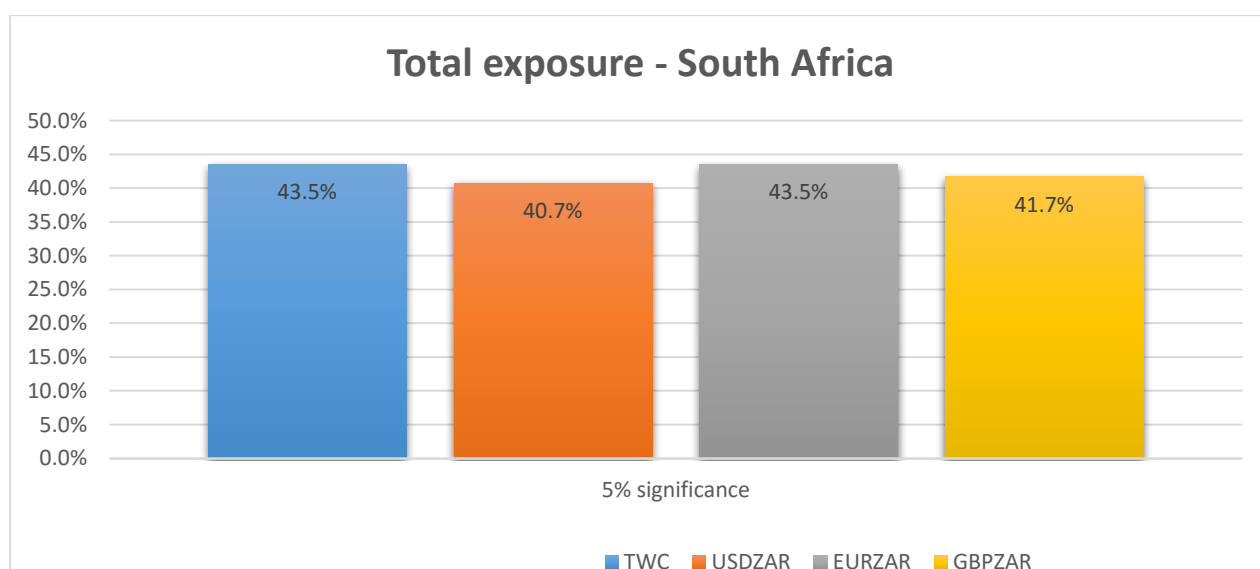
It appears that correcting for possible multicollinearity has only made marginal impact on the estimated level of systematic risk exposure. The systematic risk beta ranges in size from a minimum of -0.44 to a maximum of 2.09, with an average of 0.68 for the specification under the trade-weighted exchange rate proxy. For the USDZAR, the systematic risk beta ranges in size from a minimum of -0.55 to a maximum of 2.08, with an average of 0.68. For the EURZAR, The systematic risk beta ranges in size from a minimum of -0.33 to a maximum of 2.14, with an average of 0.72. For the GBPZAR, The systematic risk beta ranges in size from a minimum of -0.38 to a maximum of 2.14, with an average of 0.71.

Significant impact in respect of correction for multicollinearity is noticed in relation to the magnitude of the systematic risk beta in respect of the specifications involving the trade-weighted exchange rate and the USDZAR. For example, the maximum of the systematic risk beta increases from 2.09(2.08) to 2.17(2.21) for the TWC (USDZAR). The results for EURZAR mirror those of GBPZAR. There is a very limited impact with respect to the correction of multicollinearity in respect of specifications involving EURZAR and GBPZAR. The fact that systematic risk betas under TWC and USDZAR are similar and react in a similar manner with respect to adjustments that are made to correct for multicollinearity raises a key empirical question, particularly considering that specifications involving EURZAR and GBPZAR report systematic risk betas that show little response to the adjustment made to correct for multicollinearity.

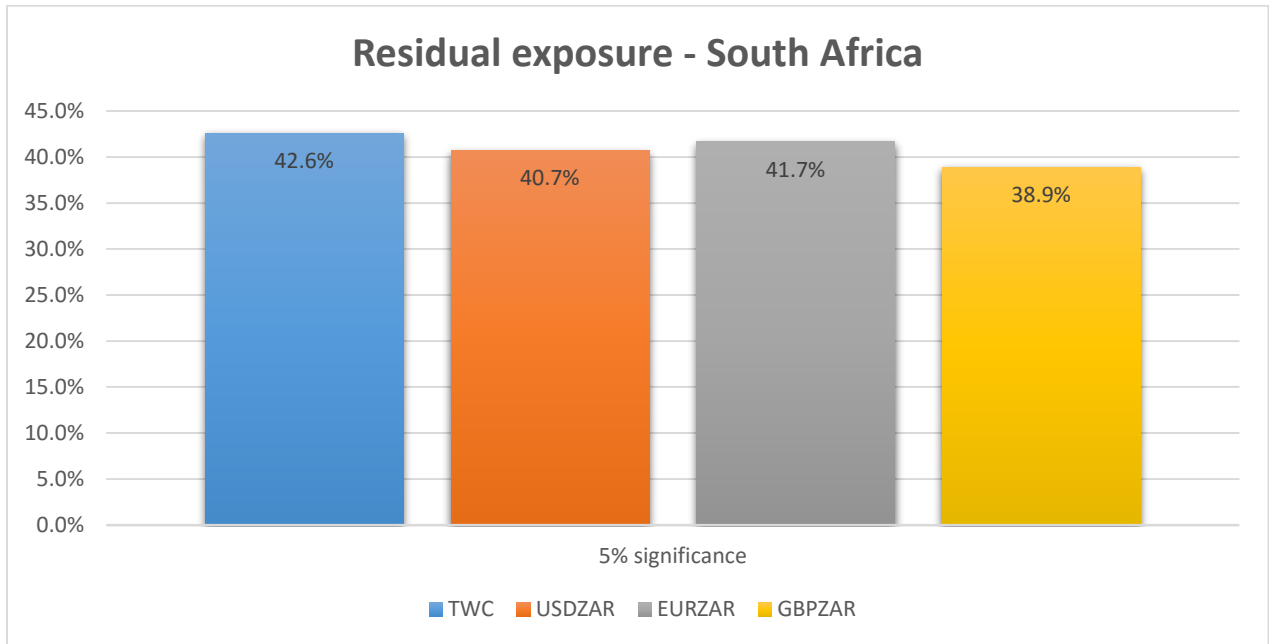
Table 4 reports foreign exchange risk exposure of nonfinancial firms as 43.5%, 40.7%, 43.5%, and 41.7% for specifications of equation (2) involving TWC, USDZAR, EURZAR, and, GBPZAR exchanges rate as alternative proxies, respectively. After correcting for possible multicollinearity between the exchange rate risk factor and the market risk factor as defined in equation (3), foreign exchange risk exposure is reported as 42.6%, 40.7%, 41.7%, and 38.9% for the TWC, USDZAR, EURZAR, and GBPZAR exchange rate proxies, respectively.

Figure (6) and figure (7) compare and contrast foreign exchange exposure under the alternative foreign exchange proxies. It is apparent that the orthogonalisation of the exchange rate only make only a marginal impact of the estimate of foreign exchange exposure. The orthogonalisation of the exchange rate risk factor as defined in equation (3) results in a marginal impact on the estimated level of foreign exchange risk exposure of nonfinancial firms in South Africa. This finding that orthogonalisation does not necessarily improve the results is line with the observation made by (Atindéhou & Gueyie, 2001; Bodnar & Gentry, 1993; Choi & Prasad, 1995).

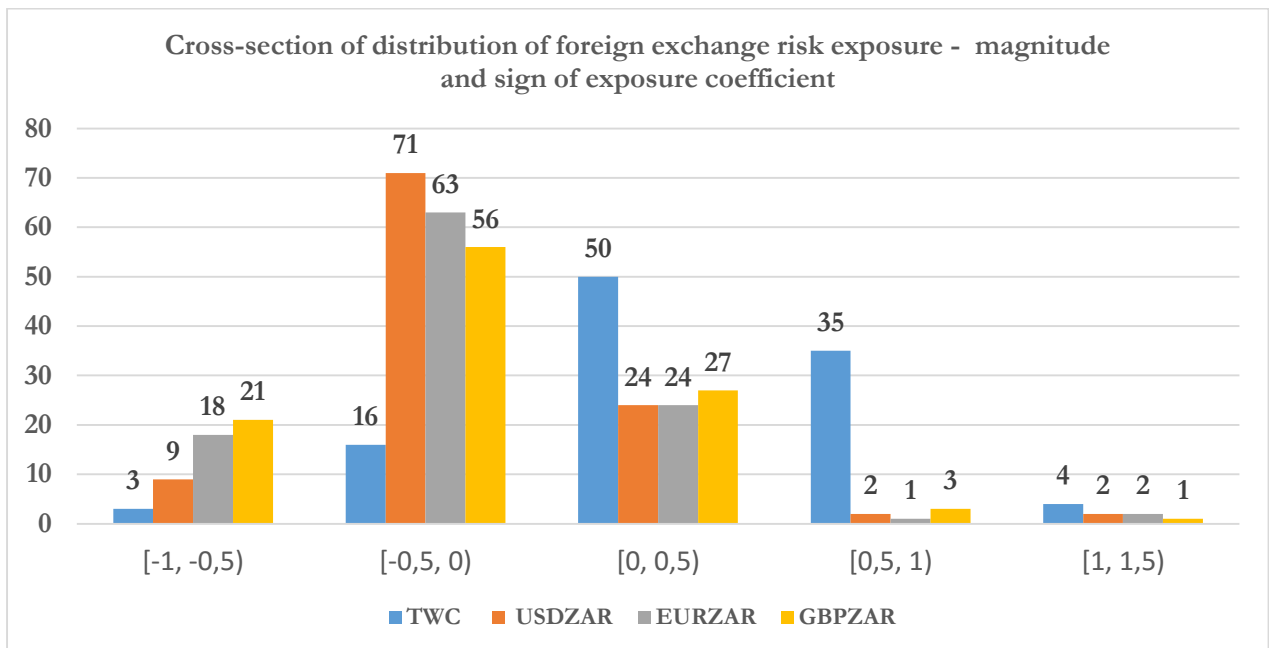
As reported in table (4), foreign exchange risk beta ranges in size from a minimum of -0.99 to a maximum of 1.25, with an average of 0.37 for the specification under the trade-weighted exchange rate proxy. For the USDZAR, the foreign exchange risk beta ranges in size from a minimum of -0.83 to a maximum of 1.42, with an average of -0.17. For the EURZAR, The foreign exchange risk beta ranges in size from a minimum of -0.81 to a maximum of 1.35, with an average of -0.19. For the GBPZAR, the foreign exchange risk beta ranges in size from a minimum of -0.87 to a maximum of 1.28, with an average of -0.19.



**Figure 6: Unconditional total foreign exchange exposure – CAPM Framework**



**Figure 7: Unconditional residual foreign exchange exposure – CAPM framework**



**Figure 8: Cross-section distribution of foreign exchange exposure - CAPM framework**

Figure 8 reports the cross-section distribution of nonfinancial firms in South Africa in respect of their foreign exchange exposure risk exposure. It is apparent that the majority of firms have a negative exposure in respect of the bilateral exchange rate proxies. However, the cross-section distribution of nonfinancial firms when considered in respect of the trade-weighted exchange rate are generally found to have a positive foreign exchange risk exposure.

### 3.5.2 Empirical tests based on Fama-French 3-factor model

**Table 5: Pooled Feasible GLS regression results for the 3-factor model of foreign exchange exposure**

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \varepsilon_{i,t}$$

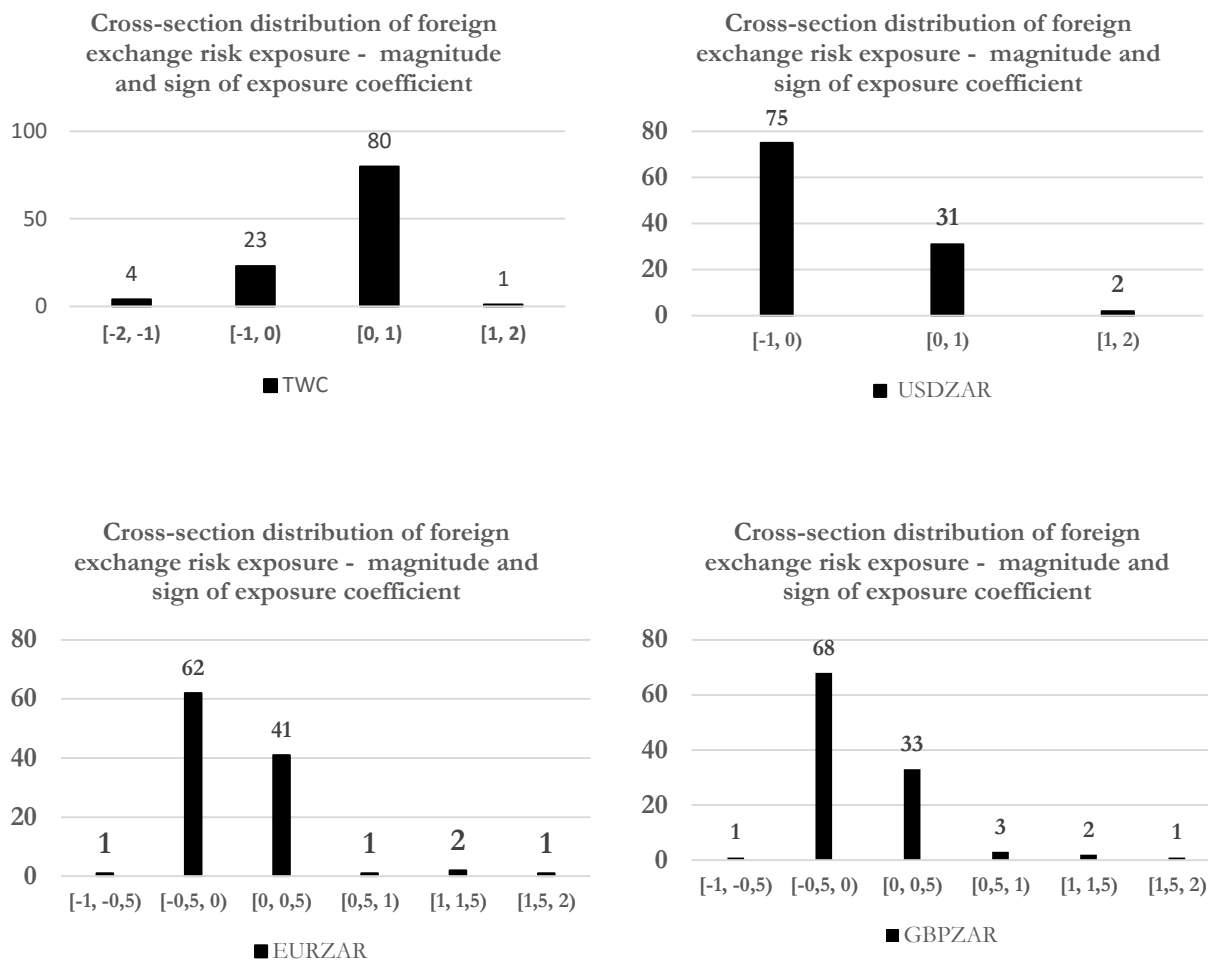
		Residual Exposure			
		TWC	USDZAR	EURZAR	GBPZAR
Mkt Exposure Coefficient $(\beta_{i,M})\beta_i$ :	Mean	1,00	1,02	1,02	1,04
	Minimum	-0,34	-0,30	-0,30	-0,18
	Maximum	2,57	2,67	2,61	2,36
	Percentage of firms with Significant FX Exposure	81.5%	84.3%	82.4%	84.3%
FX Exposure Coefficient $\beta_{i,XR}\beta_i$ :	Mean	0.11	-0.02	-0.01	-0.0001
	Minimum	-1.64	-0.79	-0.60	-0.72
	Maximum	1.37	1.79	1.79	1.71
	Percentage of firms with Significant FX Exposure	7.4%	6.5%	9.3%	12.0%
Size Exposure Coefficient $(\beta_{i,M})\beta_i$ :	Positive Exposure	81	33	45	39
	Negative Exposure	27	75	63	69
	Mean	0.71	0.75	0.75	0.77
	Minimum	-0.82	-0.57	-0.57	-0.57
Value Exposure Coefficient $(\beta_{i,M})\beta_i$ :	Maximum	3.07	2.95	2.70	2.90
	Percentage of firms with Significant Value Exposure	51.9%	59.3%	55.6%	60.2%
	Mean	0.33	0.35	0.34	0.36
	Minimum	-1.33	-0.86	-0.81	-1.03
Value Exposure Coefficient $(\beta_{i,M})\beta_i$ :	Maximum	1.83	2.13	2.18	2.11
	Percentage of firms with Significant Value Exposure	34.4%	34.3%	34.3%	35.2%
	Exposure				
R <sup>2</sup>		0.24	0.24	0.24	0.24
F-stat		9.27** (0.00)	9.27** (0.00)	9.27** (0.00)	9.29** (0.00)

The estimation of foreign exchange exposure is based on a sample spanning the period 2003M01 to 2015M11. This table shows a summary of the hypothesis test results of foreign exchange exposure of a sample of 108 nonfinancial firms listed on the JSE, as set out in section 3.2.1.5. The results are presented

across four different proxies of the exchange rate  $XR_t$  i.e. TWC, USDZAR, EURZAR, and GBPZAR. The Pooled Feasible GLS Model implemented through EViews 9.5 package corrects for cross-section heteroscedasticity, thus resulting in robust standard errors and t-statistics. By definition, the residual exposure reported in this study is estimated on the basis of an orthogonalised exchange rate factor as defined in equation (3).  $R^2$  is the coefficient of determination. The figures in the parenthesis are the p-values applied along with the F-stat in a hypothesis test of overall model fit i.e. that  $(\beta_{i,M})\beta_i = (\beta_{i,XR}) = 0$ . (\*\*) and (\*) represent significance at the 5% and 10% respectively. Detailed firm level exposure coefficients and p-values which were used in conducting hypothesis tests as specified in section 3.2.1.5 are provided in Appendix A, under Panel B.

Table (5) provides a summary of the results of estimates of residual foreign exchange exposure of nonfinancial firms in South Africa in respect of the trade-weighted currency (TWC), USDZAR, EURZAR, and GBPZAR. The measurement of foreign exchange exposure is done on the basis of the basis of equation (4). Foreign exchange exposure is reported as 7.4%, 6.5%, 9.3%, and 12% for (TWC), USDZAR, EURZAR, and GBPZAR, respectively. With regards to the magnitude of exposure, average exposure ranges in size from -0.0001 for the GBPZAR exchange rate to 0.11 for the trade-weighted exchange rate. A look at figure 11, however, reveals the distribution of exposure for the cross-section of firms, thus providing a much deeper picture of the extent of exposure of nonfinancial firms in South Africa. 80 firms out of 108 firms reported an exposure coefficient value of  $0 \leq \beta_{i,TWC} \leq 1\beta_i$  for the trade-weighted exchange rate (TWC). 75 firms out of 108 firms reported an exposure coefficient value of  $-1 \leq \beta_{i,USDZAR} \leq 0\beta_i$  for the USDZAR. 62 firms out of 108 firms reported an exposure coefficient value of  $-0.5 \leq \beta_{i,EURZAR} \leq 0\beta_i$  for the EURZAR, and 68 firms out of 108 firms reported an exposure coefficient value of  $-0.5 \leq \beta_{i,GBPZAR} \leq 0\beta_i$  for the GBPZAR.

Clearly, the majority of firms report negative exposure for the three bilateral exchange rates, whilst the majority of firms report positive exposure with regards to the trade-weighted exchange rate. A significant number of firms do report positive exposure to the three bilateral exchange rate proxies i.e. 31, 41, and 33 firms for the USDZAR, EURZAR, and GBPZAR respectively.



**Figure 9: Cross-section distribution of foreign exchange reserves - The Fama-French Three Factor model**

The overall exposure level for nonfinancial firms as reported in table (5) and figure (9), clearly mark a significant reduction in the estimated exposure estimate when compared with the results based on the standard CAPM based asset pricing model of (Jorion, 1990). The results based on the Fama-French three-factor model bring the estimated foreign exchange exposure level in the South African context to within the range that is found in the developed market context as reported in the literature. (Bartram & Bodnar, 2007) conducted a literature review on foreign exchange exposure of firms and found that the majority of studies in the developed market context report exposure levels ranging between

10% and 25%. They also indicated that exposure levels for the open, export oriented, emerging markets are slightly higher than those reported in the developed market context. The literature referred to in the (Bartram & Bodnar, 2007) is largely based on the standard CAPM-based model of (Jorion, 1990). The results based the standard (Jorion, 1990) were reported in table (5) as 42.6%, 40.7%, 41.7%, and 38.9% for the TWC, USDZAR, EURZAR, and GBPZAR exchange rate proxies, respectively. The reason for the higher than usual exposure levels in emerging market economies such as South Africa is that there are idiosyncratic factors which are unique to those markets. Thus if these are not controlled for, the foreign exchange exposure estimate will tend to be over-stated.

Table (5) provides evidence of key risk factors which explain the cross-section of firm returns in line with the work of (Fama & French, 1992, 1993). It is clear that the market risk factor, and the size risk factor are particularly most prominent. Market risk exposure of nonfinancial firms is reported as 81.5%, 84.3%, 82.4%, and 84.3 % for specifications of equation (4) involving TWC, USDZAR, EURZAR, and, GBPZAR exchange rate as alternative proxies, respectively. The size risk factor follows with exposure levels reported at 51.9%, 59.3%, 55.6%, and 60.2% for the TWC, USDZAR, EURZAR, and GBPZAR exchange rate proxies, respectively. Lastly, the value risk factor follows with exposure levels reported at 34.4%, 34.3%, 34.3%, and 35.2% for the TWC, USDZAR, EURZAR, and GBPZAR exchange rate proxies, respectively. The significance of style-based effects in the form of the size effect and the value effect as established in this study is in line with the findings of (Strugnell et al., 2011; Van Rensburg & Robertson, 2003).

### 3.5.3 Empirical tests based on the Carhart 4-factor model

**Table 6: Pooled Feasible GLS Regression of results for the 4-factor model of foreign exchange exposure**

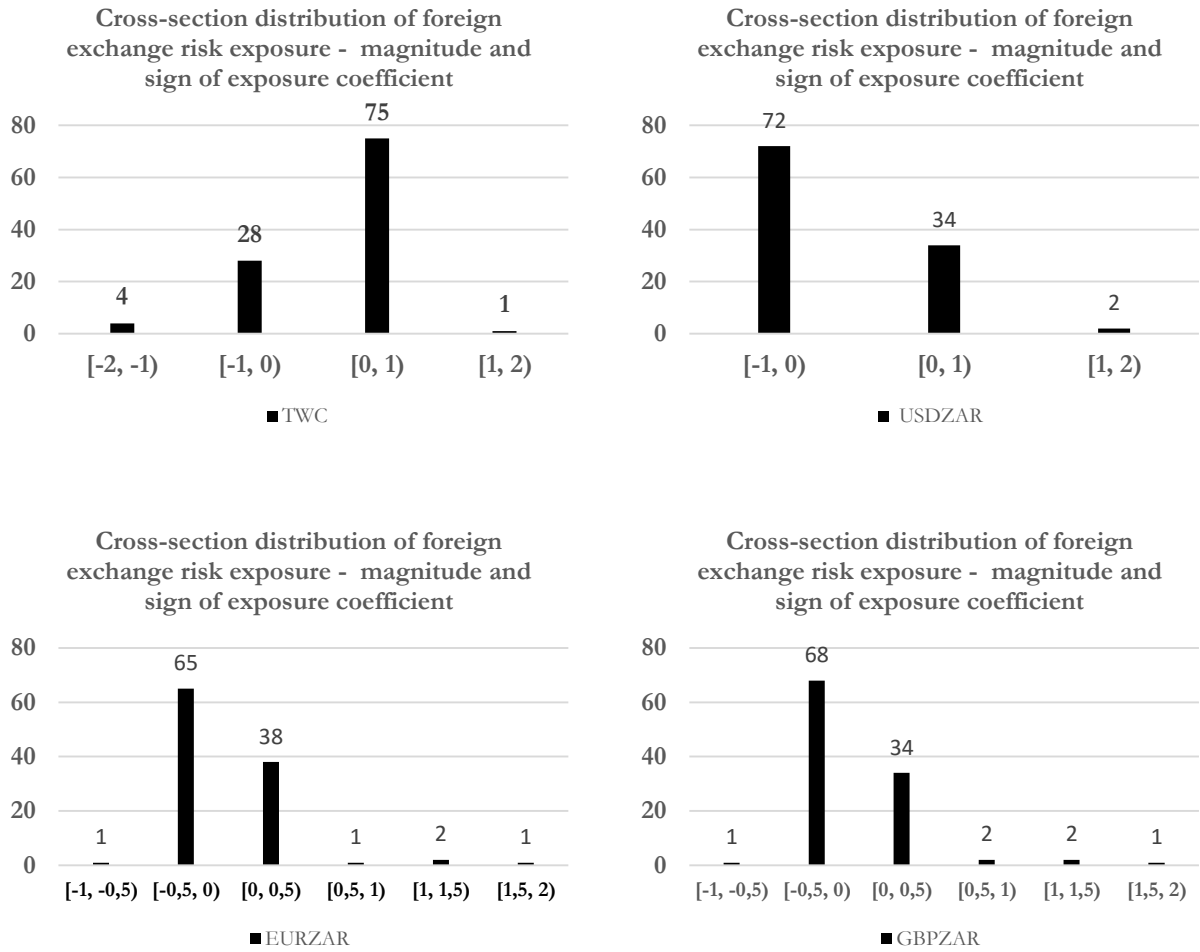
$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,UMD}R_{UMD,t} + \varepsilon_{i,t}$$

		Residual Exposure			
		TWC	USDZAR	EURZAR	GBPZAR
Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Mean	1,01	1,02	1,02	1,02
	Minimum	-0,29	-0,26	-0,26	-0,27
	Maximum	2,57	2,58	2,63	2,58
	Percentage of firms with Significant FX Exposure	82,4%	84,3%	83,3%	83,3%
Exposure Coefficient $\beta_{i,XR}$ $\beta_i$ :	Mean	0,08	-0,02	-0,01	-0,01
	Minimum	-1,81	-0,86	-0,51	-0,60
	Maximum	1,33	1,71	1,68	1,51
	Percentage of firms with Significant FX Exposure	7,4%	7,4%	8,3%	11,1%
Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Positive	76	71	42	39
	Negative	32	37	66	69
	Mean	0,78	0,81	0,82	0,82
	Minimum	-0,66	-0,48	-0,45	-0,47
Value Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Maximum	3,46	3,05	3,15	3,04
	Percentage of firms with Significant Size Exposure	52,8%	59,3%	59,3%	59,3%
	Mean	0,24	0,24	0,25	0,25
	Minimum	-1,47	-1,00	-1,05	-1,24
Momentum Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Maximum	1,67	2,09	2,06	2,15
	Percentage of firms with Significant Value Exposure	29,6%	28,7%	27,8%	27,8%
	Mean	-0,06	-0,06	-0,06	-0,06
	Minimum	-1,64	-1,41	-1,39	-1,34
R <sup>2</sup>	Maximum	0,63	0,57	0,56	0,56
	Percentage of firms with Significant Value Exposure	10,2%	11,1%	9,3%	9,3%
	Mean	0,25	0,25	0,24	0,25
	Minimum	8,06**	8,07**	8,0**	8,09**
F-stat		(0.0000)	(0.0000)	(0.0000)	(0.0000)

The estimation of foreign exchange exposure is based on a sample spanning the period 2003M01 to 2015M11. This table shows a summary of the hypothesis test results of foreign exchange exposure of a sample of 108 nonfinancial firms listed on the JSE, as set out in section 3.2.1.5. The results are presented across four different proxies of the exchange rate  $XR_t$  i.e. TWC, USDZAR, EURZAR, and GBPZAR. The Pooled Feasible GLS Model implemented through EViews 9.5 package corrects for cross-section heteroscedasticity, thus resulting in robust standard errors and t-statistics. By definition, the residual exposure reported in this study is estimated on the basis of an orthogonalised exchange rate factor as defined in equation (3).  $R^2$  is the coefficient of determination. The figures in the parenthesis are the p-values applied along with the F-stat in a hypothesis test of overall model fit i.e. that  $(\beta_{i,M})\beta_i = (\beta_{i,XR}) = 0$ . (\*\*) and (\*) represent significance at the 5% and 10% respectively. Detailed firm level exposure coefficients and p-values which were used in conducting hypothesis tests as specified in section 3.2.1.5 are provided in Appendix A, under Panel C.

Table (6) provides a summary of the results of estimates of residual foreign exchange exposure of nonfinancial firms in South Africa in respect of the trade-weighted currency (TWC), USDZAR, EURZAR, and GBPZAR. The measurement of foreign exchange exposure is done on the basis of the basis of equation (5). Foreign exchange exposure is reported as 7.4%, 7.4%, 8.3%, and 11.1% for (TWC), USDZAR, EURZAR, and GBPZAR, respectively. With regards to the magnitude of exposure, average exposure ranges in size from -0.02 for the USDZAR exchange rate to 0.08 for the trade-weighted exchange rate. A look at figure 12, however reveals the distribution of exposure for the cross-section of firms, thus providing a much deeper picture of the extent of exposure of nonfinancial firms in South Africa. 75 firms out of 108 firms reported an exposure coefficient value of  $0 \leq \beta_{i,TWC} \leq 1\beta_i$  for the trade-weighted exchange rate (TWC). 72 firms out of 108 firms reported an exposure coefficient value of  $-1 \leq \beta_{i,USDZAR} \leq 0\beta_i$  for the USDZAR. 65 firms out of 108 firms reported an exposure coefficient value of  $-0.5 \leq \beta_{i,EURZAR} \leq 0\beta_i$  for the EURZAR, and 68 firms out of 108 firms reported an exposure coefficient value of  $-0.5 \leq \beta_{i,GBPZAR} \leq 0\beta_i$  for the GBPZAR.

The results of the 4-factor model do not differ much from those of the 3-factor model in respect of the estimate of risk exposure of nonfinancial firms with regards to the market risk factor, foreign exchange risk factor, size risk factor, and the value risk factor. Even the overall model fit as measured in terms of  $R^2$ , does not seem to differ much between the 3-factor model and the 4-factor model, with the 3-factor model reporting overall  $R^2$  of 24% and the 4-factor model reporting a marginal improvement of only 1%, thus reporting an  $R^2$  of 25%.



**Figure 10: Cross-section distribution of foreign exchange exposure - The Carhart Four-factor model**

We cannot ignore, however the fact that exposure to the momentum risk factor is still significant enough to warrant further investigation in respect of the role of what (Antonacci, 2014) refers to a cognitive biases such as “anchoring, herding, and the disposition effect”. *“In anchoring, investors are slow to react to new information, which leads initially to under-reaction. In herding, buying begets more buying and causes prices to over react and move beyond fundamental value after the initial under-reaction. Through the disposition effect, investors sell winners too soon and hold losers too long. This creates a headwind making trends continue*

longer before reaching true value” (Antonacci, 2014). This however is not the focus of this study. In the current study, one is only interested in isolating the foreign exchange risk effect from the total macroeconomic risk exposure of firms.

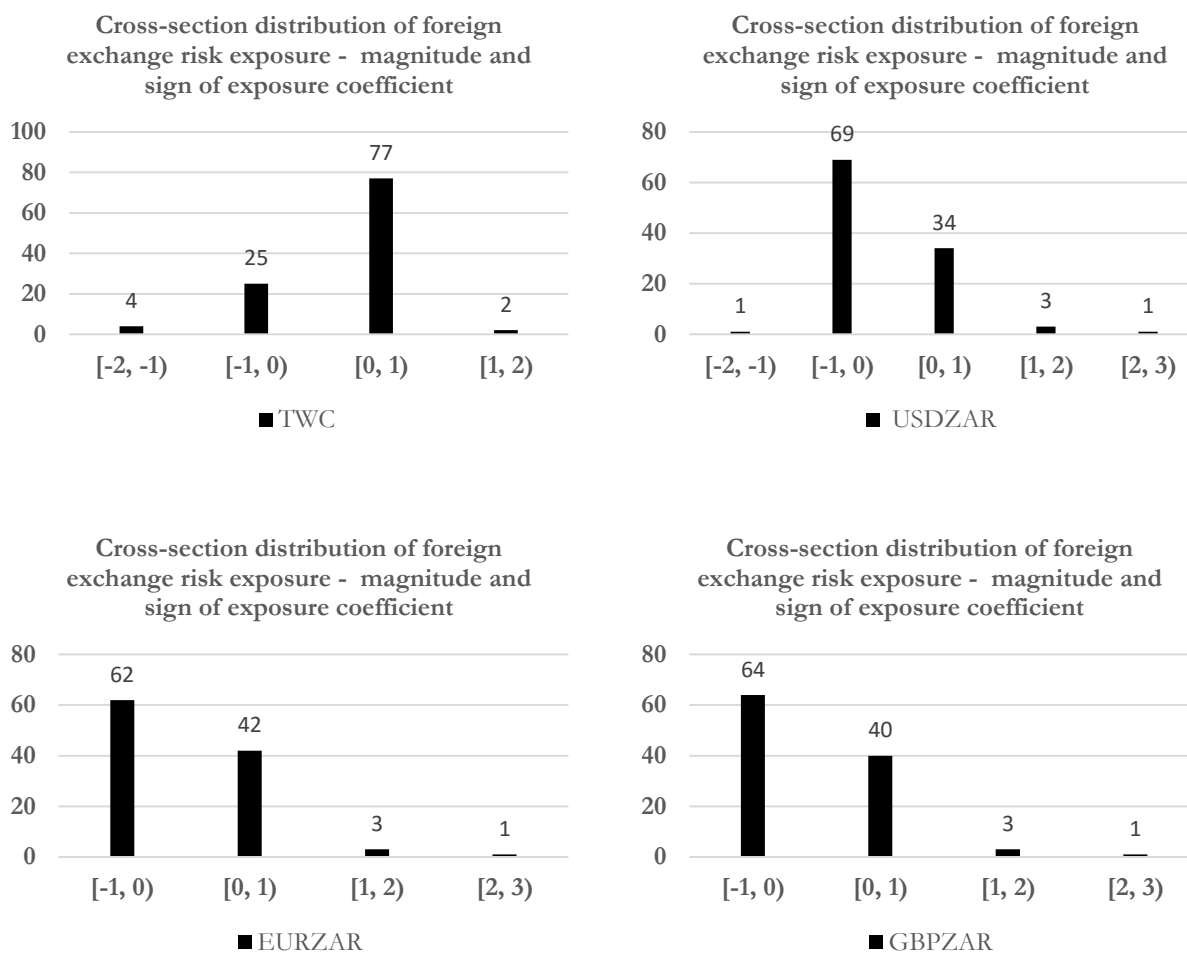
### 3.5.4 Empirical tests based on the Fama-French 5-factor Model

**Table 7: Pooled Feasible GLS regression of results for the 5-factor model of foreign exchange exposure**

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,CMA}R_{CMA,t} + \beta_{i,RMW}R_{RMW,t} + \varepsilon_{i,t}$$

		Residual Exposure			
		TWC	USDZAR	EURZAR	GBPZAR
Mkt Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Mean	1.01	1.03	1.02	1.03
	Minimum	-0.34	-0.29	-0.29	-0.30
	Maximum	2.43	2.50	2.54	2.47
	Percentage of firms with Significant FX Exposure	81.5%	84.3%	81.5%	80.6%
	Mean	0.11	-0.01	0.002	0.01
FX Exposure Coefficient $\beta_{i,XR}\beta_i$ :	Minimum	-1.66	-1.01	-0.59	-0.66
	Maximum	1.48	2.06	2.04	2.01
	Percentage of firms with Significant FX Exposure	8.3%	6.5%	10.2%	10.2%
	Positive	79	70	46	44
	Negative	29	38	62	64
Size Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Mean	0.71	0.76	0.76	0.77
	Minimum	-1.21	-0.64	-0.60	-0.78
	Maximum	2.92	2.58	2.89	2.82
	Percentage of firms with Significant Size Exposure	52.8%	55.6%	51.9%	55.6%
	Mean	0.14	0.15	0.16	0.16
Value Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Minimum	-0.99	-1.22	-0.86	-0.89
	Maximum	1.17	1.63	1.54	1.60
	Percentage of firms with Significant Value Exposure	23.1%	25.9%	18.5%	20.4%
	Mean	-0.01	-0.01	0.02	0.02
	Minimum	-1.30	-1.34	-1.16	-1.28
Profitability Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Maximum	1.80	0.94	2.18	2.09
	Percentage of firms with Significant Value Exposure	12.0%	12.0%	7.4%	9.3%
	Mean	0.05	0.04	0.04	0.04
	Minimum	-1.55	-1.61	-1.74	-1.76
	Maximum	2.32	2.22	2.16	2.31
Investment Exposure Coefficient ( $\beta_{i,M}$ ) $\beta_i$ :	Percentage of firms with Significant Value Exposure	9.3%	8.3%	9.3%	8.3%

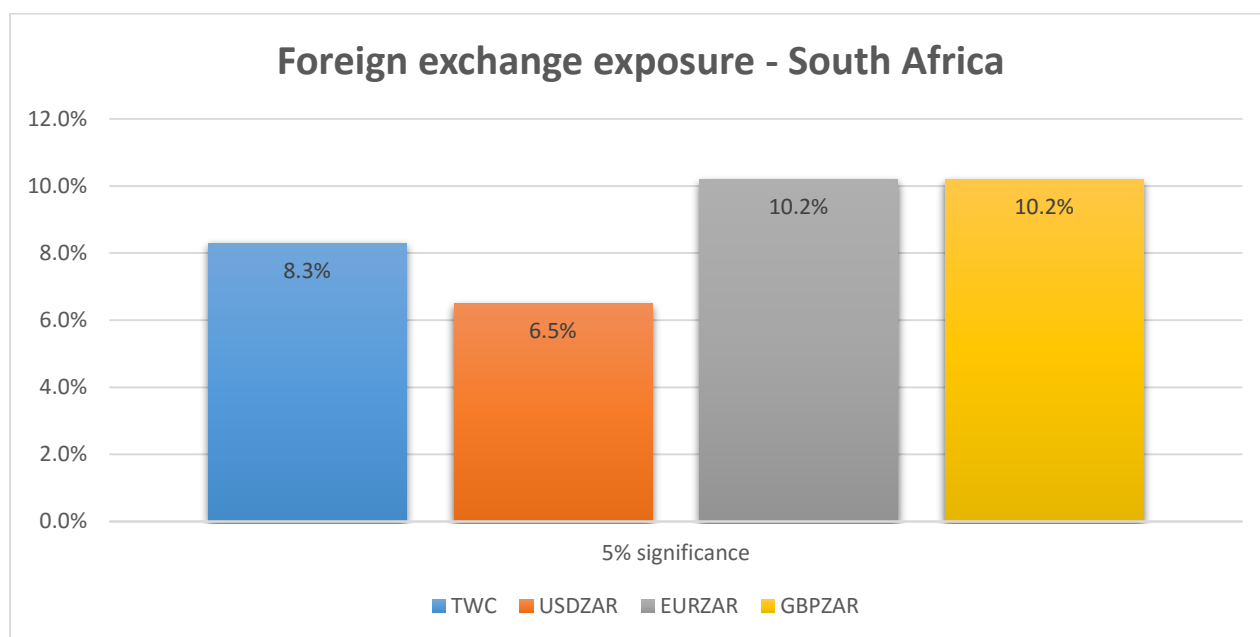
The estimation of foreign exchange exposure is based on a sample spanning the period 2003M01 to 2015M11. This table shows a summary of the hypothesis test results of foreign exchange exposure of a sample of 108 nonfinancial firms listed on the JSE, as set out in section 3.2.1.5. The results are presented across four different proxies of the exchange rate  $XR_t$  i.e. TWC, USDZAR, EURZAR, and GBPZAR. The Pooled Feasible GLS Model implemented through EViews 9.5 package corrects for cross-section heteroscedasticity, thus resulting in robust standard errors and t-statistics. By definition, the residual exposure reported in this study is estimated on the basis of an orthogonalised exchange rate factor as defined in equation (3). Detailed firm level exposure coefficients and p-values which were used in conducting hypothesis tests as specified in section 3.2.1.5 are provided in Appendix A, under Panel D).



**Figure 11: Cross-section distribution of foreign exchange risk exposure - The Fama-French Five Factor model**

The results of the 4-factor model do not differ much from those of the 3-factor model in respect of the estimate of risk exposure of nonfinancial firms with regards to the market risk factor, foreign exchange risk factor, size risk factor, and the value risk factor. Even the overall model fit as measured in terms of  $R^2$ , does not seem to differ much between the 3-factor model and the 4-factor model, with the 3-factor model reporting overall  $R^2$  of 24% and the 4-factor model

reporting a marginal improvement of only 1%, thus reporting an  $R^2$  of 25%. We cannot ignore, however the fact that exposure to the momentum risk factor is still significant enough to warrant further investigation in respect of the role of what (Antonacci, 2014) refers to a cognitive biases such as “anchoring, herding, and the disposition effect”. “*In anchoring, investors are slow to react to new information, which leads initially to under-reaction. In herding, buying begets more buying and causes prices to over react and move beyond fundamental value after the initial under-reaction. Through the disposition effect, investors sell winners too soon and hold losers too long. This creates a headwind making trends continue longer before reaching true value*” (Antonacci, 2014). This however is not the focus of this study. In the current study, one is only interested in isolating the foreign exchange risk effect from the total macroeconomic risk exposure of firms.



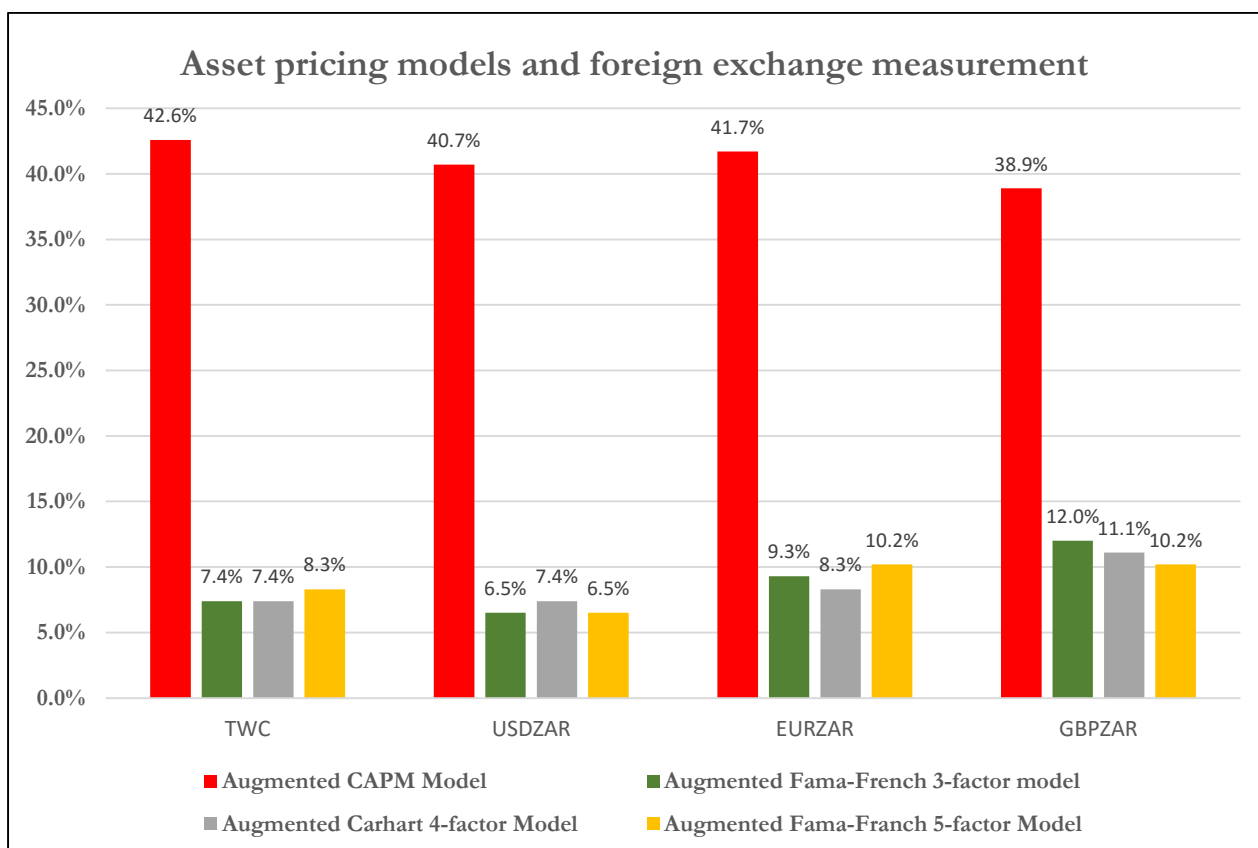
**Figure 12: Conditional Foreign Exchange Exposure – Jorion (1990) with size, value, profitability, and investment risk factors**

The results of the 4-factor model do not differ much from those of the 3-factor model in respect of the estimate of risk exposure of nonfinancial firms with regards to the market risk factor, foreign exchange risk factor, size risk factor,

and the value risk factor. Even the overall model fit as measured in terms of  $R^2$ , does not seem to differ much between the 3-factor model and the 4-factor model, with the 3-factor model reporting overall  $R^2$  of 24% and the 4-factor model reporting a marginal improvement of only 1%, thus reporting an  $R^2$  of 25%. We cannot ignore, however the fact that exposure to the momentum risk factor is still significant enough to warrant further investigation in respect of the role of what (Antonacci, 2014) refers to a cognitive biases such as “anchoring, herding, and the disposition effect”. *“In anchoring, investors are slow to react to new information, which leads initially to under-reaction. In herding, buying begets more buying and causes prices to over react and move beyond fundamental value after the initial under-reaction. Through the disposition effect, investors sell winners too soon and hold losers too long. This creates a headwind making trends continue longer before reaching true value”* (Antonacci, 2014). This however is not the focus of this study. In the current study, one is only interested in isolating the foreign exchange risk effect from the total macroeconomic risk exposure of firms.

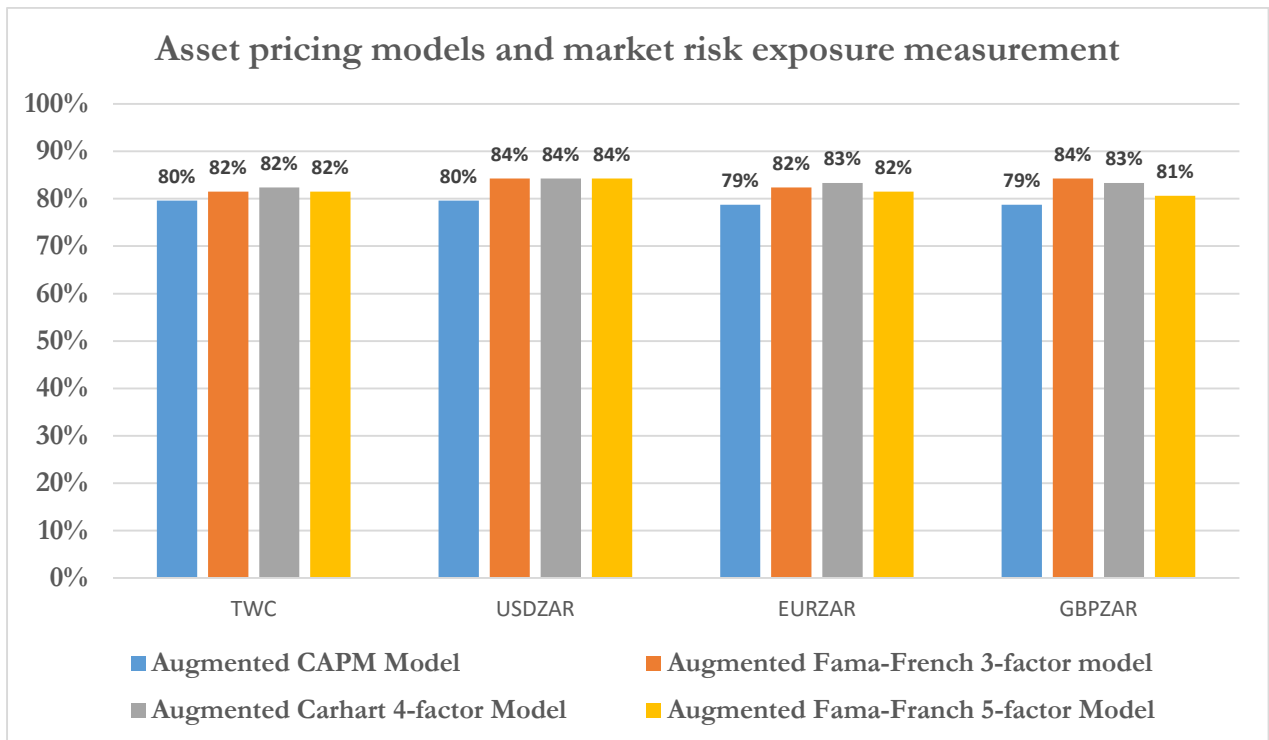
### **3.5.5 Summary of Results**

In sections 3.5.1 – 3.5.4 we analysed the degree of foreign exchange exposure of nonfinancial firms in South-Africa on the basis of four alternative asset pricing models in line with the augmented market model of (Jorion, 1990), the three-factor asset pricing model of (Fama & French, 1993), the four-factor asset pricing model of (Carhart, 1997), and the five-factor asset pricing model of (Fama & French, 2015), respectively.



**Figure 13: Residual foreign exchange exposure on nonfinancial firms in South Africa - Comparison of alternative asset pricing model results**

The results depicted in Figure (13) show that the standard augmented market model of (Jorion, 1990) tends to overstate the level of exposure of nonfinancial firms in South Africa. The results are in line with the findings of (Bartram & Bodnar, 2007) who conducted a literature review on foreign exchange exposure of firms and found that the majority of studies in the developed market context report exposure levels ranging between 10% and 25%. They also indicated that exposure levels for the open, export oriented, emerging markets are slightly higher than those reported in the developed market context. The literature referred to in the (Bartram & Bodnar, 2007) is largely based on the standard CAPM-based model of (Jorion, 1990). After controlling for risk factors that are known to prevail in equity capital markets, the study found that foreign exchange exposure of nonfinancial firms suddenly fall to within the range that is established in the literature review in respect of the developed market context.

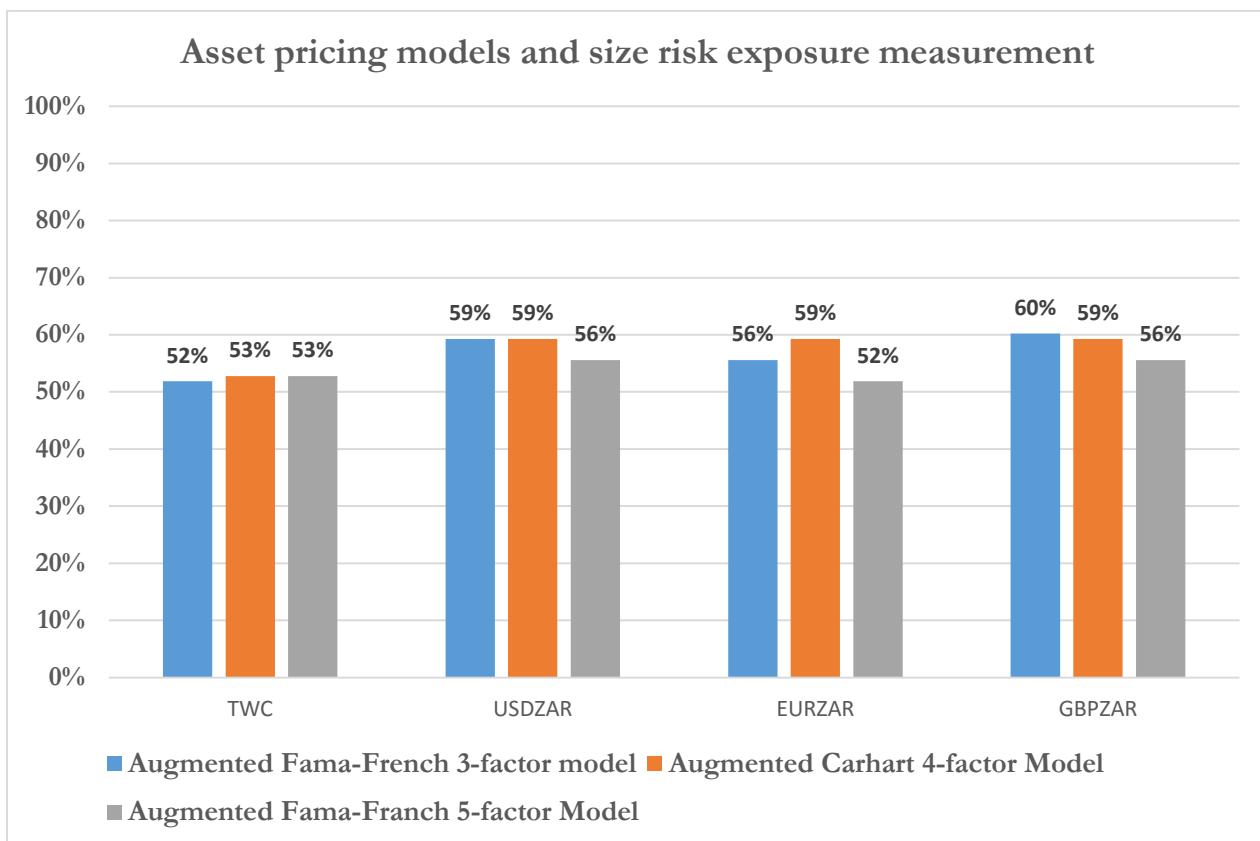


**Figure 14: Market risk exposure measurement under alternative asset pricing models**

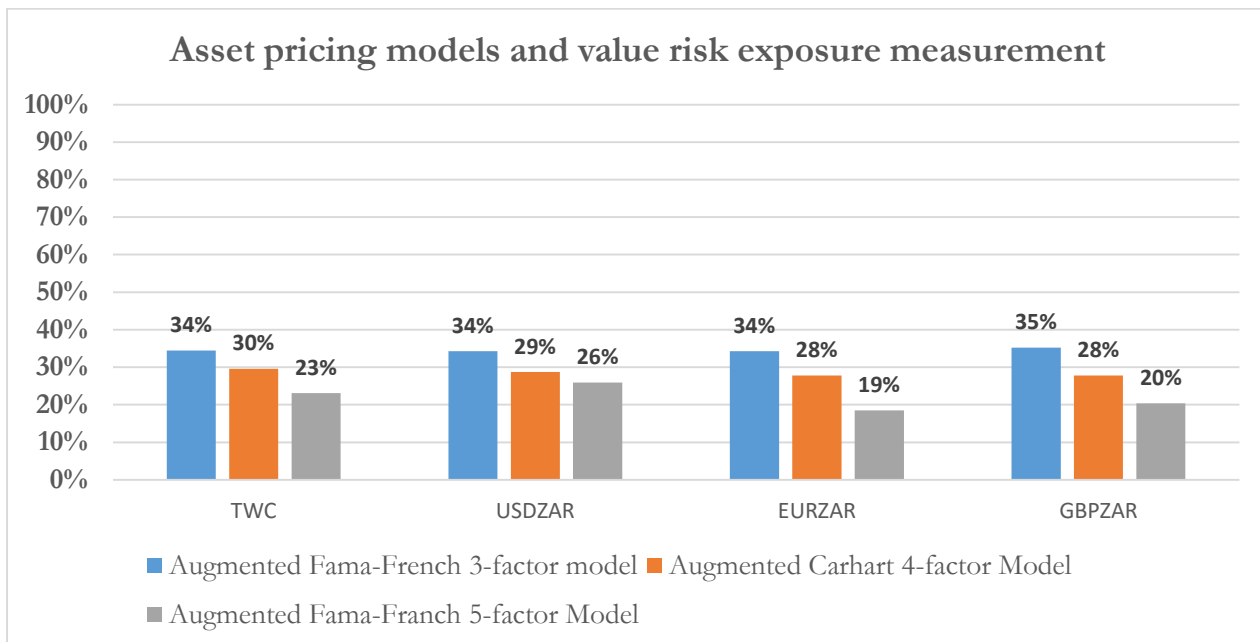
Key risk factors for the South African context were found to be the market risk factor with an exposure level of approximately 80% regardless of the asset pricing model specified (see figure (14)).

Figures (15) shows that size risk exposure of firms, like the market risk factor, is robust to the alternative asset pricing model specifications.

Figure (16) on the other hand shows that the value risk exposure of firms, unlike the market risk factor and the size risk factor, is not robust to the alternative asset pricing model specifications. The differences in respect of exposure to the value risk factor between the augmented Fama-French 3-factor model and the augmented Carhart 4-factor model is not as prominent as the case for the augmented Fama-French 5-factor model.



**Figure 15: Size risk exposure measurement under alternative asset pricing models**



**Figure 16: Value risk exposure measurement under alternative asset pricing models**

It is therefore reasonable to conclude on the basis of the findings of this study that the market, size, and value risk factors are the most important factors to be taken into account in the measurement of foreign exchange risk exposure. (Fama & French, 1996) posit that the two additional factors in the form of the size and value factor can be interpreted as proxies for relative financial distress which, rational investors see as “a particular state variable of special hedging concern to investors”. (Cochrane, 2005) cites a number of papers which argue that the size and value risk factors could be interpreted as being related to distress and recessions. With emerging markets being perceived as more risky it is hardly surprising that anomalies such as size and value are priced into equity prices of South African firms.

On the basis of the principle of parsimony and the fact that the results of foreign exchange exposure are robust across the augmented Fama-French 3-factor model, the augmented Carhart 4-factor model, and the augmented Fama-French 5-factor model, the study recommends the use of the augmented Fama-French 3-factor model or alternatively the Carhart 4-factor model in the estimation of unconditional foreign exchange exposure of nonfinancial firms in South Africa. This recommendation is also in line with recent practice in the estimation of emerging market foreign exchange exposure as evidenced by (Aggarwal & Harper, 2010; Apergis, Artikis, & Sorros, 2011; Huffman et al., 2010; Kolari et al., 2008; Priestley & Ødegaard, 2007).

## **3.6 Empirical results on the nature of foreign exchange exposure**

### **3.6.1 Time-varying foreign exchange exposure**

In this section, the percentage of firms which are found to be exposed to foreign exchange movements are plotted against the time dimension to observe if there is variation in foreign exchange exposure of nonfinancial firms in South Africa. The estimation is based on ordinary least squares (OLS) rolling window regression with a fixed window size of 31 observations and a step size of 1. The estimated exposure parameter along with the p-value for each firm are then used to conduct hypothesis tests for each of the firms over each of the months covered in the rolling window regression as follows:

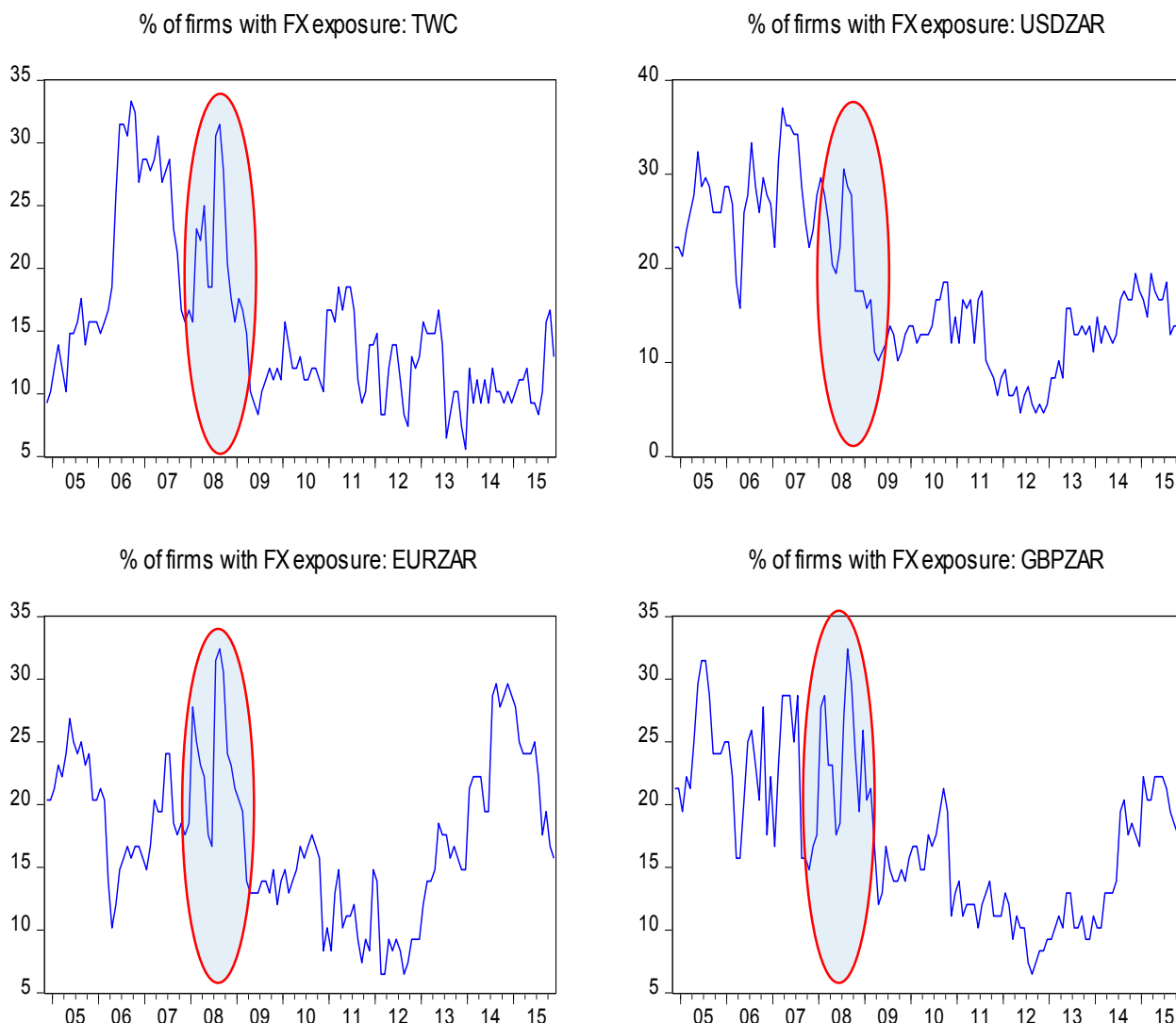
$H_0$  = Changes in exchange rates have an effect on share returns of nonfinancial firms in South Africa.

$H_1$  = Changes in exchange rates have no effect on share returns of nonfinancial firms in South Africa.

**Appendix B** presents a graphical illustration of how exposure parameters of each firm evolve over time by plotting monthly exposure parameters in a Cartesian plane. This is meant to depict the particular pattern underlying the evolution of this parameter i.e. it seeks to confirm if foreign exchange exposure parameters of each firm are constant or time-varying.

Figure 17 illustrates the finding that, regardless of the exchange rate chosen in the modelling exercise, there is time-variation in the foreign exchange exposure of firms in the South African context. Exposure levels with respect to the trade-weighted exchange rate (TWC) range from a low of 5.56% in December 2013 to a high of 33.33% in September 2006. For the USDZAR, exposure levels range from a low of 4.63% in May 2012 to a high of 37.04% in March 2007. Exposure levels with respect to the EURZAR range from a low of 6.48% in February 2012 to a

high of 32.41% in August 2008. For the GBPZAR, exposure levels range from a low of 6.48% in August 2012 to a high of 32.41% in August 2008.



**Figure 17: Time-varying foreign exchange exposure**

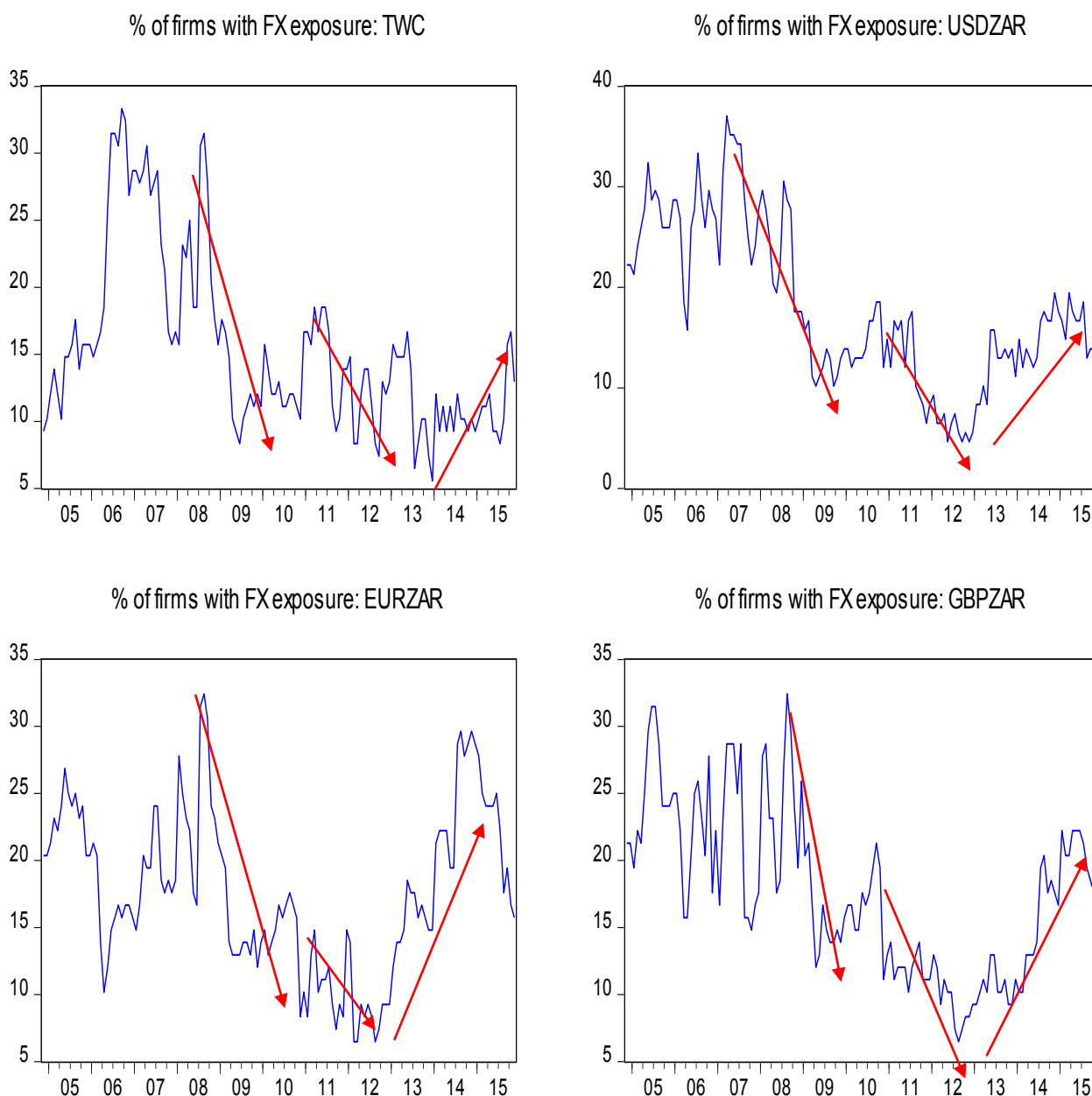
The fact that the lowest levels of firm exposure occur in the post financial crises period and the highest levels of firm exposure occur in the pre financial crises period for all exchange rates points to the likelihood of asymmetric foreign exchange exposure. The results are in line with those found in the developed markets context (Agyei-Ampomah et al., 2013; G. Allayannis, 1997; Koutmos & Martin, 2007).

It is further interesting to note that time-variation appears to be related to changes in the macroeconomic environment. For example, figure 14 clearly illustrates the sharp decline in foreign exchange exposure that coincides with the onset of the global financial crises. This clearly points to the role of macroeconomic factors in determining exposure levels. This observation is in line with the findings of (Chue & Cook, 2008) who apply the GMM-IV approach to model emerging market exchange rate exposure in a study that covers countries such as Brazil, Chile, Colombia, India, Indonesia, Korea, Mexico, Morocco, Pakistan, Philippines, South Africa, Taiwan, Thailand, Turkey, and Venezuela. (Chue & Cook, 2008) include amongst others, factors such as GDP per capita, imports, and exports, in a GMM-IV model and establish that exposure dynamics differ across two sub-periods i.e. 1999 – 2002 and 2002 – 2006.

### **3.6.2 Asymmetric foreign exchange exposure**

Figure 18 highlights common patterns in the evolution of foreign exchange exposure phenomena in respect of nonfinancial firms in the South African context for all four proxy currencies.

In spite of the exchange rate chosen, it is quite apparent that the levels of exposure undergo regular cycles of increasing and decreasing episodes. This therefore begs the question as to whether these cycles are informed by episodes of currency depreciation and appreciation. If this were to be the case, then foreign exchange exposure phenomena would be said to be asymmetric in the South African context. Of course, many studies have covered this topic in the developed market context (Koutmos & Martin, 2003; Muller & Verschoor, 2006a), however, the literature reviewed has not produced evidence of studies being conducted in the South African context that sought to establish if foreign exchange exposure is symmetric or asymmetric.



**Figure 18: Illustration of common patterns in foreign exchange exposure**

The study applies equation (10) to indirectly assess the extent of asymmetric exposure of South African firms to the appreciation and depreciation of the South African currency relative to the US\$ i.e. USDZAR.

$$R_i = \beta_0 + \beta_{i,m} R_{mkt,t} + \beta_{i,USDZAR}^+ XR_{i,USDZAR}^+ + \beta_{i,USDZAR}^- XR_{i,USDZAR}^- + \varepsilon_{i,t} \quad (25)$$

Where:

$XR_{i,USDZAR}^+$  and  $XR_{i,USDZAR}^-$  are determined by decomposing the XR factor in equation (2) into its negative and positive components; and

$\beta_{i,USDZAR}^+$  is represents  $firm_i$  exposure to the appreciation of the South African Rand relative to the US\$.

$\beta_{i,USDZAR}^-$  represents  $firm_i$  exposure to the depreciation of the South African Rand relative to the US\$.

$XR_{i,USDZAR}^+$  is a vector of positive changes in the exchange rate of the South African Rand relative to the US\$. (Iorio, Faff, Di Iorio, & Faff, 2000; Koutmos & Martin, 2003)

$XR_{i,USDZAR}^-$  is a vector of negative changes in the exchange rate of the South African Rand relative to the US\$.

Panel A in Table (8) provides a summary of descriptive statistics of the parameters of equation (10) estimated on the basis of the pooled feasible GLS estimation technique. It is interesting to note that the number of significant cases of firm exposure to foreign exchange risk at the 5% level is 60 cases and 51 cases for currency appreciation and depreciation, respectively with respect to the USDZAR exchange rate proxy. This amounts to a foreign exchange exposure of 55.6% and 47.2 % for currency appreciation and depreciation, respectively. Under the assumption that foreign exposure of firms is symmetric, foreign exchange exposure of nonfinancial firms in South Africa was reported (see table 5, under subsection 3.5.1) as 40.7% in respect of the USDZAR exchange rate proxy. When compared with the results based on the assumption of symmetric exposure, it is clear that by controlling for asymmetry in exposure, the number of significant cases increases quite significantly. This finding is in line with the findings of

(Belghitar et al., 2013) whose approach inspired the approach of this study to the testing of asymmetric exposure on the basis of indirect tests. (Belghitar et al., 2013) carry out an empirical test of asymmetric exposure of nonfinancial firms in the developed market context of France. Detailed hypothesis tests of exposure to currency appreciation and depreciation conducted in the basis of equation (10) are provided in Appendix C, under Panel A.

Another important insight from this study is that currency appreciation seems to have a much more important impact in terms of the average size of the exposure coefficient. Average exposure to currency appreciation (currency depreciation) is reported as -0.592(-0.480). Given that foreign exchange exposure in respect of currency appreciation is also found to be higher than the case for currency depreciation, it is quite reasonable for one to posit that the management of downside-risk in the form of the use of foreign currency hedging may be the cause of this asymmetry (see(Allayannis & Ofek, 2001; Allayannis & Weston, 2001b; Aretz & Bartram, 2010; Nguyen & Faff, 2003)). This assertion will however be subjected to further tests in order to find a concrete evidence of the effect the use of foreign derivatives on firm value.

As noted in (Belghitar et al., 2013), while the results estimated in terms of equation (10), give an indication of the effect of currency appreciation and depreciations on firm value, they are not a direct test of asymmetry. Exposure coefficients in respect of currency appreciation and depreciation at the individual firm levels are reported in table (10). To test more directly for the presence of asymmetric exposure the study conducts tests on the basis of Nonlinear Autoregressive Distributed Lag Model (NARDL) and the Smooth Transition Autoregressive Model (STAR).

Panel B in Table (8) provides a summary of descriptive statistics of the parameters of equation (14) estimated on the basis of the Stepwise Regression in the estimation of the Nonlinear ARDL Model. It is interesting to note that the number

of significant cases of firm exposure to foreign exchange risk at the 5% level is 59 cases and 46 cases for currency appreciation and depreciation, respectively with respect to the USDZAR exchange rate proxy. This amounts to a foreign exchange exposure of 54.6% and 42.6% for currency appreciation and depreciation, respectively. The results are similar to those estimated on the basis of equation (10). For example the median of the exposure coefficient is the same under both specifications, with the median being reported as -0.505(-0.399) for currency appreciation (depreciation), for both the indirect test under equation (10) and the direct test under equation (14). However, the advantage of the Nonlinear ARDL model is that it allows for direct tests of asymmetric exposure and it distinguishes between long-run and short-run asymmetry. Table (9) provides details of long-run and short-run asymmetric exposure tests at the firm-level. 15(38) firms report long-run (short-run) asymmetric exposure at the 5% significance level. This implies long-run asymmetric exposure of 13.9%, and a short-run asymmetric exposure of 35.2% of nonfinancial firms in South Africa.

**Table 8: Descriptive statistics of asymmetric foreign exchange exposure estimate**

**Panel A: Indirect Test based on Eq (10)**

$$R_i = \beta_0 + \beta_{i,m} R_{mkt,t} + \beta_{i,USDZAR}^+ XR_{i,USDZAR}^+ + \beta_{i,USDZAR}^- XR_{i,USDZAR}^- + \varepsilon_{i,t}$$

	$\beta_{i,USDZAR}^+$	$\beta_{i,USDZAR}^-$
Mean	-0,592	-0,480
Median	-0,505	-0,399
Maximum	1,125	4,043
Minimum	-3,978	-4,185
No of Significant Cases at 5% level	60	51
Observations	108	108

**Panel B: Asymmetric Exposure Tests Based on the Nonlinear ARDL Model**

**Direct Test based on the Nonlinear ARDL Model as follows:**

$$\Delta R_t = c + \theta_1^+ MKt_{t-1}^+ + \theta_1^- MKt_{t-1}^- + \theta_2^+ USDZAR_{t-1}^+ + \theta_2^- USDZAR_{t-1}^- + \sum_{j=1}^{p-1} \psi_j \Delta R_{t-j} + \sum_{i=0}^q \pi_{1,i}^+ \Delta MKt_{t-i}^+ + \sum_{i=0}^q \pi_{1,i}^- \Delta MKt_{t-i}^- + \sum_{i=0}^q \pi_{2,i}^+ \Delta USDZAR_{t-i}^+ + \sum_{i=0}^q \pi_{2,i}^- \Delta USDZAR_{t-i}^- + e_t$$

	$L_{USDZAR}^+$	$L_{USDZAR}^-$
Mean	-0,537	-0,457
Median	-0,505	-0,399
Maximum	16,525	13,928
Minimum	-11,794	-12,356
No of Significant Cases at 5% level	59	46
Observations	108	108

$L_{USDZAR}^+$  and  $L_{USDZAR}^-$  are the long run parameters, defined by  $L_{USDZAR}^+ = \beta^+ = -\theta^+/\rho$  and  $L_{USDZAR}^- = \beta^- = -\theta^-/\rho$ , respectively.

**Panel C: asymmetric exposure based on STAR models**

**Tests of Linearity<sup>3</sup>:**

Number of companies in which $H_0$ : Linear model is rejected at the 5% significance level	$H_1$ : Exponential model	12
	$H_1$ : Logistic model	17

**Direct Test based on the Smooth Transition Autoregressive Model**

	<i>Linear Part</i>	<i>Nonlinear Part</i>
Mean	-0,070	-0,017
Median	-0,212	0,196
Maximum	9,449	12,488
Minimum	-7,542	-9,783
No of Significant Cases at 5% level	9	7
Observations	29	29

<sup>3</sup> Detailed firm-level linearity tests are provided in Appendix X, under Panel D

**Table 9: Asymmetric foreign exchange exposure based on NARDL Model**

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
ACL	Cointegration	-0.203263 (0.4421)	0.180631 (0.5088)	0,731	0.068092 (0.7946)	18.27506*** (0.0000)	0.3379 (0.8445)	0.825648 (0.6238)	1.479237 (0.1226)
ADH	Cointegration	-0.158750 (0.3565)	0.189807 (0.2761)	0,641	0.279981 (0.5977)	0.537978 (0.4647)	0.6326 (0.7288)	1.054415 (0.4064)	1.053720 (0.4069)
ADI	Cointegration	-0.388772** (0.0400)	-0.299580 (0.1207)	0,747	1.100924 (0.2960)		4.2316 (0.12053)	0.369949 (0.9716)	1.302781 (0.2094)
AEG	<b>No Cointegration</b>								
AFE	Cointegration	-0.065397 (0.5922)	-0.036815 (0.7640)	0,688	0.279905 (0.5977)	0.109628 (0.7411)	1.0078 (0.5834)	1.284197 (0.2378)	1.069096 (0.3907)
AGL	Cointegration	0.015835 (0.9215)	0.021322 (0.8920)	0,825	0.008147 (0.9282)	0.022981 (0.8798)	2.7811 (0.2489)	0.729872 (0.7196)	1.181354 (0.2817)
AHL	Cointegration	-0.384111 (0.3320)	-0.339167 (0.3942)	0,720	0.060909 (0.8055)	0.012130 (0.9125)	25.8156*** (0.0000)	0.853267 (0.5959)	0.998177 (0.4516)
AMS	Cointegration	0.239544 (0.0904)	0.167387 (0.2353)	0,787	2.368993 (0.1264)	0.400028 (0.5283)	3.1504 (0.2070)	1.118247 (0.3531)	1.099435 (0.3549)
AOO	Cointegration	-0.078861 (0.5801)	-0.000623 (0.9965)	0,634	1.450281 (0.2308)	1.025795 (0.3131)	685.52*** (0.0000)	0.907849 (0.5416)	0.536940 (0.9293)
APK	Cointegration	-0.143298 (0.3878)	-0.116912 (0.4863)	0,690	0.121944 (0.7275)	5.510581** (0.0205)	0.6219 (0.7328)	1.017087 (0.4385)	1.837787 (0.0236)
APN	Cointegration	16.52474*** (0.0001)	13.92756*** (0.0003)	0,564	0.312283 (0.5772)	15.11768** (0.0002)	8.5410*** (0.0140)	0.831274 (0.6181)	2.093885 (0.0247)
ARI	Cointegration	0.139275 (0.4940)	0.165429 (0.4189)	0,765	0.082967 (0.7738)	0.771073 (0.3816)	1.5761 (0.4547)	0.845511 (0.6038)	1.590643 (0.0687)
ARL	Cointegration	-1.133215*** (0.0001)	-1.188102 (0.0000)	0,618	0.496840 (0.4822)	0.3816** (0.0542)	16.9972*** (0.0002)	0.485620 (0.9194)	0.756553 (0.7595)
ART	Cointegration	-0.396842 (0.1428)	-0.253986 (0.3418)	0,372	1.982410 (0.1617)	3.549720* (0.0620)	4.6120* (0.0997)	0.738730 (0.7108)	1.346422 (0.1567)
ASR	Cointegration	-0.117944 (0.5962)	0.121294 (0.5861)	0,674	5.339606** (0.0225)		0.4962 (0.7803)	1.052930 (0.4065)	2.234509 (0.0082)
AVI	Cointegration	-0.522117*** (0.0015)	-0.420741*** (0.0092)	0,707	5.072595** (0.0263)	0.394874 (0.5310)	5.7312** (0.0569)	1.285432 (0.2391)	1.243706 (0.2068)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
BAU	Cointegration	-0.657491 (0.4271)	-0.658133 (0.4360)	0,700	1.30E-05 (0.9971)	0.056376 (0.8127)	1.1675 (0.5578)	0.915818 (0.5337)	0.978064 (0.4868)
BAW	Cointegration	-0.552391** (0.0213)	-0.403719* (0.0937)	0,666	4.462439** (0.0366)	3.626863* (0.0592)	9.7429*** (0.0077)	0.693124 (0.7552)	0.530138 (0.9268)
BDM	Cointegration	-1.431356** (0.0269)	-1.442593** (0.0247)	0,671	0.003916 (0.9502)	200.6561*** (0.0000)	12.7742*** (0.0017)	0.693124 (0.5198)	2.223658 (0.0037)
BEL	Cointegration	0.285287 (0.1318)	0.463869 (0.0129)	0,767	4.533804** (0.0354)	2.813191* (0.0963)	0.4053 (0.8166)	0.582455 (0.8517)	1.117670 (0.3295)
BIL	Cointegration	-0.545919 (0.0061)	-0.511725 (0.0112)	0,867	0.868166 (0.3535)	5.583849** (0.0198)	5.2621 (0.3295)	1.046097 (0.4137)	1.003894 (0.4709)
BSR	Cointegration	0.069907 (0.8325)	-0.029405 (0.9288)	0,612	0.447903 (0.5046)	6.884926* (0.0098)	2.5380 (0.2811)	1.710620 (0.0735)	0.630620 (0.8540)
BVT	Cointegration	-0.419584*** (0.0051)	-0.366999* (0.0133)	0,795	1.250752 (0.2657)	11.07376** (0.0012)	0.4754 (0.7884)	0.381208 (0.9676)	0.918426 (0.5800)
CFR	Cointegration	-0.753628*** (0.0001)	-0.612882*** (0.0022)	0,748	7.308385*** (0.0078)	11.31773*** (0.0010)	6.2227** (0.0445)	0.925951 (0.5236)	4.869631 (0.0000)
CKS	Cointegration	1.125035*** (0.0117)	1.192351*** (0.0095)	0,719	1.935150*** (0.0078)	2.056087 (0.1545)	11.6634*** (0.0029)	0.682978 (0.7638)	1.533438 (0.0487)
CLH	Cointegration	-0.372791** (0.0205)	4.043212** (0.0466)	0,689	1.114758 (0.2932)	0.000280 (0.9867)	3.7870 (0.1505)	0.652681 (0.7923)	1.454173 (0.0978)
CLS	Cointegration	-0.945728*** (0.0000)	-0.993199*** (0.0000)	0,756	0.692628 (0.4070)	1.106991 (0.2949)	0.5463 (0.7610)	0.798467 (0.6512)	1.062085 (0.3971)
CMH	Cointegration	-3.977612* (0.0641)	-4.184800* (0.0682)	0,750	0.513152 (0.4753)	9.754456*** (0.0023)	0.7156 (0.6992)	0.609314 (0.8296)	1.536438 (0.0520)
COM	Cointegration	-0.575979** (0.0481)	-0.664239** (0.0220)	0,670	0.937237 (0.3349)	3.626023* (0.0592)	1.1536 (0.5617)	0.601482 (0.8369)	1.420470 (0.1294)
CRG	Cointegration	0.151270 (0.3536)	0.219384 (0.1868)	0,624	0.826931 (0.3648)	13.28773*** (0.0004)	2.7619 (0.2513)	0.792935 (0.6569)	1.267749 (0.2501)
CSB	Cointegration	-0.425981** (0.0471)	-0.358180* (0.0906)	0,621	0.725508 (0.3960)	0.185662 (0.6673)	0.0801 (0.9607)	1.082742 (0.3817)	0.908062 (0.5777)
CUL	Cointegration	-0.341048 (0.1435)	-0.165307 (0.4877)	0,616	3.037770* (0.0836)		67.4910*** (0.0000)	0.402532 (0.9603)	0.650045 (0.7829)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
DAW	Cointegration	-0.179432 (0.1918)	-0.087827 (0.5260)	0,705	2.038977 (0.1560)	17.05379*** (0.0001)	47.4407*** (0.0000)	1.321338 (0.2173)	0.579089 (0.9348)
DCT	Cointegration	-0.581363** (0.0370)	-0.547135* (0.0588)	0,695	0.188659 (0.6648)	1.750400 (0.1883)	0.8608 (0.6503)	0.405569 (0.9588)	0.927351 (0.5541)
DST	Cointegration	-0.382777** (0.0360)	-0.386848 0.0345 **	0,706	0.005080 (0.9433)	1.281390 (0.2599)	2.5139 (0.1845)	0.730437 (0.7189)	1.421826 (0.1179)
DTA	Cointegration	-0.716952*** (0.0178)	-0.730453*** (0.0161)	0,672	0.021750 (0.8830)	9.210830*** (0.0029)	365.7494 (0.0000)	0.630350 (0.8129)	1.113713 (0.3565)
DTC	Cointegration	-0.548616*** (0.0019)	-0.534624*** (0.0036)	0,741	0.065801 (0.7980)	0.445239 (0.5059)	0.2433 (0.8855)	0.602407 (0.8359)	1.969416 (0.0101)
ELR	Cointegration	-0.341069 (0.1778)	-0.204848 (0.4150)	0,669	2.277229 (0.1342)	6.444453*** (0.0125)	4.4232 (0.1095)	0.215518 (0.9974)	1.224606 (0.2211)
EOH	Cointegration	-1.676120*** (0.0000)	-1.594233*** (0.0001)	0,656	1.588263 (0.2102)	17.32697*** (0.0001)	2.3781 (0.3045)	0.454888 (0.9360)	0.919747 (0.5857)
EXX	Cointegration	-2.379994*** (0.0008)	-2.361887*** (0.0013)	0,700	0.027161 (0.8694)	0.015195 (0.9021)	1922.312 (0.0000)	0.305580 (0.9873)	1.531254 (0.0825)
FBR	Cointegration	-1.298514*** (0.0000)	-1.251300*** (0.0001)	0,761	0.345410 (0.5579)	0.003600 (0.9523)	1.6660 (0.4347)	0.753431 (0.6960)	0.701446 (0.8714)
GND	Cointegration	-0.421114*** (0.0030)	-0.273681** (0.0480)	0,805	12.06471*** (0.0007)	36.40796*** (0.0000)	1.6531 (0.4376)	1.072150 (0.3925)	1.029099 (0.4406)
GRF	Cointegration	0.089632 (0.5619)	0.151551 (0.3419)	0,732	1.483508 (0.2258)	11.92080*** (0.0008)	14.5928 (0.0007)	1.270824 (0.2475)	0.644608 (0.9098)
GRT	Cointegration	-0.737380*** (0.0005)	-0.686827*** (0.0014)	0,713	0.692706 (0.4070)	1.152236 (0.2853)	2.1590 (0.3340)	1.044472 (0.4150)	1.227984 (0.2260)
HCI	Cointegration	-0.487470 (0.3110)	-0.526404 (0.2746)	0,573	0.073374 (0.7869)	2.162446 (0.1440)	1285.95 (0.0000)	0.637707 (0.8060)	2.412357 (0.0024)
HDC	Cointegration	-0.122192 (0.3457)	-0.032822 (0.8017)	0,608	2.606651 (0.1087)		8.2031 (0.0165)	0.957383 (0.4931)	0.897181 (0.5450)
HWA	Cointegration	-0.258575 (0.5024)	-0.211147 (0.5886)	0,730	0.074485 (0.7853)		435.1277 (0.0000)	0.816749 (0.6328)	1.796488 (0.0549)
HWN	Cointegration	-1.658067*** (0.0031)	-1.590089*** (0.0053)	0,656	0.427360 (0.5145)	11.15007*** (0.0011)	255.7703 (0.0000)	0.450759 (0.9385)	3.113393 (0.0001)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
HYP	Cointegration	-0.751975*** (0.0013)	-0.763998*** (0.0011)	0,609	0.033470 (0.8551)	3.495780* (0.0639)	2.0575 (0.3575)	0.634185 (0.8092)	1.079949 (0.3805)
IDQ	Cointegration	-1.760253*** (0.0001)	-1.620510*** (0.0002)	0,795	3.153331* (0.0788)	0.244059 (0.6224)	133.9760 (0.0000)	1.636517 (0.0957)	1.207079 (0.2245)
IMP	Cointegration	0.047554 (0.7889)	-0.038805 (0.8293)	0,746	1.247991 (0.2661)	2.616864 (0.1082)	15.0007 (0.0006)	0.664871 (0.7816)	1.265210 (0.2220)
ING	Cointegration	0.442491 (0.4931)	0.319599 (0.6255)	0,589	0.193891 (0.6604)	7.404765**** (0.0073)	163009.4 (0.0000)	0.372657 (0.9709)	2.336910 (0.0175)
IPL	Cointegration	-1.023112*** (0.0031)	-0.871461*** (0.0112)	0,798	2.846336* (0.0943)	1.544325 (0.2165)	3.9630 (0.1379)	0.354813 (0.9758)	2.295680 (0.0016)
ISA	Cointegration	-1.470942*** (0.0081)	-1.296089** (0.0198)	0,820	1.241861 (0.2675)	19.6151*** (0.0000)	126.262 (0.4931)	1.120156 (0.3523)	2.918090 (0.0000)
ITE	Cointegration	-0.307923 (0.1562)	-0.266665 (0.2214)	0,757	0.178231 (0.6737)	5.187079** (0.0246)	83.64118 (0.0000)	0.733266 (0.7159)	0.824198 (0.7164)
ITU	Cointegration	-0.848152*** (0.0008)	-0.756571*** (0.0032)	0,684	2.288485 (0.1330)	0.831851 (0.3636)	86.5578 (0.0000)	0.740472 (0.7091)	0.904239 (0.5895)
IVT	Cointegration	-0.466569*** (0.0012)	-0.227231 (0.1128)	0,727	14.60963*** (0.0002)	6.225677*** (0.0140)	3.8811 (0.1436)	0.840724 (0.6087)	0.730291 (0.8165)
-	Cointegration	-0.644081*** (0.0016)	-0.520503*** (0.0115)	0,714	1.956527 (0.1645)	1.797001 (0.1826)	0.7401 (0.7091)	0.784594 (0.6651)	2.025217 (0.0094)
LAB	Cointegration	0.095603 (0.9056)	-0.604902 (0.4646)	0,740	5.279049** (0.0234)	0.337497 (0.5624)	60.5286 (0.0000)	0.413889 (0.9552)	1.252400 (0.2136)
LON	No Cointegration								
MFL	No Cointegration								
MRF	Cointegration	-0.056154 (0.8619)	-0.174529 (0.5860)	0,772	0.702731 (0.4036)	0.994311 (0.3208)	8.5267 (0.0141)	1.056467 (0.4044)	1.514838 (0.0733)
MRP	Cointegration	-1.101783*** (0.0004)	-1.035931*** (0.0010)	0,689	0.556789 (0.4570)	3.750080** (0.0552)	2.2637 (0.3224)	0.689801 (0.7580)	1.130034 (0.3245)
MSM	Cointegration	-0.706490*** (0.0009)	-0.619972*** (0.0042)	0,752	0.556789 (0.4570)	3.199792* (0.0765)	2.6790 (0.2620)	0.507935 (0.9049)	1.236412 (0.2059)
MST	Cointegration	-0.391715** (0.0458)	-0.313383 (0.1145)	0,746	0.793666 (0.3748)	8.290855*** (0.0047)	0.6912 (0.7077)	0.597583 (0.8398)	0.813046 (0.7141)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
MTA	Cointegration	-0.160704 (0.3473)	0.055221 (0.7472)	0,637	7.302069*** (0.0078)		5.9547 (0.0510)	0.673327 (0.7739)	2.168304 (0.0168)
MTN	Cointegration	-0.160704 (0.3473)	0.055221 (0.7472)	0,778	3.572016* (0.0613)	6.832492*** (0.0101)	4.6958 (0.0956)	1.653388 (0.0883)	1.262442 (0.2034)
MUR	Cointegration	-0.862873*** (0.0037)	-0.897327*** (0.0031)	0,619	0.150179 (0.6990)	1.491544 (0.2243)	2.1574 (0.3400)	0.566926 (0.8646)	1.110177 (0.3540)
NCS	Cointegration	-0.636677 (0.0857)	-0.500073 (0.1731)	0,760	1.067746 (0.3033)	17.17633 *** (0.0001)	1163.427 (0.0000)	0.741525 (0.7085)	2.055504 (0.0323)
NHM	Cointegration	-0.747317*** (0.0084)	-0.895310 *** (0.0022)	0,685	2.877741* (0.0923)	3.393333* (0.0678)	3.9923 (0.1359)	0.561240 (0.8689)	1.124090 (0.3370)
NPK	Cointegration	-0.183314 (0.2932)	-0.021055 (0.9032)	0,598	6.209904*** (0.0140)	7.631269*** (0.0066)	9.8243 (0.0074)	0.643587 (0.8010)	1.200339 (0.2797)
NPN	Cointegration	-0.555219*** (0.0026)	-0.545988*** (0.0028)	0,756	0.025503 (0.8734)	12.57408*** (0.0006)	1.2499 (0.5353)	0.441128 (0.9433)	0.884709 (0.5879)
NTC	Cointegration	0.048366 (0.8777)	0.045441 (0.8886)	0,748	0.001347 (0.9708)	8.821131*** (0.0036)	6.9202 (0.0314)	0.845923 (0.6034)	1.075405 (0.3821)
NWL	Cointegration	-0.740066** (0.0216)	-0.779555** (0.0174)	0,662	0.176531 (0.6751)	1.407988 (0.2378)	10.6433 (0.0049)	0.164959 (0.9993)	0.789849 (0.7428)
OCE	Cointegration	0.211114 (0.2158)	0.238040 (0.1757)	0,712	0.183990 (0.6688)	0.084628 (0.7716)	10.5388 (0.0051)	0.4628 (0.9320)	0.8554 (0.6638)
OLG	Cointegration	-0.656668** (0.0290)	-0.576183* (0.0614)	0,616	0.466370 (0.4959)	0.012357 06(0.9117)	0.3366 (0.8451)	0.5942 (0.8431)	1.3435 (0.1863)
OMN	Cointegration	-0.753600*** (0.0000)	-0.550154*** (0.0006)	0,805	25.26057*** (0.0000)	23.60397*** (0.0000)	0.7762 (0.6783)	0.480878 (0.9212)	0.868675 (0.6805)
PET	Cointegration	-0.533088** (0.0136)	-0.498395** (0.0215)	0,737	0.183471 (0.6692)	0.602439 (0.4392)	18.4313 (0.0001)	0.8598 (0.5895)	0.3467 (0.9972)
PIK	Cointegration	-0.341861* (0.0633)	-0.357021** (0.0465)	0,735	0.096735 (0.7564)	5.652829** (0.0191)	1.8173 (0.4031)	0.7241 (0.7249)	1.6723 (0.0314)
PNC	Cointegration	-0.957112** (0.0243)	-0.777559* (0.0755)	0,676	2.392586 (0.1246)	0.133591 (0.7154)	5.7941 (0.0552)	0.4529 (0.9372)	0.6676 (0.8735)
PPC	Cointegration	-0.317790* (0.1007)	-0.242899 (0.2070)	0,661	1.105557 (0.2951)	1.865055 (0.1745)	4.1955 (0.1227)	2.0117 (0.0291)	1.3893 (0.1571)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
PPR	Cointegration	-0.180979 (0.2027)	-0.102209 (0.4722)	0,710	1.549221 (0.2156)	6.321376*** (0.0132)	15.3942 (0.0005)	0.7157 (0.7334)	1.5251 (0.0883)
RCL	Cointegration	-0.597755*** (0.0001)	-0.644029*** (0.0001)	0,752	1.153622 (0.2850)	0.567616 (0.4527)	1.5122 (0.4695)	0.9800 (0.4726)	1.1917 (0.2683)
RDF	Cointegration	-0.788456*** (0.0085)	-0.836311*** (0.0062)	0,695	0.418176 (0.5192)	0.006431 (0.9362)	0.0968 (0.9527)	0.8874 (0.5621)	1.3927 (0.1149)
REM	Cointegration	-1.352731*** (0.0000)	-1.283978*** (0.0000)	0,844	4.957807** (0.0281)	1.926916 (0.1680)	242.887 (0.0000)	1.1481 (0.3322)	2.7939 (0.0000)
RLO	Cointegration	-0.758797*** (0.0001)	-0.694856*** (0.0003)	0,666	1.381506 (0.2421)	0.327976 (0.5679)	5.2129 (0.0738)	0.3488 (0.9776)	1.0921 (0.3680)
RTO	Cointegration	-0.389349** (0.0253)	-0.265223 (0.1299)	0,660	2.613428 (0.1085)	0.123440 (0.7259)	24.3952 (0.0000)	0.5919 (0.8449)	1.0428 (0.4173)
SAP	Cointegration	-0.121286 (0.4419)	-0.109961 (0.4840)	0,756	0.024983 (0.8747)		12.5280 (0.0019)	0.6718 (0.7753)	2.5433 (0.0020)
SBV	Cointegration	0.055543 (0.7884)	0.180028 (0.3960)	0,687	2.755633* (0.0996)	4.395155** (0.0382)	16.6427 (0.0002)	1.3191 (0.2186)	1.2241 (0.2358)
SHP	Cointegration	-0.891397*** (0.0002)	-0.812072*** (0.0006)	0,755	1.910511 (0.1696)	0.013404 (0.9080)	0.4582 (0.7952)	0.7321 (0.7172)	1.7023 (0.0298)
SNH	Cointegration	-1.602139*** (0.0000)	-1.660324*** (0.0000)	0,829	1.186369 (0.2785)	2.613428 (0.1085)	1.1816 (0.5539)	0.8496 (0.5999)	0.9596 (0.5381)
SNU	Cointegration	-0.767153*** (0.0088)	-0.736492*** (0.0125)	0,711	0.076471 (0.7826)	3.049689* (0.0834)	23.8231 (0.0000)	0.5833 (0.8513)	1.2578 (0.2017)
SOL	Cointegration	-0.584853*** (0.0096)	-0.523889** (0.0219)	0,842	1.137138 (0.2885)	4.713875** (0.0320)	9.2523 (0.0098)	0.4623 (0.9321)	0.4250 (0.9946)
SPA	Cointegration	-0.575769** (0.0425)	0.501830* (0.0766)	0,609	0.660823 (0.4177)		19.7055 (0.0001)	0.5631 (0.8677)	0.6764 (0.7588)
SPG	Cointegration	-0.824208 *** (0.0105)	0.543730* (0.0900)	0,829	24.68406*** (0.0000)	5.343420** (0.0227)	0.1400 (0.9324)	0.8131 (0.6364)	1.5125 (0.0570)
SUI	Cointegration	-0.046406 (0.7324)	-0.028536 (0.8308)	0,708	0.088111 (0.7671)	5.801667** (0.0175)	1.0238 (0.5993)	0.6005 (0.8377)	0.9318 (0.5487)
SUR	Cointegration	-0.174340 (0.2463)	-0.126009 (0.3990)	0,627	0.499909 (0.4809)	4.783723** (0.0227)	3.3261 (0.1896)	0.8492 (0.6000)	0.9679 (0.4956)

	Asymmetric Cointegration Test:	$L_{USDZAR}^+$	$L_{USDZAR}^-$	$R^2$	$W_{LR, USDZAR}$	$W_{SR, USDZAR}$	$\chi_N^2$	$\chi_{LM}^2$	$\chi_{ARCH}^2$
SVB	Cointegration	0.532067 (0.1214)	0.380095 (0.2698)	0,755	1.856719 (0.1755)	1.807698 (0.1812)	72.4452 (0.0000)	0.5534 (0.8746)	1.1782 (0.2919)
TBS	Cointegration	-0.679085*** (0.0067)	-0.662185*** (0.0115)	0,748	0.049458 (0.8244)	0.099594 (0.7529)	1.9655 (0.3743)	0.8411 (0.6082)	0.5991 (0.9304)
TDH	Cointegration	-0.283260 (0.4806)	-0.320302 (0.4288)	0,672	0.092143 (0.7620)	3.091543* (0.0813)	7.5086 (0.0234)	0.6025 (0.8359)	1.1347 (0.3196)
TFG	Cointegration	-2.288876*** (0.0000)	-2.269265*** (0.0000)	0,698	0.054628 (0.8156)	0.017626 (0.8946)	5.6085 (0.0606)	1.1821 (0.3058)	0.9385 (0.5555)
TPC	Cointegration	-0.261904 (0.1418)	-0.269509 (0.1379)	0,660	0.008132 (0.9283)	0.370642 (0.5438)	9.1906 (0.0101)	0.9775 (0.4748)	1.0017 (0.4655)
TRE	Cointegration	-0.069290 (0.6972)	0.052853 (0.7630)	0,608	0.054628 (0.8156)	23.33538 *** (0.0000)	8.6568 (0.0132)	0.6929 (0.7555)	0.6808 (0.7790)
TSX	Cointegration	-1.166541*** (0.0015)	-1.117957*** (0.0023)	0,672	0.326988 (0.5685)	3.714816* (0.0563)	2.1525 (0.3409)	1.6189 (0.0968)	0.7073 (0.8305)
VLE	Cointegration	-0.935287*** (0.0012)	-0.825617*** (0.0044)	0,650	0.326988 (0.5685)	8.360025** (0.0227)	0.2297 (0.8915)	0.6486 (0.7963)	2.0192 (0.0147)
WBO	Cointegration	-0.471111*** (0.0014)	-0.394976*** (0.0075)	0,718	3.982276** (0.0483)	0.019351 (0.8896)	0.7236 (0.6964)	0.4411 (0.9429)	0.7523 (0.7967)
WHL	Cointegration	-0.906725*** (0.0006)	-0.784271*** (0.0024)	0,697	2.906676* (0.0907)	0.336229 (0.5631)	9.4223 (0.0090)	0.6893 (0.7587)	1.1890 (0.2830)
WNH	Cointegration	-0.961573*** (0.0007)	-0.907591*** (0.0016)	0,656	0.434341 (0.5111)	0.006771 (0.9345)	19.1202 (0.0001)	0.834366 (0.6150)	1.1679 (0.3078)

Note: The estimation of dynamic asymmetric exposure is based on the Nonlinear Autoregressive Distributed Lag model,  $\Delta R_t = c + \theta_1^+ MKt_{t-1}^+ + \theta_1^- MKt_{t-1}^- + \theta_2^+ USDZAR_{t-1}^+ + \theta_2^- USDZAR_{t-1}^- + \sum_{j=1}^{p-1} \psi_j \Delta R_{t-j} + \sum_{i=0}^q \pi_{1,i}^+ \Delta MKt_{t-i}^+ + \sum_{i=0}^q \pi_{1,i}^- \Delta MKt_{t-i}^- + \sum_{i=0}^q \pi_{1,i}^+ \Delta USDZAR_{t-i}^+ + \sum_{i=0}^q \pi_{1,i}^- \Delta USDZAR_{t-i}^- + e_t$ . The estimation is executed through Stepwise Regression.  $_P$  and  $_N$  represent positive partial sums and negative partial sums respectively, and are equivalent the superscripts “+” and “-“.  $L_{USDZAR}^+$  and  $L_{USDZAR}^-$  are the long run parameters, defined by  $\beta^+ = -\theta^+/\rho$  and  $\beta^- = -\theta^-/\rho$ , respectively.  $W_{LR,USDZAR}$  is the Wald test for long run asymmetric exposure defined by  $-\theta^+/\rho = -\theta^-/\rho$ .  $W_{SR,USDZAR}$  refers to the Wald test for short run asymmetric exposure to changes in USDZAR, defined by  $\sum_{i=0}^q \pi_{1,i}^+ \Delta USDZAR_{t-i}^+ = \sum_{i=0}^q \pi_{1,i}^- \Delta USDZAR_{t-i}^-$ .  $\chi_N^2$ ,  $\chi_{LM}^2$ , and  $\chi_{ARCH}^2$  represent to tests for normality, serial correlation, and heteroscedasticity respectively.

Panel C in Table (8) provides a summary of descriptive statistics of the parameters of equation (15) estimated on the basis of the Smooth Transition Autoregressive Model (STAR) as described in (Teräsvirta, 1994). 29 firms out of a sample of 108 firms rejected the null hypothesis of linearity (See detailed firm-level linearity tests in Appendix C, under Panel C). Only seven firms report significant nonlinear components in respect of their foreign exchange exposure at the 5% level. When contrasted with the indirect test and direct test specified in panel A and B respectively, it is clear that the STAR model does not seem to capture the dynamics of the South African context very well.

**Table 10: Results based on the STAR Model**

$$R_{i,t} = \alpha_i + \beta_{i,mkt} * R_{mkt,t} + \left\{ \beta_{i,USDZAR} + \beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d}) \right\} * XR + \varepsilon_{i,t}$$

Firm-Code	The preferred Model	Linear Part		Nonlinear Part	
		$\beta_{i,USDZAR}$	P-value	$\beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d})$	P-value
ACL	Exponential Model	-0,620	0,0426**	0,738	0,590
ADI	Logistic Model	-2,199	0,0444**	2,597	0,0537**
AFE	Exponential Model	-0,212	0,204	0,044	0,915
APK	Logistic Model	0,142	0,732	-0,431	0,342
BAU	Exponential Model	-0,429	0,465	12,488	0,654
CMH	Exponential Model	2,217	0,396	-2,702	0,313
DCT	Logistic Model	-0,363	0,599	0,053	0,599
FBR	Logistic Model	-1,554	0,500	1,262	0,595
GND	Exponential Model	-0,211	0,297	-1,623	0,0922*
GRT	Exponential Model	-1,082	0,0001***	1,211	0,0001***
HDC	Logistic Model	0,191	0,627	0,415	0,204
IMP	Logistic Model	0,038	0,864	-3,687	0,0438**
MST	Logistic Model	-0,134	0,617	0,512	0,291
NPK	Logistic Model	-0,681	0,542	0,411	0,718
NWL	Logistic Model	0,973	0,024**	-1,609	0,0007***
OCE	Logistic Model	-0,230	0,390	0,196	0,707
OLG	Logistic Model	9,449	0.0000***	-9,783	0***
OMN	Logistic Model	0,855	0,0076***	-1,232	0,0004***
PIK	Exponential Model	-0,441	0,0076***	0,696	0,286
PPR	Logistic Model	0,190	0,374	-2,425	0,912
RDF	Logistic Model	-0,237	0,594	-0,219	0,638
REM	Exponential Model	-7,542	0.0000***	7,466	0***

$$R_{i,t} = \alpha_i + \beta_{i,mkt} * R_{mkt,t} + \{ \beta_{i,USDZAR} + \beta_{i,USDZAR} * G_i(\gamma, c, z_{t-d}) \} * XR + \varepsilon_{i,t}$$

		Linear Part		Nonlinear Part	
RLO	Logistic Model	-1,032	0,0129***	0,626	0,146
SAP	Logistic Model	-0,096	0,547	-3,975	0,0001***
SPG	Logistic Model	-0,469	0,380	0,588	0,312
SUI	Exponential Model	-0,230	0,181	0,409	0,915
TFG	Exponential Model	1,441	0,458	-2,141	0,275
TSX	Exponential Model	-0,044	0,888	0,651	0,781
VLE	Exponential Model	0,289	0,296	-1,019	0,398

### 3.6.3 Summary of results

The results have demonstrated on the basis of rolling-window regressions that there is time-variation in the foreign exchange exposure parameter of nonfinancial firms in South Africa. Furthermore, on the basis of hypothesis tests of monthly exposure in the cross-section of nonfinancial firms in South Africa, the study demonstrated that the degree of exposure is also time-varying.

Having established that there is time-variation in the degree of exposure, the study further sought to investigate if there is asymmetric exposure to currency appreciations and currency depreciations. An indirect test of asymmetric exposure revealed results that are similar to those estimated on the basis of a more direct test in the form of a Nonlinear ARDL model. In line with findings from other studies conducted in other parts of the world, exposure levels of South African firms estimated by controlling for asymmetry, were found to be higher than those estimated on the basis of the standard (Jorion, 1990) model (Koutmos & Martin, 2003; Muller & Verschoor, 2006a).

The Nonlinear ARDL model also distinguished between short-run and long-run asymmetry exposure and further demonstrated that asymmetric exposure is much more pronounced in the short-run than in the long-run. The results estimated through the STAR Model, however, report much lower levels of asymmetric exposure.

### **3.7 Empirical results on firm-specific determinants of foreign exchange exposure**

The study applied panel regression models in an attempt at identifying the determinants of foreign exchange exposure at the firm-level in South Africa. The study followed the market-approach and to a great extent, was inspired by the work of (Agyei-Ampomah et al., 2013).

Table (11) presents results of panel regression models estimated on the basis of four different proxies of exchange rates of the South African Rand (ZAR). In line with the work of (Agyei-Ampomah et al., 2013), the study assesses the role of firm size (MV serving as the proxy), leverage/financial distress (debt-to-assets ratio (DTA) serving as proxy), growth-opportunity (market-to-book ratio (MTB), serving as proxy), and liquidity (quick-ratio (QR), serving as proxy) in determining the degree of foreign exchange exposure of firms.

The random model is accepted in respect of the USDZAR, EURZAR, and the GBPZAR on the basis of the Hausman Test, whilst the TWC chooses the fixed effects model.

Market Capitalisation (MC) which serves as a proxy of firm size is found to have a negative association with measures of foreign exchange exposure of firms under most of the specifications of the panel regression model. (Agyei-Ampomah et al., 2013) who establish a similar relationship in the developed market context of the UK, attributed this finding to the so-called “ability to hedge” argument. According to this argument, large firms are thought to be in a better position to hedge against foreign exchange risk and as such are less likely to be exposed to the same as extent as their smaller counterparts (Pantzalis et al., 2001). This provides evidence that firms located in dynamic emerging market economies such as South Africa have similar attributes to firms located in developed markets.

In a clear departure from theory which predicts that growth firms are more likely to hedge (see (Froot et al., 1993)), MTB which serves as proxy for growth-opportunities is found to have a positive association with foreign exchange exposure at the firm-level in the South African context. This is particularly interesting because in a recent study, (Agyei-Ampomah et al., 2013) found evidence of a negative association between MTB and measure of foreign exchange exposure in the developed market context of the UK. This provides evidence that unlike their developed market counterparts, growth firms in emerging markets such as South Africa do not hedge. It must however be noted that growth firms in developed markets tend to have operations in multiple locations throughout the world, thus providing a natural operational hedge in line with the prediction of (Soenen & Madura, 1991). There is recent evidence provided in the literature highlighting the effectiveness of operational hedging in lowering the foreign exchange exposure of firms in the developed market context (See (Jay & Jiang, 2009). Anecdotal evidence suggests that emerging market growth firms are not as likely to have operations in multiple locations, thus minimizing the effectiveness of their financial hedges, however, this remains an empirical question which is not the subject of this study. The importance of combining both operational and financial hedging in the management of foreign exchange risk exposure is clearly supported by the literature. (Allayannis, Ihrig, Ihrig, Weston, & Weston, 1995) find that, “while firms' operational hedges are not associated with higher value, the use of operational hedges in conjunction with foreign-currency derivatives improves firm value”.

QR, the proxy variable for firm liquidity, shows a positive association with firm exposure in respect of the USDZAR, EURZAR, and GBPZAR. This finding is in line with theory (Froot et al., 1993; Nance et al., 1993), and corroborated by evidence found in studies conducted in the developed markets of the US and Europe (Choi & Kim, 2003; He & Ng, 1998; Muller & Verschoor, 2006b).

In the context of developed markets of Europe, (Muller & Verschoor, 2006b) posit that “*a firm can reduce its probability of financial distress and agency costs by maintaining a larger short-term liquidity position. By keeping a higher quick ratio...a firm is therefore less compelled to hedge and hence more exposed to exchange rate risk.*” They find that firms with “strong short-term liquidity positions have less incentive to hedge and hence have larger exchange rate exposures. Similar evidence is found in the US context (Choi & Kim, 2003) and the Japanese context (He & Ng, 1998). Thus, the current study confirms that firm liquidity affects foreign exchange exposure of nonfinancial firms in emerging markets such as South Africa in a manner that is similar to the developed markets contexts of America, Europe, and Asia.

The study finds mixed results in respect of the proxy for financial distress, Debt-to-Assets (DTA), when compared across the four exchange rate proxies. DTA is found to be positively associated with foreign exchange exposure and statistically significant, in respect of the USDZAR and GBPZAR exchange rate proxies. The results show a negative association between DTA and measures of foreign exchange exposure, in respect of the EURZAR and TWC exchange rate proxies, however, they are also found to be statistically insignificant.

**Table 11: Results of panel regression models of determinants of foreign exchange exposure**

	<b>GLS Method: Panel EGLS (Cross- section weights)</b>	<b>GLS with firm dummies</b>	<b>GLS with period dummies</b>	<b>GLS with period dummies: {Method: Panel EGLS (Period weights)}</b>	<b>GLS with both firm and period dummies</b>	<b>Random Effects Model with firm effects</b>	<b>Random Effects Model with period effects</b>	<b>Random Effects Model with both firm and period dummies</b>
<b>Panel A:</b>	<b>TWC</b>							
Intercept	<b>0.6833</b> (0.0000)	<b>0.6932</b> (0.0000)	<b>0.7104</b> (0.0000)	<b>0.7110</b> (0.0000)	<b>0.6994</b> (0.0000)	<b>0.6954</b> (0.0000)	<b>0.7094</b> (0.0000)	<b>0.6983</b> (0.0000)
MC	<b>-2.22E-13</b> (0.0000)	<b>2.60E-13</b> (0.0001)	<b>-3.65E-13</b> (0.0001)	<b>-3.78E-13</b> (0.0000)	7.26E-14 (0.2820)	<b>1.81E-13</b> (0.0038)	<b>-3.38E-13</b> (0.0000)	9.67E-14 (0.1253)
MTB	0.0002 (0.1039)	0.0002 (0.3872)	<b>0.0004</b> (0.0261)	0.0003 (0.0621)	6.54E-05 (0.7479)	0.000191 (0.3510)	<b>0.000430</b> (0.0159)	0.0001 (0.5124)
QR	5.86E-08 (0.6541)	<b>-4.00E-07</b> (0.0000)	-3.06E-08 (0.7032)	-2.40E-08 (0.7459)	<b>-4.10E-07</b> (0.0000)	<b>-3.85E-07</b> (0.0000)	-2.88E-08 (0.7199)	<b>-3.91E-07</b> (0.0000)
DTA	<b>0.0005</b> (0.0090)	-3.91E-05 (0.8625)	-0.0003 (0.2031)	-0.0002 (0.4321)	-0.0003 (0.1849)	-3.27E-05 (0.8842)	-0.0002 (0.4813)	-0.0002 (0.4555)
Adjusted R <sup>2</sup>	0.0070	0.2080	0.0357	0.0362	0.2364	0.0022	0.0076	0.0017
Hausman Test Chi-Sq. Statistic = 17.97; <b>P-Value = 0.0013</b> Decision: Reject H <sub>0</sub> : Random Effects Model; thus accept H <sub>1</sub> : Fixed Effects Model								

	<b>GLS Method: Panel EGLS (Cross- section weights)</b>	<b>GLS with firm dummies</b>	<b>GLS with period dummies</b>	<b>GLS with period dummies: {Method: Panel EGLS (Period weights)}</b>	<b>GLS with both firm and period dummies</b>	<b>Random Effects Model with firm effects</b>	<b>Random Effects Model with period effects</b>	<b>Random Effects Model with both firm and period dummies</b>
<b>Panel B:</b>	<b>USDZAR</b>							
Intercept	<b>0.5598</b> (0.0000)	<b>0.5752</b> (0.0000)	<b>0.5699</b> (0.0000)	<b>0.5699</b> (0.0000)	<b>0.5729</b> (0.0000)	<b>0.5747</b> (0.0000)	<b>0.5701</b> (0.0000)	<b>0.5734</b> (0.0000)
MC	<b>-4.37E-14</b> (0.0211)	<b>-1.83E-13</b> (0.0005)	<b>-6.34E-14</b> (0.0151)	<b>-6.71E-14</b> (0.0081)	-1.01E-13 (0.0576)	<b>-1.70E-13</b> (0.0007)	<b>-7.03E-14</b> (0.0069)	<b>-1.22E-13</b> (0.0156)
MTB	<b>0.0005</b> (0.0002)	6.70E-05 (0.6827)	<b>0.0006</b> (0.0000)	<b>0.0006</b> (0.0000)	4.71E-05 (0.7699)	9.21E-05 (0.5705)	<b>0.0006</b> (0.0000)	7.77E-05 (0.6274)
QR	<b>4.00E-07</b> (0.0000)	<b>2.44E-07</b> (0.0002)	<b>4.72E-07</b> (0.0000)	<b>4.80E-07</b> (0.0000)	<b>3.25E-07</b> (0.0000)	<b>2.49E-07</b> (0.0001)	<b>4.41E-07</b> (0.0000)	<b>3.03E-07</b> (0.0000)
DTA	<b>0.0006</b> (0.0002)	<b>0.0013</b> (0.0000)	<b>0.0006</b> (0.0002)	<b>0.0006</b> (0.0001)	<b>0.0011</b> (0.0000)	<b>0.0013</b> (0.0000)	<b>0.0007</b> (0.0001)	<b>0.0012</b> (0.0000)
Adjusted R <sup>2</sup>	0.0038	0.2187	0.0386	0.0432	0.2534	0.0044	0.0053	0.0039
Hausman Test Chi-Sq. Statistic = 5.20; <b>P-Value = 0.2674</b> Decision: Accept H <sub>0</sub> : Random Effects Model								

	<b>GLS Method: Panel EGLS (Cross- section weights)</b>	<b>GLS with firm dummies</b>	<b>GLS with period dummies</b>	<b>GLS with period dummies: {Method: Panel EGLS (Period weights)}</b>	<b>GLS with both firm and period dummies</b>	<b>Random Effects Model with firm effects</b>	<b>Random Effects Model with period effects</b>	<b>Random Effects Model with both firm and period dummies</b>
<b>Panel C: EURZAR</b>								
Intercept	<b>0.5782</b> (0.0000)	<b>0.5936</b> (0.0000)	<b>0.5997</b> (0.0000)	<b>0.6001</b> (0.0000)	<b>0.5940</b> (0.0000)	<b>0.5944</b> (0.0000)	<b>0.5996</b> (0.0000)	<b>0.5945</b> (0.0000)
MC	<b>-8.51E-14</b> (0.0000)	<b>1.07E-13</b> (0.0507)	<b>-1.56E-13</b> (0.0000)	<b>-1.73E-13</b> (0.0000)	8.38E-14 (0.1330)	7.81E-14 (0.1355)	<b>-1.50E-13</b> (0.0000)	6.91E-14 (0.1886)
MTB	<b>0.0006</b> (0.0000)	0.0003 (0.1050)	<b>0.0007</b> (0.0000)	<b>0.0007</b> (0.0000)	<b>0.0004</b> (0.0348)	1.19E-07 (0.0874)	<b>1.19E-07</b> (0.0000)	<b>0.0003</b> (0.0545)
QR	<b>1.83E-07</b> (0.0037)	1.17E-07 (0.0811)	<b>2.24E-07</b> (0.0009)	<b>2.26E-07</b> (0.0005)	<b>2.04E-07</b> (0.0020)	2.04E-07 (0.0751)	<b>0.0006</b> (0.0109)	<b>1.57E-07</b> (0.0175)
DTA	6.69E-06 (0.9681)	-0.0002 (0.3150)	<b>-0.0002</b> (0.2075)	-0.0002 (0.3403)	<b>-0.0004</b> (0.0299)	-0.0002 (0.3312)	1.71E-07 (0.5562)	-0.0003 (0.1371)
Adjusted R <sup>2</sup>	0.0032	0.2270	0.0310	0.0432	0.2566	0.0004	0.0036	0.0008
Hausman Test Chi-Sq. Statistic = 3.57; P-Value = 0.4674 Decision: Accept H <sub>0</sub> : Random Effects Model								

	<b>GLS Method: Panel EGLS (Cross- section weights)</b>	<b>GLS with firm dummies</b>	<b>GLS with period dummies</b>	<b>GLS with period dummies: {Method: Panel EGLS (Period weights)}</b>	<b>GLS with both firm and period dummies</b>	<b>Random Effects Model with firm effects</b>	<b>Random Effects Model with period effects</b>	<b>Random Effects Model with both firm and period dummies</b>
<b>Panel D:</b>	<b>GBPZAR</b>							
Intercept	<b>0.5877</b> (0.0000)	<b>0.6048</b> (0.0000)	<b>0.6046</b> (0.0000)	<b>0.6052</b> (0.0000)	<b>0.6055</b> (0.0000)	<b>0.6050</b> (0.0000)	<b>0.6045</b> (0.0000)	<b>0.6054</b> (0.0000)
MC	-2.88E-14 (0.1621)	-1.57E-14 (0.7774)	-1.06E-13 (0.0000)	<b>-1.13E-13</b> (0.0000)	-4.97E-14 (0.3735)	-2.61E-14 (0.6195)	<b>-1.03E-13</b> (0.0001)	-4.65E-14 (0.3773)
MTB	<b>0.0004</b> (0.0096)	<b>-0.0004</b> (0.0180)	<b>0.0004</b> (0.0050)	<b>0.0003</b> (0.0168)	-0.0003 (0.0612)	<b>-0.0004</b> (0.0293)	<b>0.0004</b> (0.0076)	-0.0003 (0.0621)
QR	<b>2.36E-07</b> (0.0052)	<b>2.14E-07</b> (0.0017)	<b>3.33E-07</b> (0.0000)	<b>3.11E-07</b> (0.0000)	<b>3.12E-07</b> (0.0000)	<b>2.16E-07</b> (0.0014)	<b>3.00E-07</b> (0.0000)	<b>2.82E-07</b> (0.0000)
DTA	<b>0.0009</b> (0.0000)	<b>0.0017</b> (0.0000)	<b>0.0011</b> (0.0000)	<b>0.0010</b> (0.0000)	<b>0.0014</b> (0.0000)	<b>0.0016</b> (0.0000)	<b>0.0011</b> (0.0000)	<b>0.0015</b> (0.0000)
Adjusted R <sup>2</sup>	0.0036	0.2044	0.0534	0.0534	0.2544	0.0055	0.0048	0.0048

Hausman Test Chi-Sq. Statistic = 3.55; P-Value = 0.4706 Decision: Accept H<sub>0</sub>: Random Effects Model

Note: TWC is the trade-weighted exchange rate of the Rand, USDZAR is the change in exchange rate of the Rand relative to the US\$, EURZAR is the exchange rate of the Rand relative to the Euro(€), GBPZAR is the exchange rate of the Rand relative to the British Pound (£). Market Capitalisation (MC) is the proxy for firm size, MTB is the Market-to-Book value of the firm, QR is the proxy for firm liquidity, and DTA is the Debt-to-Assets and serves as a proxy for leverage. The results are based on alternative panel specifications through the use of the Pooled Model:  $y_{it} = \alpha + x'_{it}\beta + u_{it}$ , Fixed Effects Model:  $y_{it} = \alpha_i + x'_{it}\beta + u_{it}$ , and the Random Effects Model:  $y_{it} = x'_{it}\beta + (\alpha_i + e_{it})$ . Bold figures indicate statistical significance at the 5% level.

### **3.7.1 Summary of results**

The range of factors that can conceivably determine the foreign exchange risk exposure of firms encompasses macroeconomic factors which are external to the organisation environment, along with firm-specific factors that are within the control of the firm. The focus of this study was on firm-specific factors. In particular the study followed the market-approach and to a great extent, was inspired by the work of (Agyei-Ampomah et al., 2013).

The study assessed the role of firm size (MV), leverage/financial distress (DTA), growth-opportunity (MTB), and liquidity (QR) in determining the degree of foreign exchange exposure of firms. Firm size is found to have a negative association with measures of foreign exchange exposure of firms under most of the specifications of the panel regression model. MTB which serves as proxy for growth-opportunities is found to have a positive association with foreign exchange exposure at the firm-level in the South African context. QR, the proxy variable for firm liquidity, shows a positive association with firm exposure in respect of the USDZAR, EURZAR, and GBPZAR. DTA, a measure of leverage, is found to be positively associated with foreign exchange exposure and statistically significant, in respect of the USDZAR and GBPZAR exchange rate proxies. However, leverage is found to be statistically insignificant with respect to the EURZAR and GBPZAR exchange rate proxies. Thus, highly leveraged firms are found to be particularly exposed to foreign currency risk in respect of the USDZAR and GBPZAR exchange rate proxies.

The study has therefore established that smaller firms, that are highly leveraged, with higher growth prospects, and more liquid are more likely to be exposed to foreign exchange risk in the South African context.

## **CHAPTER 4**

### **CURRENCY HEDGING AND CORPORATE VALUATIONS**

*“In a competitive financial environment, financial derivative instruments such as options, swaps, futures and forwards are more and more widely used by corporations to alleviate exposure from fluctuations in interest rates, currency and commodity prices”*(Nguyen & Faff, 2002).

#### **4.1 Introduction**

This chapter presents an analysis of the hedging behaviour of nonfinancial firms from an emerging market perspective, and in particular the South African context. The first section presents an outlined of the theoretical framework of the study. The second section provides a description of the data and descriptive statistics summarising key variables utilised in this part of the study. The third section describes the empirical methodology used to test the hypothesis raised in the previous section. The fourth section provides empirical results of the study, with subsection 4.4.1 focusing on univariate test results, whilst 4.4.2 focuses on multivariate tests. Both univariate and multivariate tests are used to study and identify firm-specific factors affecting the decision of firms to use foreign currency derivatives and foreign currency denominated debt to hedge against foreign exchange risk exposure. The study further identifies firm-specific factors affecting the extent of use of foreign-currency denominated debt. Then the chapter concludes by assessing the corporate value effects of the use of foreign currency derivatives (FCD) and foreign currency denominated debt (FCDD).

#### **4.2 Theoretical framework and hypothesis**

The theoretical framework of the study is grounded on the so-called optimal hedging theories (see (Bessembinder, 1991; Froot et al., 1993; Nance et al., 1993;

Smith & Stulz, 1985; Stulz, 1984)). These theories are largely based on a relaxation of the seemingly unrealistic assumption of perfect capital markets underlying the (Modigliani & Miller, 1958) framework. The Modigliani and Miller framework asserts that corporate risk management is irrelevant for corporate valuations. In a world of perfect capital markets, there are no taxes, financial distress costs, transaction costs, and information costs (Charumathi & Kota, 2012).

To test the applicability of optimal hedging theories in the emerging markets context, the study investigates the relation between firm-level factors of nonfinancial firms in South Africa and firm decisions to hedge against foreign exchange exposure. Furthermore the study will seek to establish if the extent of hedging is determined by firm-specific factors. Firm-specific factors proxy for costs associated with the relaxation of the assumption of perfect capital markets. Finally, the study seeks to assess if there are corporate value effects of corporate risk management in the form of foreign currency derivative use and the use of foreign currency denominated debt in the South African context.

### **Costs of financial distress**

(Smith & Stulz, 1985) develop what they refer to as a positive theory of hedging behaviour in terms of which they show how costs of financial distress provide a rationale for value-maximising firms to hedge. In the first instance, transaction costs of bankruptcy are shown to induce value-maximising firms to hedge, and secondly bond covenants are found to provide incentives for firms to hedge. *“hedging provides a means whereby the firm can reduce the costs of financial distress imposed by bond covenants that constrain the shareholders to take actions they would otherwise avoid”* (Smith & Stulz, 1985). Thus, it is expected that firms facing higher financial distress costs are more likely to hedge.

(Froot et al., 1993) argue that hedging can reduce the probability of bankruptcy. They further posit that hedging can be an effective instrument at the disposal of firms looking to increase their debt capacity. This gives further support to the view that there should be a positive association between a proxy of financial distress and the decision to hedge and the extent of hedging.

### **Underinvestment Costs**

Much theoretical work is documented in the literature which illustrates how non-hedging firms are more likely to underinvest in profitable projects due to their inability to raise external funding (Bessembinder, 1991; Froot et al., 1993; Myers, 1977). (Myers, 1977) shows that when a firm is in financial distress, managers of firms are less likely to invest in profitable projects. Thus to mitigate against the risk of cash flow volatility and risk of distress, firms will hedge, ultimately ensuring that firms do not underinvest. In relation to the current study the (Froot et al., 1993) paper provides key insights to the relation between hedging and underinvestment costs: a) *“Firms will want to hedge less, the more closely correlated are their cash flows with future investment opportunities”*, b) *“Firms will want to hedge more, the more closely correlated are their cash flows with collateral values (and hence with their ability to raise external finance)”*. Thus a positive relationship is expected between a proxy for growth firms and the decision to hedge.

### **Hedging Substitutes**

(Nance et al., 1993; Nguyen & Faff, 2002) show that firms can substitute the use of off-balance sheet instruments such as derivatives by opting to use on-balance sheet methods in their management of corporate risk. They argue that the decision to payout more dividends, effectively incentives firms to hedge more given that they will be subjected to liquidity constraints.

## Agency Costs

(Smith & Stulz, 1985) show that, the more invested, managers of a firm are in the firm, the more they are likely to hedge. Since their interests are more aligned with those of shareholders, managers will be more likely to hedge in order to protect shareholder value.

The reader is referred to (Aretz & Bartram, 2010; Bessembinder, 1991; Nance et al., 1993; Smith & Stulz, 1985; Stulz, 1984) for a more detailed outline of the theories of optimal hedging.

The study will apply the following proxies in its assessment of the determinants of corporate hedging behaviour in respect of foreign exchange exposure in the South African context.

**Table 12: Determinants of corporate hedging behaviour**

Factor	Proxy	Definition of the proxy variable
<b>Financial Distress</b>	(DR = Debt Ratio)	The ratio of total debt to the book value of a firm
	(DE = Debt Equity Ratio)	The ratio of long-term debt to equity capital
	(IC = Interest Coverage)	The ratio of EBIT to the interest expense
<b>Underinvestment</b>	(MTB = Market to Book)	The ratio of the market value of a firm to its book value
<b>Hedging Substitutes</b>	(QR = Quick Ratio)	The ratio of the difference between current assets minus inventories to current liabilities.
	(DY = Dividend Yield)	The ratio of dividends paid to share price
<b>Information and Transaction Costs/ Economies of scale/ Firm Size</b>	(SIZE = log(MC))	The log of market capitalisation of a firm
<b>Agency Costs</b>	(MI = Managerial Incentive)	Director's %Shareholding in Firm's Stock
<b>Sources of cashflow volatility</b>	(FSTS = Foreign Sales/Total Sales)	The ratio of foreign sales to total sales

(Géczy et al., 1997) find that “*foreign-denominated debt and currency derivatives act as substitutes for hedging foreign operations.*” Thus, in order to assess the determinants of corporate hedging behaviour, the study will follow the approach of (Judge, 2006) by not only focusing on foreign currency derivatives (FCD), but also foreign currency denominated debt (FCDD).

As already stated elsewhere in the document, the study seeks to assess firm-specific factors affecting a) the decision by firms to hedge against currency risk, b) the extent of use of FCD and FCDD, and c) to assess the effects of the use of FCD and FCDD on corporate valuations in the South African context. The following sets of hypothesis will be tested in this study:

**a) Hypothesis tests to assess firm-specific factors affecting the hedging decision:**

**Hypothesis:**

*H<sub>1a</sub>: There is no relationship between the use of foreign currency derivatives (FCD) and proxies of firm-specific factors*

*H<sub>1b</sub>: There is a relationship between the use of foreign currency derivatives (FCD) and proxies of firm-specific factors.*

*H<sub>2a</sub>: There is no relationship between the use of foreign currency derivatives (FCDD) and proxies of firm-specific factors.*

*H<sub>2b</sub>: There is a relationship between the use of foreign currency derivatives (FCDD) and proxies of firm-specific factors.*

**b) Hypothesis tests to assess firm-specific factors affecting the extent of use of foreign currency denominated debt (FCDD)**

**Hypothesis:**

*H<sub>3a</sub>: There is no relationship between the extent of use of foreign currency derivatives (FCDD) and proxies of firm-specific factors.*

*H<sub>3b</sub>: There is a relationship between the extent of use of foreign currency derivatives (FCDD) and proxies of firm-specific factors.*

**c) Hypothesis tests of corporate value effects of the use of FCD and FCDD:**

**Hypothesis in relation to FCD:**

**I. Firms with foreign exchange sales**

*H<sub>4a</sub>: Mean Tobin's Q of hedgers is equal to mean Tobin's Q of non-hedgers*

*H<sub>4b</sub>: Mean Tobin's Q of hedgers is unequal to mean Tobin's Q of non-hedgers.*

**II. Firms with foreign exchange sales**

*H<sub>5a</sub>: Mean Tobin's Q of hedgers is equal to mean Tobin's Q of non-hedgers*

*H<sub>5b</sub>: Mean Tobin's Q of hedgers is unequal to mean Tobin's Q of non-hedgers.*

**Hypothesis in relation to FCDD:**

**I. Firms with foreign exchange sales**

*H<sub>6a</sub>: Mean Tobin's Q of hedgers is equal to mean Tobin's Q of non-hedgers*

*H<sub>6b</sub>: Mean Tobin's Q of hedgers is unequal to mean Tobin's Q of non-hedgers.*

**II. Firms without foreign exchange sales**

*H<sub>7a</sub>: Mean Tobin's Q of hedgers is equal to mean Tobin's Q of non-hedgers*

*H<sub>7b</sub>: Mean Tobin's Q of hedgers is unequal to mean Tobin's Q of non-hedgers.*

### 4.3 Econometric methods and estimation procedures

The analysis of the determinants of corporate hedging in the emerging markets context of South Africa will comprise of three stages. We proceed by conducting non-parametric univariate tests on the two samples comprising of hedgers and non-hedgers respectively. Then we apply the logistic regression model in the estimation of marginal effects of independent regressors on the decision to hedge. Finally, the study models the extent of hedging activities of nonfinancial firms in relation to the use of foreign currency denominated debt through the application of the Tobit model.

#### 4.3.1 A Logit model of corporate currency hedging

To assess firm attributes affecting the decision to use foreign currency derivatives and foreign currency denominated debt, the study will apply the following Logit model as follows:

$$y = \begin{cases} 1 & \text{if a firm is a hedger} \\ 0 & \text{if a firm is a nonhedger} \end{cases}$$

$$p = pr[y = 1 | \mathbf{x}] = \mathbf{x}'\beta \quad (26)$$

$$F(\mathbf{x}'\beta) = \Lambda(\mathbf{x}'\beta) = \frac{e^{\mathbf{x}'\beta}}{1 + e^{\mathbf{x}'\beta}} = \frac{\exp(\mathbf{x}'\beta)}{1 + \exp(\mathbf{x}'\beta)} \quad (27)$$

The above model will be estimated through maximum likelihood methods. The study analyses and reports the following indicators for use in the analysis of model results: a) coefficients, and b) marginal effect. To assess the role of firm-specific attributes in relation to their effect on the likelihood of use of foreign currency derivatives and foreign currency denominated debt by nonfinancial

South african firms the following partial derivatives will be estimated:

$$\frac{\partial E(y_i / x_i, \beta)}{\partial x_{ij}} = f(-x_i' \beta) \beta_j$$

#### 4.3.2 A Tobit regression model of corporate currency hedging

To assess firm-specific factors affectng the extent of use of foreign currency denominated debt (FCDD) of nonfinancial firms in South Africa the study will apply a tobit model given as follows:

$$y^* = x' \beta + e \tag{28}$$

where  $x'$  is given as the ratio of foreign currency denominated debt (FCDD) to total assets of the firm, and  $x'$  is a vector of firm-specific factors.  $y^*$  is censored as follows:

$$y = \begin{cases} y^* & \text{if } y^* > 0 \\ 0 & \text{if } y^* \leq 0 \end{cases} \tag{29}$$

#### 4.3.3 Independent samples t-tests and panel regression models

a) Independent Samples T-tests

In order to test the null hypothesis that mean Tobin's Q for hedgers is equal to the mean Tobin's Q for non-hedgers against the alternative that they are not equal, the study will conduct univariate tests on the basis of Independent Samples *t* Tests using the SPSS software. The hypotheses take the following form:

$$H_1 : u_1 = u_2$$

$$H_1 : u_1 \neq u_2$$

The two groups in this instance are the samples of firms who hedge against currency risk and those that do not hedge.

Hypothesis tests are conducted at two levels. We distinguish between firms that have foreign sales and those that do not. Foreign sales introduce cash flow variability which is a function of the fluctuations in foreign exchange rates. Thus it is important that we categorise our analyses according to whether individual firms have foreign exchange exposure in the form of foreign sales or not.

#### b) Pooled OLS and Fixed Effects Models

It is understood that corporate value is not only a function of corporate hedging activities, but that there are other firm-specific factors which are also important in the determination of corporate value. It is therefore necessary that we conduct multivariate tests that control for the effects of the other firm-specific factors which are known to affect firm value.

To assess corporate value effects of corporate risk management of currency risk exposure in the form of the use of foreign currency derivatives (FCD) and foreign currency denominated debt (FCDD) the study will further apply the further apply multivariate tests in the form of pooled OLS regression methods and fixed effects regression methods.

The pooled OLS regression model is given as follows:

$$y_{it} = \alpha + \mathbf{x}'_{it} \beta + u_{it} \quad (29)$$

Whilst the

The fixed effects regression model is given as follows:

$$y_{it} = \alpha_i + \mathbf{x}'_{it} \beta + u_{it} \quad (30)$$

Where  $y_{it}$  refers to Tobin's Q for firm  $i$  at time  $t$ .  $\mathbf{x}'_{it}$  is a vector of explanatory factors limited to the following firm-specific factors, dummy variable (FCD-DUM) of foreign currency derivatives use which takes the value 1 if a firm uses foreign currency derivatives and 0 otherwise, dummy variable (FCDD-DUM) of foreign currency denominated debt use which takes the value 1 if a firm uses foreign

currency denominated debt and 0 otherwise, LOG(TA) which is a proxy for firm size, ROA which is a proxy for firm profitability, DE which is a proxy for leverage, IND-DUM which is a proxy for industry diversification dummy which takes the value 1 if a firm operates in more than one industry and 0 otherwise<sup>4</sup>, DIV-DUM is the dividend pay-out dummy which serves as a proxy for access to capital markets which takes the value 1 if a firm has paid out dividends and 0 otherwise.

#### 4.4 Data and descriptive statistics

**Table 13: Summary statistics of determinants of corporate hedging behaviour: Full Sample**

	Mean	Median	Maximum	Minimum	Std. Dev.	N
<b>Financial Distress Costs</b>						
DR	0,48	0,49	1,33	0,02	0,23	412
DE	2,28	0,86	288,97	-4,07	14,83	412
IC	0,51	0,50	97,91	-53,91	6,82	412
<b>Costs of Underinvestment</b>						
MTB	3,36	1,61	239,99	-5,18	12,79	412
<b>Hedging Substitutes</b>						
QR	0,02	0,97	8,71	-73,63	9,08	412
DY	2,63	2,16	70,83	0,00	4,59	395
<b>Information and Transaction Costs/ Economies of scale</b>						
Size	22,28	22,74	27,29	16,31	2,48	412
<b>Agency Costs</b>						
MI	18,19	5,52	394,18	0,00	32,36	412
<b>Sources of cashflow volatility</b>						
FSTS	0,28	0,16	1,04	0,00	0,32	412

When one compares summary statistics of samples of firms with foreign sales to those of firms without foreign sales it is apparent that firms with foreign sales have higher profitability levels. The mean ROA for firms with foreign sales is reported as 7% compared to 5.9% for firms without foreign sales. However the

<sup>4</sup> A firm is assumed to be diversified if it operates in more than one SIC industry, measured at the one digit level

median ROA magnifies the point even much more. The median ROA for firms with foreign sales is 8% and in contrast, the media ROA for firms without foreign sales is only 2%.

**Table 14: Summary Statistics of determinants of corporate value**

Panel A: Firms with Foreign Sales						
	Mean	Median	Maximum	Minimum	Std. Dev.	N
FCD-DUM	1	1	1	0	0	283
FDD-DUM	0	0	1	0	0	275
ROA	7	8	61	-29	13	279
DE	1	1	15	0	1	283
IND-DUM	1	1	1	0	0	283
DIV-DUM	1	1	2	0	1	279
Panel B: Firms without Foreign Sales						
	Mean	Median	Maximum	Minimum	Std. Dev.	N
FCD-DUM	0,9	1,0	1,0	0,0	0,3	129
FDD-DUM	0,2	0,0	1,0	0,0	0,4	129
ROA	5,9	2,0	30,4	-28,6	10,6	129
DE	0,7	0,5	6,2	0,2	0,7	129
IND-DUM	0,8	1,0	1,0	0,0	0,4	129
DIV-DUM	0,5	0,0	2,0	0,0	0,5	129

Firms with foreign sales also seem to be well diversified in terms of their industry operations. The Industry dummy variable (IND-DUM) has a mean value of 1 which means that on average firms in this category operated in more than one industry, whilst the mean IND-DUM for firms without foreign sales is less than one, meaning that a significant number of firms in this category only operates in one industry. In theory industry diversification should be value enhancing (Lewellen, 1971). However, empirical evidence suggests that industry diversification destroys value (Allayannis & Weston, 2001b; Lang & Stulz, 1994).

Firms with foreign sales also seem to be highly leveraged when compared to firms without foreign sales. The mean DE ratio for firms with foreign sales is reported as 1, whilst in cotrast it is only reported as 0.7 for firms without foreign sales. The dividend-payout dummy which serves as proxy for firm access to capital

markets suggests that firms with foreign sales have better access to capital markets than those that do not have foreign sales. The mean Div-Dum and median Div-Dum for firms with foreign sales are both reported as 1. In contrast, the mean Div-Dum and median Div-Dum for firms without foreign sales are reported as 0.59 and 0 respectively.

## **4.5 Empirical results on corporate hedging behaviour of firms**

In this section the study conducts both univariate and multivariate tests in regard to hypotheses stated in section 4.2 under sub-section a) and b). The hypotheses are meant to assess the relationship between firm attributes and corporate hedging behavior in relation to the management of foreign currency risk exposure in the South African context.

### **4.5.1 Univariate Test Results**

Table 15 provides a comparison of firm-specific attributes of foreign currency hedgers and non-hedgers. The t-tests indicate that the mean debt ratio (DR), debt-equity ratio (DE), and interest coverage of both FCD and FCDD hedgers are found to be equal to that of the respective nonhedgers at the 5% significance level. This implies that financial distress costs are not a determinant of hedging decisions of firms.

Dividend yield on the otherhand is found to be significantly higher for FCD-hedgers relative to FCD-non-hedgers. This is in line with theory which suggests that firms that payout more dividends are more likely to hedge given that they would be more likely to face liquidity constraints. On the other hand, dividend yield for FCDD-hedgers is found to be equal to that of FCDD-non-hedgers. The quick ratio is found to be equal between the two categories in respect of FCD use, whilst in the FCDD case the quick ratio is found to be significantly lower for FCDD-hedgers relative to FCDD-non-hedgers.

**Table 15: Comparison between Hedgers and Non-Hedgers – Independent Sample t Tests**

<b>Panel A: Univariate Tests Results - FCD Hedgers and Non-Hedgers</b>							
		Hedgers (N = 315)		Non-Hedgers (N = 66)		$H_0$ : Hedgers = Non-Hedgers	
Variables	Theoretical Relationship	Mean	SD	Mean	SD	t-stat	p-value
DR	Hedgers > Non-Hedgers	0,48	0,23	0,46	0,22	0,634	0,2638
DE	Hedgers > Non-Hedgers	2,51	16,24	1,12	1,18	1,567	0,0590*
IC	Hedgers < Non-Hedgers	47,85	1258,08	408,76	2092,32	-1,373	0,0869*
DY	Hedgers > Non-Hedgers	2,77	4,98	1,94	1,57	2,465	0,0071***
QR	Hedgers < Non-Hedgers	0,47	7,61	-2,22	14,18	1,531	0,0649*
MTB	Hedgers < Non-Hedgers	3,48	13,98	2,80	2,10	0,853	0,1971
SIZE	Hedgers > Non-Hedgers	22,25	2,53	22,43	2,24	-0,599	0,2752
MI	Hedgers > Non-Hedgers	19,66	34,46	10,87	17,06	3,172	0,0009***
FSTS	Hedgers > Non-Hedgers	0,29	0,33	0,20	0,25	2,686	0,0041***

<b>Panel B: Univariate Tests Results - FCDD Hedgers and Non-Hedgers</b>							
		Hedgers (N = 152)		Non-Hedgers (N = 252)		$H_0$ : Hedgers = Non-Hedgers	
Variables	Theoretical Relationship	Mean	SD	Mean	SD	t-stat	p-value
DR	Hedgers > Non-Hedgers	0,48	0,24	0,48	0,23	0,074	0,4704
DE	Hedgers > Non-Hedgers	3,70	23,68	1,41	3,46	1,202	0,1155
IC	Hedgers < Non-Hedgers	8,96	23,34	172,62	1835,37	-1,395	0,0821*
DY	Hedgers > Non-Hedgers	2,71	3,58	2,57	5,15	0,320	0,3747
QR	Hedgers < Non-Hedgers	-1,12	12,19	0,72	6,43	-1,748	0,0409**
MTB	Hedgers > Non-Hedgers	4,21	19,49	2,84	5,65	0,854	0,1972
SIZE	Hedgers > Non-Hedgers	23,94	1,87	21,27	2,25	12,952	0,0000***
MI	Hedgers > Non-Hedgers	7,94	18,51	24,44	37,09	-5,994	0,0000***
FSTS	Hedgers > Non-Hedgers	0,44	0,33	0,18	0,26	8,396	0,0000***

Director's % Shareholding in Firm's Stock (MI) which captures agency costs is found to be significantly higher for FCD-hedgers relative to FCD-non-hedgers and the same applies in respect to FCDD use. This confirms the agency costs hypothesis in respect of the optimal hedging theories in the South African context. Firm size is found to be significantly higher for hedgers when compared to non-hedgers in respect of FCD and FCDD hedging instruments. This is in line with theory as outlined in section 4.2. FCD and FCDD users are found to be highly exposed to currency risk when compared to their respective non-hedgers.

## 4.5.2 Multivariate Test Results

### 4.5.2.1 Empirical Results based on the logit model

**Table 16: Logit model of the likelihood of use of FCD**

<i>Panel A: Logit Model Estimates</i>						
Variable	Predicted Sign	Coefficient	SE	$\Delta$ Prob.	z-stat	p-value
C	—	0,4796	1,7315	0,0519	0,2770	0,7818
DR	+	0,2155	0,7247	0,0233	0,2974	0,7662
DE	+	0,1548	0,0942	0,0168	1,6423	0,1005*
IC	—	-0,0001	0,0001	-0,00001	-1,9554	0,0505**
DY	+	0,1105	0,0653	0,0120	1,6918	0,0907*
QR	—	0,0387	0,0135	0,0042	2,8737	0,0041***
MTB	+	-0,0781	0,0541	-0,0085	-1,4451	0,1484
SIZE	?	-0,0020	0,0794	-0,0002	-0,0253	0,9798
MI	—	0,0164	0,0067	0,0018	2,4667	0,0136**
FSTS	+	2,6473	0,6693	0,2867	3,9555	0,0001***

<i>Panel B: Summary Statistics for Logit Model</i>				
Prediction Evaluation (Success Cut-off = 0.5)		Dep = 0	Dep = 1	Total
% Correct Prediction		24.54	84.29	73.99
% Incorrect Prediction		75.46	15.71	26.01
Mean Dependant Variable	0.8277	LR Statistic		35.8891
SE of Regression	0.3658	Prob. (LR Statistic)		0.00004
Sum Squared Residuals	49.9051	McFadden R-Squared		0.10195
Log Likelihood	-158.0638	H-L Statistic		14.9181 (0.0608)
Restricted Log Likelihood	-176.008	Andrews Statistic		76.1703 (0.0000)

$\Delta$ Prob is the partial (or marginal) effect of the regressors on the likelihood of FCD use and is measured as  $\frac{\partial E(y_i / x_i, \beta)}{\partial x_{ij}} = f(-x_i' \beta) \beta_j$ . (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively

Multivariate tests of firm-specific factors affecting the hedging decision of firms in relation to foreign currency risk management are conducted on the basis of logistic regression models. In particular the study is interested in estimating the marginal effects of firm-attributes on the likelihood of firms' use FCD and FCDD to manage foreign currency risk. Tables 16 and 17 present the results of the logit model of FCD and FCDD use respectively.

The results reported in Panel A of table 16 show that of the three proxies of financial distress costs, the debt-equity ratio is statistically significant at the 10% level, interest coverage ratio is statistically significant at the 5% level, whilst the debt ratio is found to be statistically insignificant. All three measures of financial distress are found to have the predicted sign hypothesised in the theories of (Froot et al., 1993; Géczy et al., 1997; Judge, 2006; Smith & Stulz, 1985). Empirical studies found, using survey methods, that the sample of hedging firms found in Fortune 500 firms tended to have “less coverage of fixed claims” (Nance et al., 1993). In their study on the international evidence on financial derivative use (Bartram, Brown, & Fehle, 2009) survey the theoretical literature and find that in the main, finance theory predicts that “firms with higher leverage, shorter debt maturity, lower interest coverage, and less liquidity (e.g., lower quick ratios) are more likely to use derivatives to hedge financial risk”. “The lower a firm's coverage ratio and the higher its long-term debt ratio, the greater the probability of financial distress” (Géczy et al., 1997). Thus the finding of this study confirm the validity of the financial distress costs hypothesis of optimal-hedging theories in the South African context. Dividend yield as a proxy for access to capital markets is found to be positively related to the decision to hedge.

Liquidity (measured by QR) is found to be positively related to firm use of foreign currency derivatives at the 1% significance level. This finding is not in line with theory and empirical evidence found in studies focused on other markets. For example, (Berkman & Bradbury, 1996) find that firm use of foreign currency derivatives is positively related to firm size, leverage, director's % shareholding in firms' stock, the dividend payout ratio, and at the same time it is negatively related to interest coverage and firm liquidity.

Firm size and MTB (proxy of growth opportunities) are found to be negatively associated with corporate use of foreign currency derivatives, however these relationships are not found to be statistically significant, even at the 10% significance level.

The ratio of foreign sales to total sales is found to be positively related to firm use of foreign currency derivatives at the 1% significance level. The magnitude of the marginal effect is also highest in relation to this ratio, indicating the important role of foreign sales in the determination of firms' decision to hedge against foreign currency risk through the use of foreign currency derivatives. This finding is in line with those found in (Allayannis & Ofek, 2001; Géczy et al., 1997).

Thus, in a nutshell, South African nonfinancial firms are likely to hedge using foreign currency derivatives when they have foreign sales, have lower interest coverage, have access to capital markets, are highly liquid, higher gearing (only at the 10% significance level) , and whose management have equity stakes in the firm.

Table 17 provides results which show that in contrast, South African nonfinancial firms are likely to hedge using foreign currency denominated debt when they are small in size, have foreign sales, are highly leveraged, have less growth opportunities, are highly liquid. The magnitude of the marginal effects show that foreign sales is the single most important determinant of the decision to hedge using foreign currency denominated debt. In contrast, managerial incentives play no role in the decision to hedge using foreign currency denominated debt.

The finding on firm size is in line with theory that "since bankruptcy costs are less than proportional to firm size, smaller firms should be more likely to hedge" (Bartram et al., 2009). Thus, the optimal hedging-theory that larger firms are likely to hedge due to economies of scale is not supported by the findings in the South African context.

**Table 17: Logit model of the likelihood of use of FCDD**

<i>Panel A: Logit Model Estimates</i>						
Variable	Predicted Sign	Coefficient	SE	$\Delta$ Prob.	z-stat	p-value
C	—	-18,5434	2,0524	0,1132	-9,0350	0,0000***
DR	+	-0,9872	0,7186	0,0509	-1,3737	0,1695
DE	+	0,5056	0,1143	0,0365	4,4251	0,0000***
IC	—	-0,0001	0,0001	-0,00003	-1,6150	0,1063
DY	+	-0,0002	0,0379	0,0261	-0,0055	0,9956
QR	—	0,0268	0,0121	0,0091	2,2222	0,0263**
MTB	+	-0,3670	0,0787	-0,0184	-4,6622	0,0000***
SIZE	?	0,8173	0,0922	-0,0005	8,8661	0,0000***
MI	—	-0,0099	0,0063	0,0039	-1,5709	0,1162
FSTS	+	1,7124	0,5559	0,6249	3,0803	0,0021***
<i>Panel B: Summary Statistics for Logit Model</i>						
Prediction Evaluation (Success Cut-off = 0.5)				Dep = 0	Dep = 1	Total
% Correct Prediction				76.55	65.84	72.19
% Incorrect Prediction				23.45	34.16	27.81
Mean Dependant Variable		0.40701		Restricted Log Likelihood		-250.704
SE of Regression		0.38104		LR Statistic		189.1925
Sum Squared Residuals		52.4137		Prob. (LR Statistic)		0,0000
Log Likelihood		-156.1074		McFadden R-Squared		0,1119
				H-L Statistic		12.9773 (0.1126)
				Andrews Statistic		68.1734 (0.0000)

$\Delta$ Prob is the partial (or marginal) effect of the regressors on the likelihood of FCDD use and is measured as  $\frac{\partial E(y_i/x_i, \beta)}{\partial x_{ij}} = f(-x_i' \beta) \beta_j$ . (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively

#### 4.5.2.2 Empirical Results based on the Tobit model

Having established key firm-attributes affecting the decision by South African firms to hedge using foreign currency derivatives (FCD) and foreign currency denominated debt (FCDD), this subsection seeks to establish key-firm attributes affecting the extent of use of foreign currency denominated debt in the South African context. The study will only focus on FCDD due to insufficient data on the notional amounts of FCD.

**Table 18: A Tobit Model of the factors affecting the extent of use of FCDD**

<i>Panel A: Tobit Model Estimates</i>						
Variable	Predicted Sign	Coefficient	SE	ΔProb.	z-stat	p-value
C		-6,8673	1,9585	-1,5504	-3,5064	0,0005***
DE		0,1434	0,0382	0,0324	3,7567	0,0002***
DR		1,2577	0,4374	0,2840	2,8753	0,0040***
IC		0,0002	0,0001	0,0000	3,3102	0,0009***
DY		-0,0054	0,0176	-0,0012	-0,3038	0,7613
QR		0,0114	0,0052	0,0026	2,2008	0,0278**
MTB		-0,2054	0,0638	-0,0464	-3,2196	0,0013***
SIZE		0,2673	0,0767	0,0603	3,4834	0,0005***
MI		0,0136	0,0083	0,0031	1,6348	0,1021*
FSTS		0,7370	0,3771	0,1664	1,9545	0,0506**
<i>Panel B: Summary Statistics for Tobit</i>						
Left censored obs		35		Uncensored obs		147
Right censored obs		0		Total obs		188
Mean Dependant Variable		0.3464		Sum Squared Residuals		262.133
SE of Regression		1.2381		Log Likelihood		-265.731

ΔProb is the partial (or marginal) effect of the regressors on the likelihood of FCDD use and is measured as  $\frac{\partial E(y_i/x_i, \beta)}{\partial x_{ij}} = f(-x_i' \beta) \beta_j$ . (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively. The results are obtained by running a tobit model where the dependent variable is the level of FCDD scaled by assets for those firms that chose to hedge, which is a function of firm-specific factors.

The study finds that the most prominent factors affecting the extent of use of foreign currency denominated debt for hedging purposes are the ratio of foreign sales to total sales and leverage (measured by the debt-equity ratio). In other words. In particular, for those firms that have taken the decision to hedge, the extent of their usage of FCDD increases when the firms are larger, have high leverage, firm management have higher equity stakes in the firm, the firm has foreign sales, less growth opportunities, highly liquid, and lower coverage of their fixed claims.

#### **4.6 Empirical results on corporate value effects of currency hedging**

This sub-section seeks to assess the value effects of corporate hedging using foreign currency derivatives and foreign currency denominated debt in the South

African context. The purpose of this section can also be stated in the form of a question as follows: “Is there a hedging premium in respect of the use of foreign currency derivatives and foreign currency denominated debt in the South African context?”. The answer to this question should help to guide corporate financial policy in respect of the management of foreign exchange risk exposure management. To answer this question the study conducts both univariate and multivariate tests of the hypothesis stated in sub-section 4.2.

#### **4.6.1 Univariate test results**

In order to test the null hypothesis that mean Tobin’s Q for hedgers is equal to the mean Tobin’s Q for non-hedgers against the alternative that they are not equal, the study conducts univariate tests on the basis of Independent Samples *t* Tests using the SPSS software. The two groups in this instance are the samples of firms who hedge against currency risk and those that do not hedge.

Table 19 provides results of *t*-tests showing that corporate use of FCD and FCDD is not rewarded by the market. The results show that the mean Tobin’s Q for FCD-hedgers without foreign sales is equal to that of non-hedgers who are without foreign sales at the 10% statistical significance level. The mean Tobin’s Q for FCDD-hedgers without foreign sales is found to be less than that of non-hedgers who are without foreign sales. However, for those firms that hedge using FCD and FCDD, and have foreign sales, the study finds there is what one may call a hedging penalty in the South African context. This is not in line with theory which suggests that there should be a hedging premium associated with the use of FCD and FCDD in the management of foreign currency risk exposure.

**Table 19: Univariate tests of Tobin's Q: Hedgers Vs Non-Hedgers**

<b>Panel A: Corporate Hedging with Foreign Currency Derivatives (FCD)</b>								
	Foreign sales > 0		Foreign sales = 0		Differences		Differences	
	Hedgers (1)	Non-Hedgers (2)	Hedgers (3)	Non-Hedgers (4)	(5) = (1) – (2)	p-value	(6) = (3) – (4)	p-value
Differences in Means								
Mean	1.18	1.22	1.10	1.71	-0.04	0,44	-0.61	0,06*
Std. Dev.	1.07	1.57	0.87	0.09				
N	241	42	102	27				
<b>Panel B: Corporate Hedging with Foreign Currency Denominated Debt (FCDD)</b>								
	Foreign sales > 0		Foreign sales = 0		Differences		Differences	
	Hedgers (1)	Non-Hedgers (2)	Hedgers (3)	Non-Hedgers (4)	(5) = (1) – (2)	p-value	(6) = (3) – (4)	p-value
Differences in Means								
Mean	1.18	1.20	1.35	1.20	-0.03	0.42	0.15	0,27
Std. Dev.	1.12	1.19	0.90	1.22				
N	139	144	21	108				

(\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively

#### 4.6.2 Multivariate tests results

In this subsection we conduct multivariate tests by controlling for other factors which are expected to have an effect on the valuation of firms. The study controls for firm size (Log(TA), the log of total assets), profitability (ROA, the return on assets), leverage (DE, debt to equity ratio), Industry diversification Dummy<sup>5</sup> (IND-DUM), and the Dividend Dummy<sup>6</sup>.

**Table 20: Foreign currency derivative (FCD) use and corporate value**

Variable Name	Foreign sales > 0		Foreign sales = 0	
	Coefficient	p-value	Coefficient	p-value
Panel A: Pooled OLS Regression Models				
C	-1.106439	0.0005***	-1.234365	0.0056***
FCD-DUM	-0.341972	0.0013***	-0.323713	0.0257**
LOG(TA)	0.051266	0.0080***	0.067148	0.0273**
ROA	0.031695	0.0000***	0.032439	0.0000***
DE	0.001966	0.3355	0.013274	0.2749
IND-DUM	-0.058738	0.4356	-0.067931	0.6429
DIV-DUM	0.479540	0.0000***	0.267328	0.0435**
Adjusted-R-Squared	0.507198		0.383007	
Prob(F-statistic)	0.000000		0.000000	
Panel B: Panel Fixed Effects Models				
C	-1.116046	0.0005***	-1.242989	0.0053***
FCD DUM	-0.343899	0.0013***	-0.321132	0.0265**
LOG(TA)	0.051981	0.0076***	0.065242	0.0320**
ROA	0.031510	0.0000***	0.033288	0.0000***
DE	0.001930	0.3487	0.014798	0.2275
IND-DUM	-0.059751	0.4297	-0.063796	0.6628
DIV-DUM	0.482324	0.0000***	0.296628	0.0268**
Adjusted-R-Squared	0.503271		0.387255	
Prob(F-statistic)	0.000000		0.000000	

FCD-DUM is a dummy variable which takes the value 1 when a firm hedges with foreign currency derivatives and 0 otherwise. Log(TA) is the logarithm of total assets of firms which serves as a proxy for firm size. ROA is the firm's return on assets which serves as a proxy for firm profitability. DE is the ratio of long-term debt to owner's equity of a firm and it serves as a proxy for firm leverage. IND-DUM which is a proxy for industry diversification dummy which takes the value 1 if a firm operates in more than one industry and 0 otherwise. DIV-DUM is the dividend pay-out dummy which serves as a proxy for access to capital markets which takes the value 1 if a firm has paid out dividends and 0 otherwise.. Panel A and B reports results based on the pooled ols regression model and the panel fixed effects model respectively.

<sup>5</sup> Takes the value 1 if a firm has operations in more than one industry, and 0 otherwise.

<sup>6</sup> Takes the value 1 if a firm has paid out dividends, and 0 otherwise

In line with findings established on the basis of univariate tests, multivariate tests confirm that the use of foreign currency derivatives is negatively associated with Tobin's Q in the South African context. Table 20 shows that regardless of the estimation method, firms which use FCD to hedge currency risk exposure are penalised by the market. The magnitude of the penalty in respect of FCD use by firms with foreign sales is reported as -0.3420 and -0.3489 under the pooled ols regression and panel fixed effects model specifications respectively. The penalty is found to be statistically significant at the 1% significance level. The magnitude of the penalty in respect of FCD use by firms without foreign sales is reported as -0.3237 and -0.3211 under the pooled ols regression and panel fixed effects model specifications respectively. The penalty is found to be statistically significant at the 5% significance level.

Table 21 shows, however, that the penalty in respect of FCDD is found to be statistically insignificant even at the 10% significance level. The magnitude of the penalty in respect of FCDD use by firms with foreign sales is reported as -0.0087 under both the estimation methods. The magnitude of the penalty in respect of FCDD use by firms without foreign sales is reported as -0.0211 and -0.0031 under the pooled ols regression and panel fixed effects model specifications respectively.

The results reported in tables 20 and 21 in respect of the the other firm-specific factors affecting firm value as measured in terms of Tobin's are consistent with theory. Firm size and ROA are found to be positive associated with firm value at the 5% and 1% significance level respectively. The relationship is robust to model specification and whether the firm has foreign sales or not. The dividend dummy (DIV-DUM) which serves as proxy for firm access to capital markets is found to be negatively associated with firm value. This finding is not in line with theory which suggests that the relationship should be positive (Allayannis & Weston, 2001a). This finding is found to be statistically significant at the 1% and 5%

significance level for firms with foreign sales and firms without foreign sales respectively, regardless of the model specification .

**Table 21: Foreign currency denominated debt (FCDD) Use and corporate value**

Variable Name	Foreign sales > 0		Foreign sales = 0	
	Coefficient	p-value	Coefficient	p-value
Panel A: Pooled OLS Regression Models				
C	-1.343659	0.0001***	-1.538166	0.0013***
FCDD-DUM	-0.008712	0.9242	-0.022117	0.9028
LOG(TA)	0.047323	0.0356**	0.072571	0.0381**
ROA	0.032625	0.0000***	0.033345	0.0000***
DE	0.001880	0.3680	0.010005	0.4165
IND-DUM	-0.045206	0.5706	0.013360	0.9266
DIV-DUM	0.472420	0.0000***	0.203318	0.1311
Adjusted-R-Squared	0.487865		0.356843	
Prob(F-statistic)	0.000000		0.000000	
Panel B: Panel Fixed Effects Models				
C	-1.352761	0.0001***	-1.522400	0.0014***
FCDD-DUM	-0.008666	0.9250	-0.003113	0.9863
LOG(TA)	0.047888	0.0348**	0.068747	0.0496**
ROA	0.032475	0.0000***	0.034197	0.0000***
DE	0.001865	0.3764	0.011407	0.3581
IND-DUM	-0.046041	0.5653	0.018039	0.9008
DIV-DUM	0.474882	0.0000***	0.235436	0.0850*
Adjusted-R-Squared	0.483523			
Prob(F-statistic)	0.000000			

FCDD-DUM is a dummy variable which takes the value 1 when a firm hedges with foreign currency denominated debt and 0 otherwise. Log(TA) is the logarithm of total assets of firms which serves as a proxy for firm size. ROA is the firm's return on assets which serves as a proxy for firm profitability. DE is the ratio of long-term debt to owner's equity of a firm and it serves as a proxy for firm leverage. IND-DUM which is a proxy for industry diversification dummy which takes the value 1 if a firm operates in more than one industry and 0 otherwise. DIV-DUM is the dividend pay-out dummy which serves as a proxy for access to capital markets which takes the value 1 if a firm has paid out dividends and 0 otherwise.. Panel A and B reports results based on the pooled ols regression model and the panel fixed effects model respectively.

The industry diversification dummy variable (IND-DUM) which takes the value 1 if a firm operates in more than one SIC industry when measured at the one digit level , and 0 otherwise, is found to be negatively associated with firm value (Allayannis & Weston, 2001a; Lang & Stulz, 1994). This is particularly the case in respect of firms that hedge with foreign currency derivatives regardless of whether they have foreign sales or not. With regards to firms that hedge with foreign currency denominated debt the relationship between IND-DUM and firm value is found to be positive in instances where firms have no foreign sales. It must, however, be noted that these relationships are not found to be statistically significant even at the 10% significance level.

## **CHAPTER 5**

### **CONCLUSIONS. CORPORATE FINANCIAL POLICY. RECOMMENDATIONS**

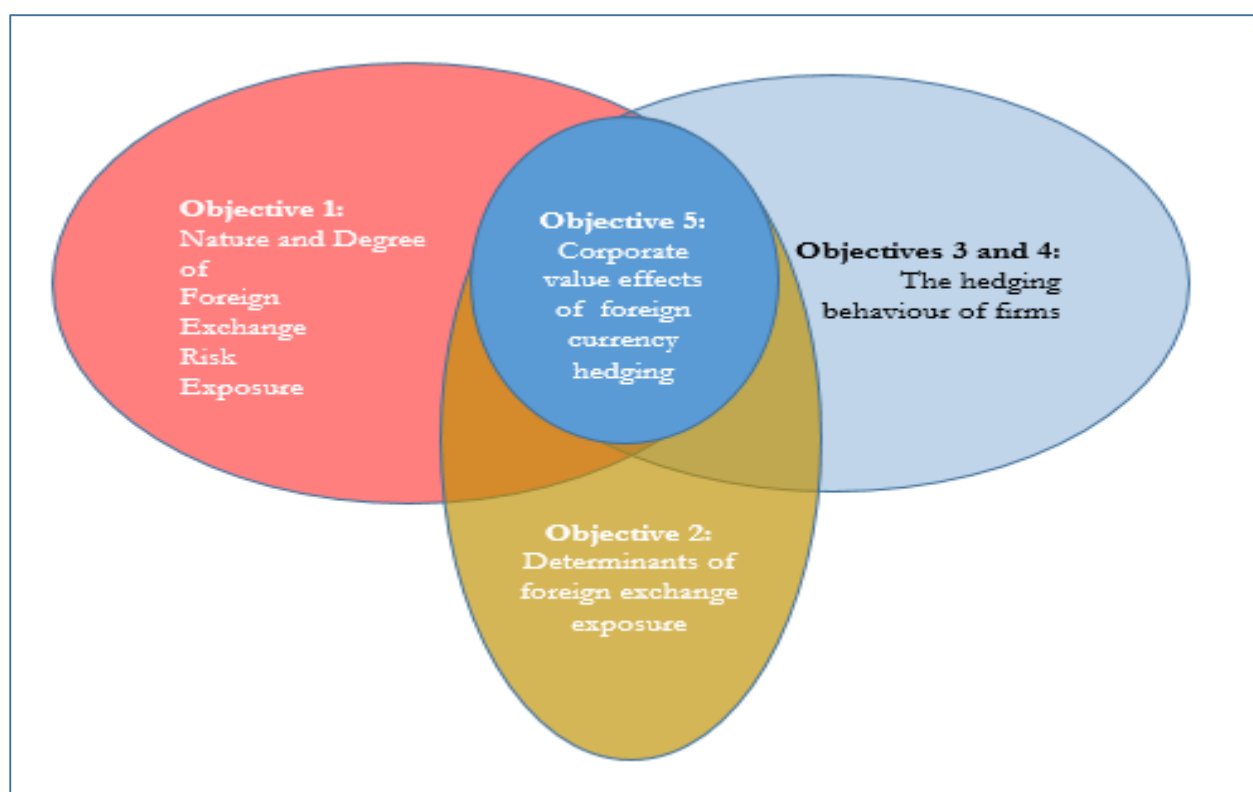
#### **6.1 Introduction**

The unravelling of a breakdown of the gold standard under the Bretton Woods system in the period between 1971 and 1973 led many countries to remove official barriers to alternative exchange rate arrangements. Many countries around the world, including South Africa, have adopted the free float exchange rate system. In a world of accelerating global integration of economies, exchange rates of emerging market economies such as are subject to excessive levels of volatility (Hausmann et al., 2006).

In such an environment, nonfinancial firms in South Africa could be subjected to foreign exchange risk exposure, particularly in light of the finding by (Su et al., 2012) that purchasing power parity (PPP) does not hold in South Africa. (S M. Bartram et al., 2005) posit that in the absence of PPP, nonfinancial firms are subject to currency risk stemming from unanticipated changes in exchange rates. The empirical literature based to a great extent on the developed market context has found limited support for this hypothesis (Bartram & Bodnar, 2007).

The literature review found no evidence of studies covering time-varying foreign exchange risk exposure of firms, corporate hedging behaviour, and the effect of corporate hedging practices in respect of foreign exchange risk, on corporate valuations in the context of African equity capital markets. Furthermore, the literature review in both the developed market and developing market context revealed no evidence of the application of augmented Fama-French five factor model (Fama & French, 2015) in the estimation of foreign exchange risk exposure.

This study therefore sought to assess the nature and degree of foreign exchange risk exposure and to identify determinants of foreign exchange risk exposure of South African nonfinancial firms. Given that the literature generally attributes the low levels of exposure to the hedging activities of firms, the study further sought to assess the hedging practices of nonfinancial firms in South Africa and to determine if corporate hedging practices in respect of currency risk management has beneficial effects on corporate valuations.



**Figure 19: The organisation of the study**

Figure 19 illustrates how the objectives of the study are related to each other.

## **6.2 Foreign exchange exposure of firms**

### **6.2.1 The Nature and Degree of Foreign Exchange Exposure of Firms**

#### **6.2.1.1 The degree of foreign exchange exposure**

The study analysed the degree of foreign exchange exposure of nonfinancial firms in South-Africa on the basis of four alternative asset pricing models in line with the standard augmented market model of (Jorion, 1990), the three-factor asset pricing model of (Fama & French, 1993), the four-factor asset pricing model of (Carhart, 1997), and the five-factor asset pricing model of (Fama & French, 2015), respectively. The study is conducted on the basis of four alternative exchange rate proxies i.e. the trade-weighted exchange rate (TWC), the Rand /US\$ exchange rate (USDZAR), the Rand/Euro exchange rate (EURZAR), and the Rand/Pound Sterling exchange rate GBPZAR.

The study estimates the degree of foreign exchange risk exposure at 42,6%, 40,7%, 41,7%, and 38,9% for the TWC, USDZAR, EURZAR, and GBZAR respectively, on the basis of the standard augmented market model of (Jorion, 1990). This finding is in line with the evidence found in other emerging markets (Bartram & Bodnar, 2007). The study specifically hypothesised that the standard model may not be a correct asset pricing model in the emerging market context, considering the dynamics of emerging markets. In particular, it was thought that since emerging markets of Africa are partially segmented (see (Kodongo & Ojah, 2012)), the correct asset pricing model should take into account idiosyncratic factors specific to the South African market. There was evidence also to the effect that the CAPM model on which the standard model is based was not an adequate model of equity valuation of firms listed on the JSE (Basiewicz & Auret, 2010).

To control for idiosyncratic factors in the estimation of foreign exchange exposure, the study applied the augmented Fama-French three factor model as recommended by (Kodongo, 2011). The application of the augmented Fama-French three factor model in the study of foreign exchange risk exposure has become popular in the literature in recent years (Aggarwal & Harper, 2010; Huffman et al., 2010). The study estimates the degree of foreign exchange risk exposure at 7,4%, 6,5%, 9,3%, and 12,0% for the TWC, USDZAR, EURZAR, and GBZAR respectively, on the basis of the augmented Fama-French three factor model. Size and value effects were found to be important factors in the determination of the variations in equity returns in line South African context in line with (Basiewicz & Auret, 2010).

Similar results in relation to the degree of foreign exchange risk exposure are documented in this study. The application of the augmented Carhart four factor model resulted in the finding that exposure levels are 7,4%, 7,4%, 8,3%, and 11,1% for the TWC, USDZAR, EURZAR, and GBZAR respectively. The application of the augmented Carhart four factor model is only recently being adopted in the study of the foreign exchange risk exposure (see (Kolari et al., 2008)).

To the knowledge of the author, this is the first study to apply the augmented (Fama & French, 2015) five factor model in the study of foreign exchange risk exposure. The results, however, do not differ much from the results obtained from the augmented Fama-French three factor model and the augmented Carhart four factor model. The application of the augmented Fama-French five factor model resulted in the finding that exposure levels are 8,3%, 6,5%, 10,7%, and 10,2% for the TWC, USDZAR, EURZAR, and GBZAR respectively.

#### **6.2.1.2 The nature of foreign exchange exposure**

The study considered that with the changing global macroeconomic environment and that of the South African economy, it would be unrealistic to expect that

exposure levels will remain constant the period of the study. Thus, to model time-varying exposure, the study applied ordinary least squares (OLS) rolling window regression models with a fixed window size of 31 observations and a step size of 1. The estimated results were plotted on a Cartesian plane with the x-axis depicting the time dimension, whilst the y-axis depicted exposure levels.

Exposure levels with respect to the trade-weighted exchange rate (TWC) range from a low of 5.56% in December 2013 to a high of 33.33% in September 2006. For the USDZAR, exposure levels range from a low of 4.63% in May 2012 to a high of 37.04% in March 2007. Exposure levels with respect to the EURZAR range from a low of 6.48% in February 2012 to a high of 32.41% in August 2008. For the GBPZAR, exposure levels range from a low of 6.48% in August 2012 to a high of 32.41% in August 2008.

The lowest levels of firm exposure occur in the post financial crises period and the highest levels of firm exposure occur in the pre financial crises period for all exchange rates. This points to the likelihood of asymmetric foreign exchange exposure. The results are in line with those found in the developed markets context (Agyei-Ampomah et al., 2013; Allayannis, 1997; Koutmos & Martin, 2007). The nature of time-variation appears to be related to changes in the macroeconomic environment. We notice a sharp decline in foreign exchange exposure that coincides with the onset of the global financial crises. This points to the role of macroeconomic factors in determining exposure levels. The role of macroeconomic factors in the determination of currency risk exposure is documented in the emerging markets context is documented in (Chue & Cook, 2004). Using micro, firm-level data, this study therefore provides further indications of the role of macroeconomic factors in the time-variation of currency risk exposure.

Having established that there is time-variation in the degree of exposure, the study further sought to investigate if there is asymmetric exposure to currency

appreciations and currency depreciations. An indirect test of asymmetric exposure revealed results that are similar to those estimated on the basis of a more direct test in the form of a Nonlinear ARDL model. In line with findings from other studies conducted in other parts of the world, exposure levels of South African firms estimated by controlling for asymmetry, were found to be higher than those estimated on the basis of the standard model (Bartram & Bodnar, 2007; Koutmos & Martin, 2003; Muller & Verschoor, 2006a). The Nonlinear ARDL model also distinguished between short-run and long-run asymmetry exposure and further demonstrated that asymmetric exposure is much more pronounced in the short-run than in the long-run. The results estimated through the STAR Model, however, report much lower levels of asymmetric exposure. The finding of asymmetric exposure has implications on the hedging policies of firms in the emerging market, and in particular the South African context.

The finding of short-run asymmetry implies that the risk is much more pronounced in the short-run and that corporate hedging policies may tend to be a lot more focused on managing short-term currency risk. This is in line with the assertion that, “... *nonfinancial corporations are confronted with risks stemming from the impact of unexpected exchange rate...especially in the short- and the medium-term*” (Bartram et al., 2005). The fact that in the long-run asymmetric exposure disappears supports the view that in the long-run, operational hedges are a lot more effective in the management of currency risk (Choi & Jiang, 2009; Pantzalis et al., 2001; Soenen & Madura, 1991).

It is therefore recommended that South African nonfinancial firms, particularly those engaged in international business should take a longer term perspective in terms of how they manage their exposure to foreign exchange risk. They should consider investing in multiple operations, closer to their markets. This will provide a natural hedge and ensure that they stay competitive.

### **6.2.2 Determinants of Foreign Exchange Exposure of Firms**

The range of factors that can conceivably determine the foreign exchange risk exposure of firms encompasses macroeconomic factors which are external to the organisation environment, along with firm-specific factors that are within the control of the firm. The focus of this study was on firm-specific factors. In particular the study followed the market-approach and to a great extent, was inspired by the work of (Agyei-Ampomah et al., 2013).

In line with the work of (Agyei-Ampomah et al., 2013), the study assesses the role of firm size (MV serving as the proxy), leverage/financial distress (debt-to-assets ratio (DTA) serving as proxy), growth-opportunity (market-to-book ratio (MTB), serving as proxy), and liquidity (quick-ratio (QR), serving as proxy) in determining the degree of foreign exchange exposure of firms.

Firm size is found to have a negative association with measures of foreign exchange exposure of firms under most of the specifications of the panel regression model. (Agyei-Ampomah et al., 2013) who establish a similar relationship in the developed market context of the UK, attributed this finding to the so-called “ability to hedge” argument.

In a clear departure from theory which predicts that growth firms are more likely to hedge (see (Froot et al., 1993)), MTB which serves as proxy for growth-opportunities is found to have a positive association with foreign exchange exposure at the firm-level in the South African context. This is particularly interesting because in a recent study, (Agyei-Ampomah et al., 2013) found evidence of a negative association between MTB and measures of foreign exchange exposure in the developed market context of the UK. This provides evidence that unlike their developed market counterparts, growth firms in South Africa do not hedge.

QR, the proxy variable for firm liquidity, shows a positive association with firm exposure in respect of the USDZAR, EURZAR, and GBPZAR. This finding is in line with theory (Froot et al., 1993; Nance et al., 1993), and corroborated by evidence found in studies conducted in the developed markets of the US and Europe (Choi & Kim, 2003; He & Ng, 1998; Muller & Verschoor, 2006b).

DTA, a measure of leverage, is found to be positively associated with foreign exchange exposure and statistically significant, in respect of the USDZAR and GBPZAR exchange rate proxies. However, leverage is found to be statistically insignificant with respect to the EURZAR and GBPZAR exchange rate proxies. Thus, highly leveraged firms are found to be particularly exposed to foreign currency risk in respect of the USDZAR and GBPZAR exchange rate proxies.

The study has established that smaller firms that are highly leveraged, with higher growth prospects, and more liquid are more likely to be exposed to foreign exchange risk in the South African context.

### **6.3 The hedging behaviour of firms**

The study considered hedging practices of South African firms in the management of foreign exchange risk exposure. In particular the study focuses of currency hedging through the use of foreign currency derivatives and foreign currency denominated debt.

The study established that South African nonfinancial firms are likely to hedge using foreign currency derivatives (FCD) when they have foreign sales, have lower interest coverage, have access to capital markets, are highly liquid, higher gearing (only at the 10% significance level) , and whose management have equity stakes in the firm.

In contrast, South African nonfinancial firms were found to be more likely to hedge using foreign currency denominated debt when they are small in size, have foreign sales, are highly leveraged, have less growth opportunities, are highly liquid. The magnitude of the marginal effects show that foreign sales is the single most important determinant of the decision to hedge using foreign currency denominated debt. In contrast, managerial incentives play no role in the decision to hedge using foreign currency denominated debt.

The study finds that the most prominent factors affecting the extent of use of foreign currency denominated debt for hedging purposes are the ratio of foreign sales to total sales and leverage (measured by the debt-equity ratio). In particular, for those firms that have taken the decision to hedge, the extent of their usage of FCDD increases with firms size, financial distress, managerial incentives, the firm has foreign sales, less growth opportunities, highly liquid, and lower coverage of their fixed claims.

The study could not consider the dynamics in relation to the extent of use of FCD due to a lack of data on notional amounts of FCD.

#### **6.4 Corporate value effects of foreign currency hedging**

The study conducted both univariate and multivariate tests of the hypothesis that corporate use of hedging instruments should have beneficial effects of corporate value.

Univariate tests were conducted on the basis of independent samples t-tests. The results of t-tests show that corporate use of FCD and FCDD is not rewarded by the market. The results show that the mean Tobin's Q for FCD-hedgers without foreign sales is equal to that of non-hedgers who are without foreign sales at the 10% statistical significance level. The mean Tobin's Q for FCDD-hedgers without foreign sales is found to be less than that of non-hedgers who are without foreign sales. However, for those firms that hedge using FCD and FCDD, and have foreign sales, the study finds there is what one may call a hedging penalty in the South

African context. This is not in line with theory which suggests that there should be a hedging premium associated with the use of FCD and FCDD in the management of foreign currency risk exposure. The study further conducted multivariate tests and confirmed the hedging penalty found on the basis of univariate tests in the South African context. Multivariate tests were conducted on the basis of pooled ols regression and panel fixed effects models. The study controlled for firm size (The log of Total Assets), firm profitability, leverage, Industry diversification Dummy<sup>7</sup> (IND-DUM), and the Dividend Dummy<sup>8</sup>.

Many other studies conducted in the developed market context find that there is a hedging premium associate with the use of financial instruments such as FCD nd FCDD in the management of foreign exchnage risk exposure (Allayannis & Weston, 2001a; Judge, 2006) .

Thus, corporate currency risk management using foreign currency derivatives and foreign currency denominated debt has no beneficial effects on corporate value.

## **6.5 Implications for corporate financial policy**

The study recommends the use of the (Fama & French, 1993) in the estimation of foreign exchange risk exposure in the South African context. This is primarily on the basis of the principle of parsimony. (Fama & French, 1996) posit that the two additional factors in the form of the size and value factor can be interpreted as proxies for relative financial distress which, rational investors see as “a particular state variable of special hedging concern to investors”.

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<sup>7</sup> Takes the value 1 if a firm has operations in more than one industry, and 0 otherwise.

<sup>8</sup> Takes the value 1 if a firm has paid out dividends, and 0 otherwise

The finding that asymmetric currency risk exposure mainly occurs in the short-run implies South African corporates are mainly preoccupied with managing downside risk in the short-term. In other words, they are more concerned with transactional exposure and do not pay particular attention to the more long-term aspects of currency risk exposure, which is sometimes referred to as economic exposure.

The finding of positive association between a proxy for firms with growth opportunities and foreign exchange risk exposure implies that growth firms in the South African context are not taking enough cover against currency risk. The cover could be in the form of financial hedges and operation hedges. The literature recommends the use of both financial and operational hedges in the management of foreign currency risk (Allayannis et al., 1995).

Furthermore, South African firms, and in particular growth firms must consider operating in multiple locations across their markets in order to provide a natural operation hedge. (Soenen & Madura, 1991) posit that firms should adopt a more strategic approach to the management of economic exposure. In a much more recent paper (Bartram et al., 2005) outline key aspects of the strategic approach to the management of economic foreign exchange risk exposure as follows, “a) *a long-term, forward-looking perspective; b) the clear focus on cash flows; c) taking into account price and quantity effects of exchange rate changes; d) the consideration of operative flexibility of the firm (adjustment of prices, changes of market for inputs and outputs); e) the focus on the currencies of denomination and determination.*”

The finding of the study further confirms the benefits of firms focusing on currencies of denomination and determination in the management of currency risk exposure. Corporate value effects of the use of foreign currency denominated debt were found to be much more more beneficial when compared to the use of foreign currency derivatives. The penalty in respect of the use of FCDD was found to be statistically insignificant even at the 10% significance level. The magnitude

of the penalty in respect of FCDD use by firms with foreign sales was reported as -0.0087. The magnitude of the penalty in respect of FCDD use by firms without foreign sales was reported as -0.0211 and -0.0031. On the other hand, the magnitude of the penalty in respect of FCD use by firms with foreign sales is reported as -0.3420 and -0.3489 under the pooled ols regression and panel fixed effects model specifications respectively. The penalty is found to be statistically significant at the 1% significance level. The magnitude of the penalty in respect of FCD use by firms without foreign sales is reported as -0.3237 and -0.3211 under the pooled ols regression and panel fixed effects model specifications respectively. The penalty is found to be statistically significant at the 5% significance level.

South African firms are therefore encouraged not to simply focus on the short-term in their management of foreign currency risk. They must rather elevate the issue of currency risk to the boardroom and not relegate it to the back office of their treasury departments as originally recommended in (Dufey, 1972). The automotive sector which is known for being particularly susceptible (as evidenced by the number of papers found in the literature, (see (S. Bartram et al., 2010; Williamson, 2001)) to foreign exchange risk exposure have begun to adopt a much more strategic approach in their management of foreign currency risk. In a 2016 industry report focusing on the automotive sector, PWC writes as follows: “For the past 10 years, OEMs and suppliers have generally chased global sales growth while hoping to improve margins by leveraging automobile platforms in multiple regions and striving for scale wherever possible” (PWC, 2016).

### **6.3 Contributions to the body of knowledge**

The study provides an account of the foreign exchange exposure of nonfinancial firms from an emerging market perspective. There is scant literature on foreign exchange exposure in an African context (Abor, 2005; Asaolu, 2011; Chen,

Naylor, & Lu, 2004; Molele, 2014; Salifu, Osei, & Adjasi, 2007). The current study improves on (Molele, 2014) by incorporating (Fama & French, 1993) as recommended by (Kodongo, 2011). To the best of the author's knowledge this is the first study to apply the Fama-French Five factor asset pricing model (Fama & French, 2015) in the study of foreign exchange risk exposure. This study provides evidence that the standard market model overstates the level of foreign exchange risk exposure of emerging markets nonfinancial firms. An important contribution of this study is therefore to highlight the role of idiosyncratic factors in modelling foreign exchange risk exposure of nonfinancial firms in the emerging market context.

The study is the first to model asymmetric foreign exchange risk exposure in the emerging market context of South Africa. To the best of the author's knowledge, this is the first time that a Smooth Transition Autoregressive Model and a Non-Linear autoregressive Distributed Lag model have been used in the study of foreign exchange risk exposure in respect of South African non-financial firms and Africa in general.

This is the first study to estimate time-varying foreign exchange risk exposure of nonfinancial firms in respect of South African non-financial firms and Africa in general.

The study further adds to the body of knowledge by providing empirical evidence of firm-specific factors affecting hedging behaviour of South African firms and how hedging behaviour in the South African context affects the nature and degree of foreign exchange exposure.

Furthermore, the study will provides empirical evidence of the effect of foreign currency derivatives use on corporate valuations. Lastly the study provides a foreign exchange risk exposure measurement framework which will inform corporate financial policy with regards to the management of foreign currency

risk in South Africa and other emerging markets. To the best of the author's knowledge this is the first study of its kind in the emerging market context of Africa, and more specifically the South African context

#### **6.4 Recommended areas of future research**

The particular focus of this study was on corporate financial hedging through the use of financial instruments such as foreign currency derivatives and foreign currency denominated debt. It is recommended that future research explore in greater depth, the strategic approach to the management of economic foreign exchange risk exposure from an emerging market perspective.

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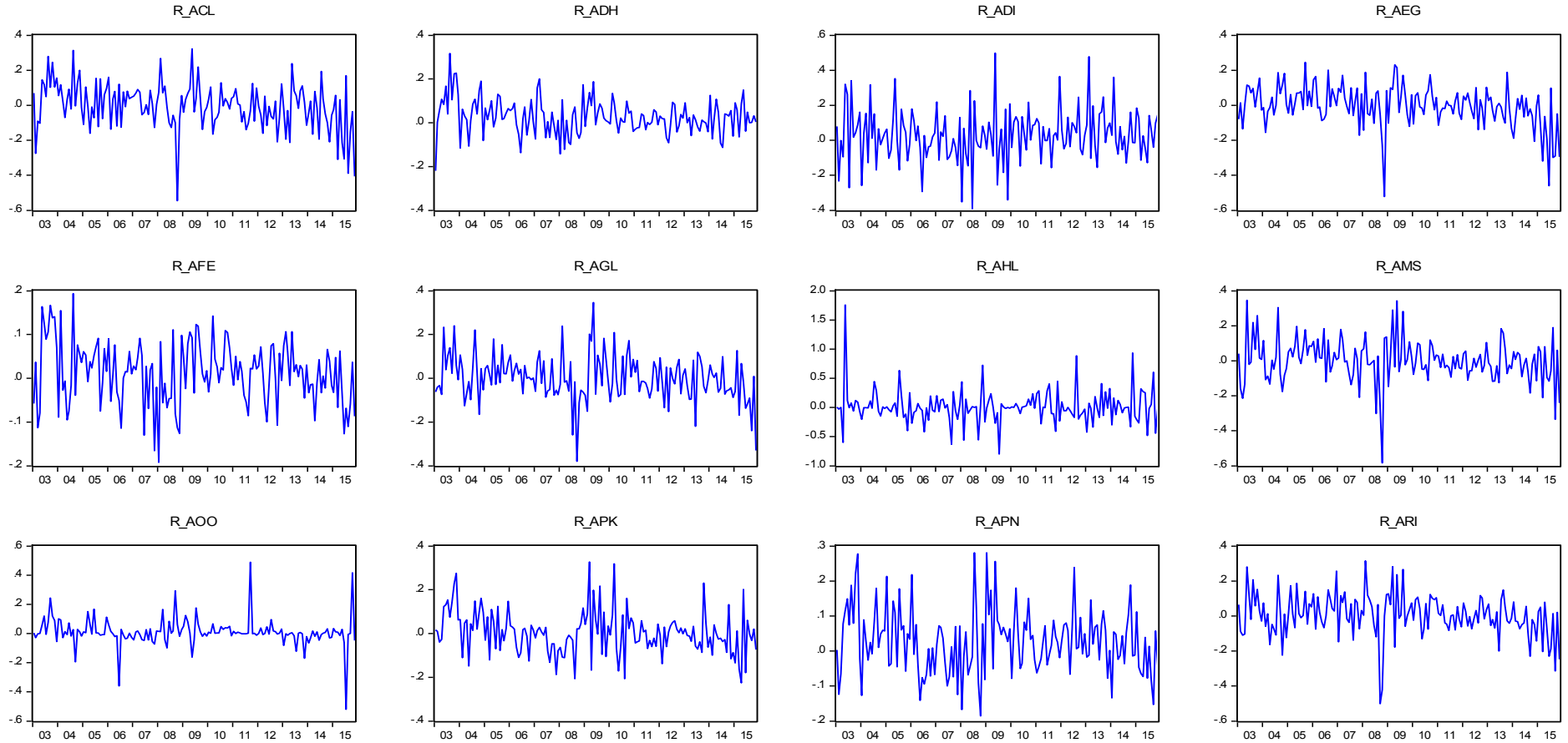
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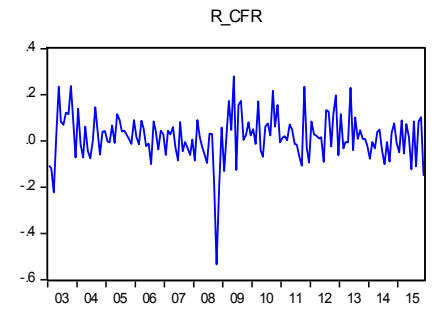
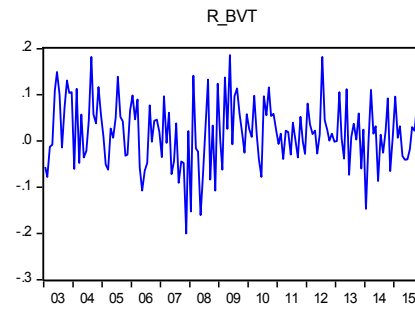
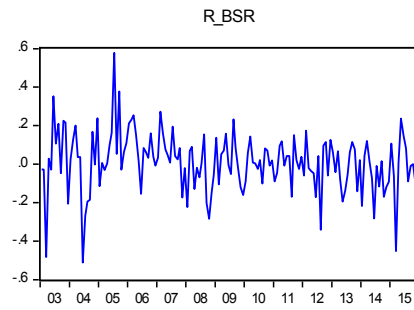
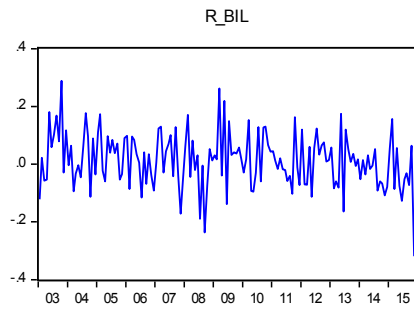
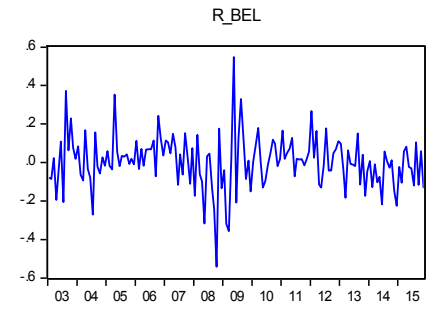
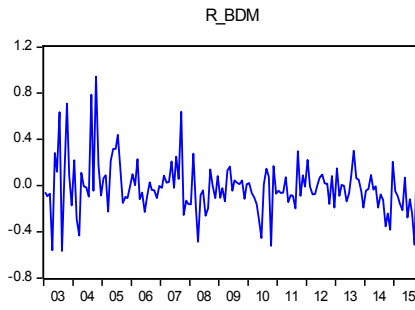
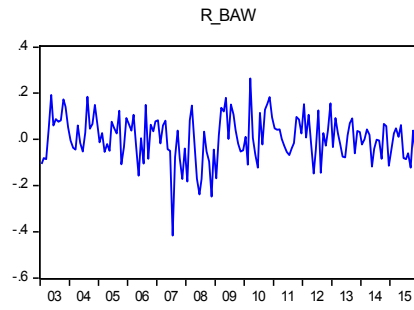
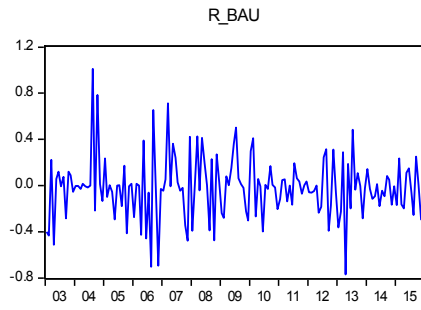
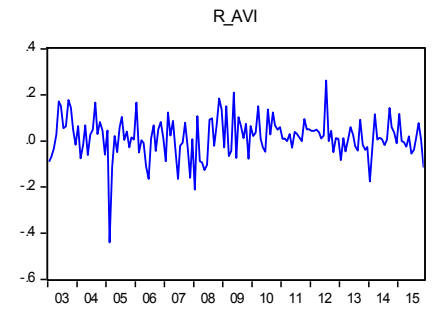
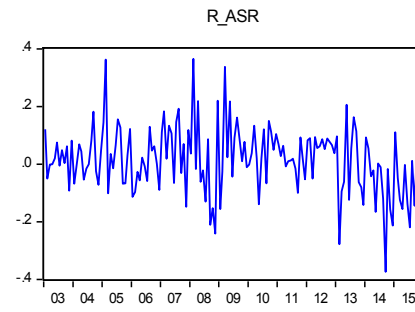
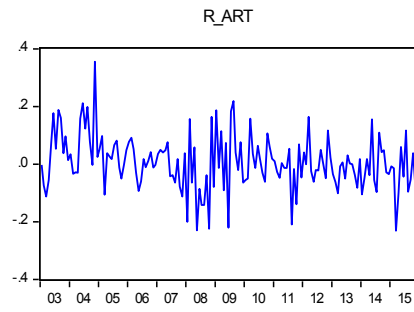
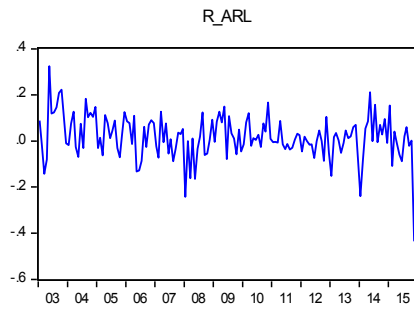
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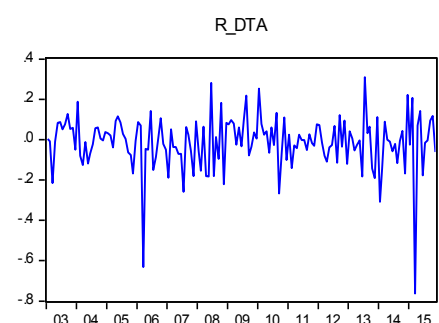
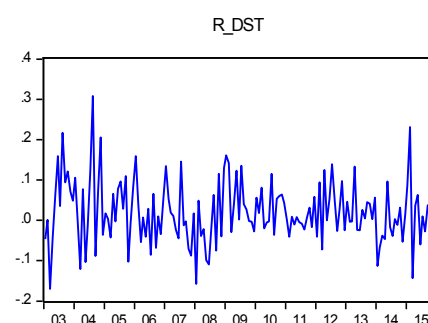
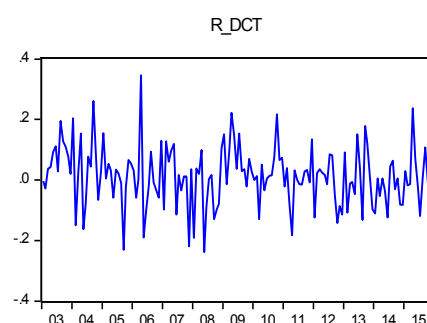
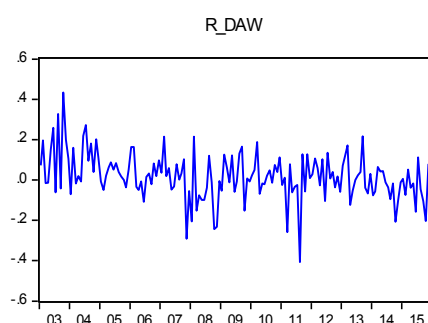
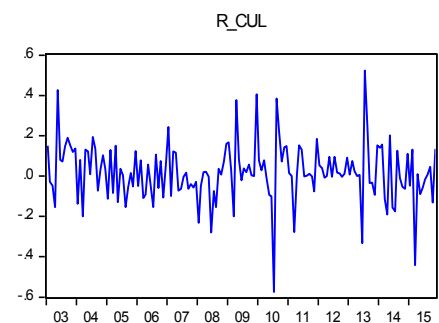
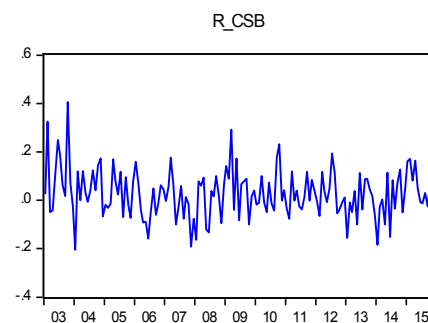
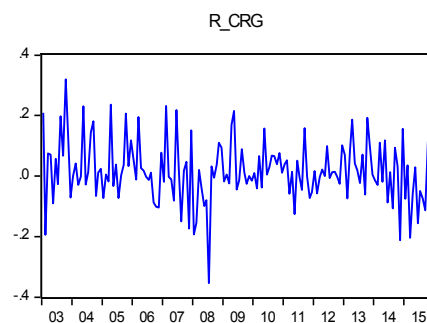
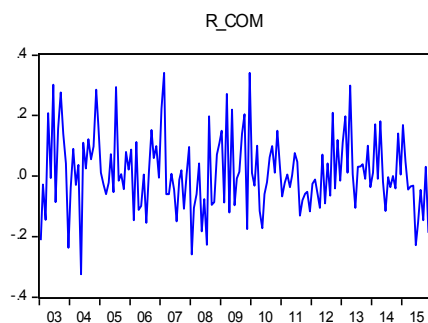
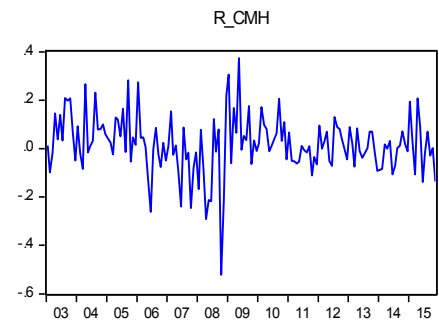
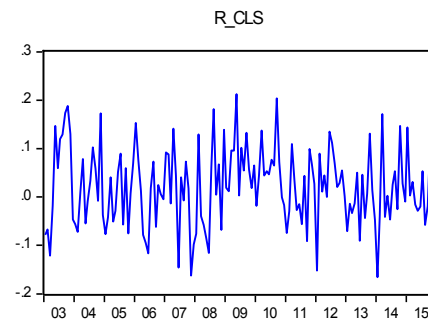
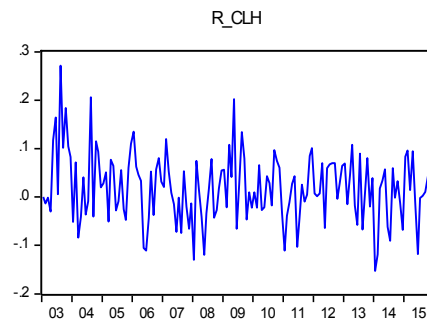
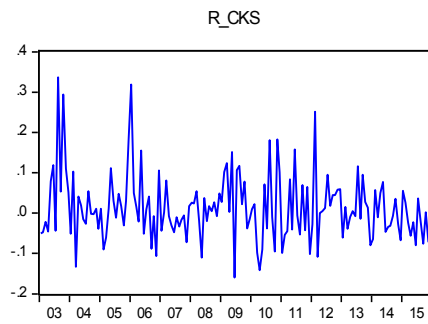
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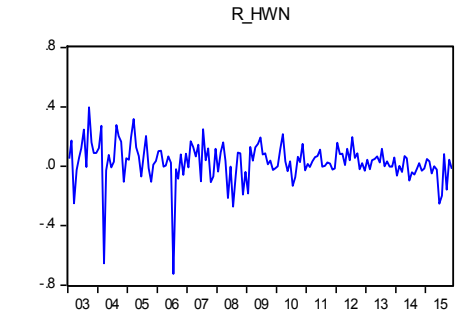
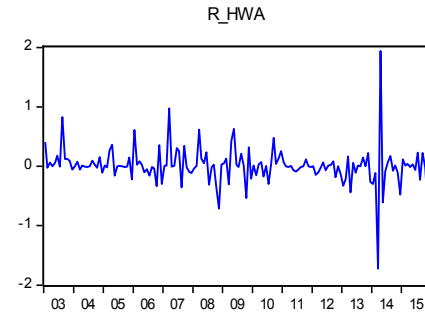
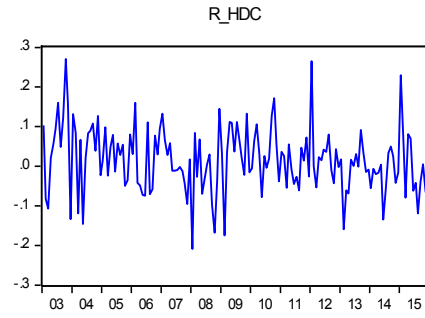
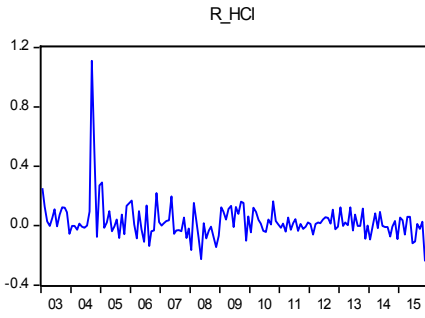
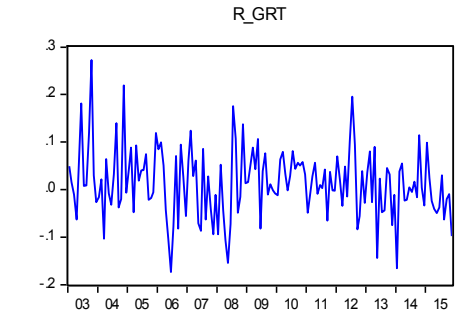
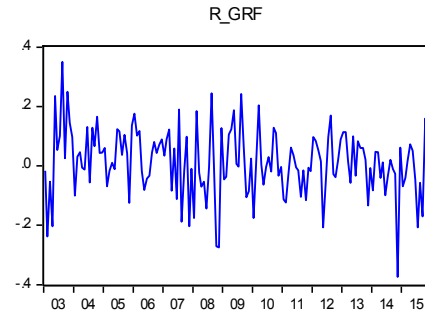
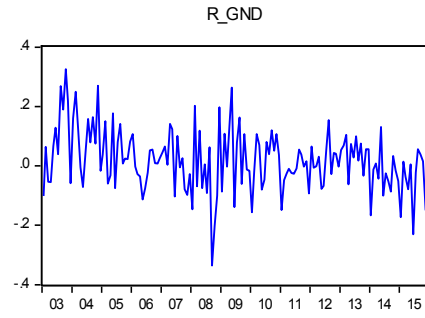
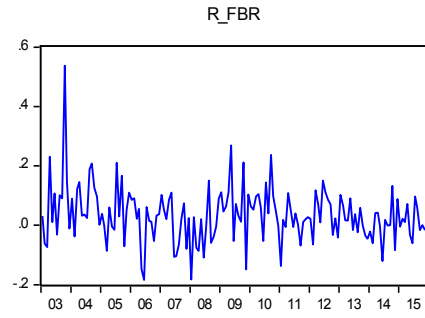
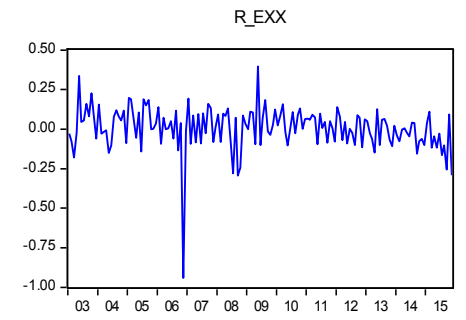
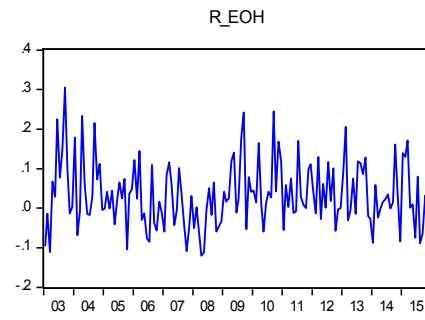
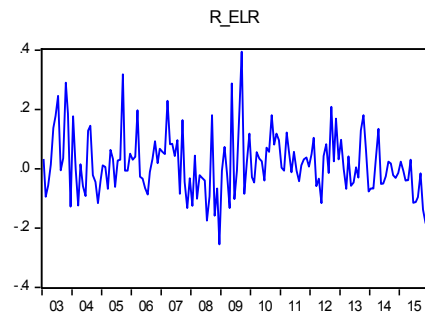
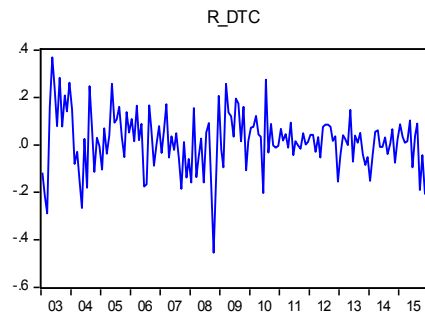
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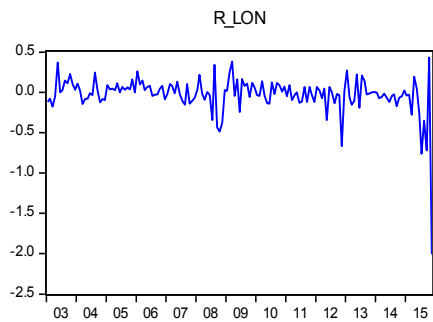
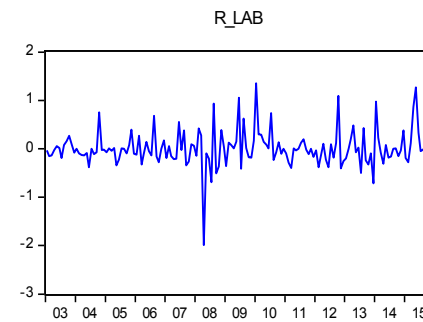
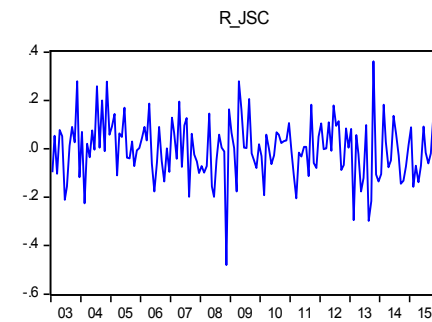
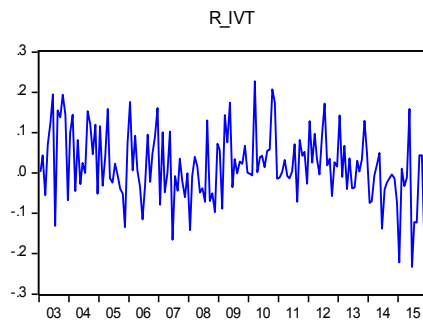
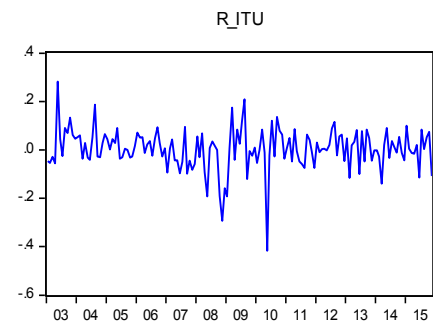
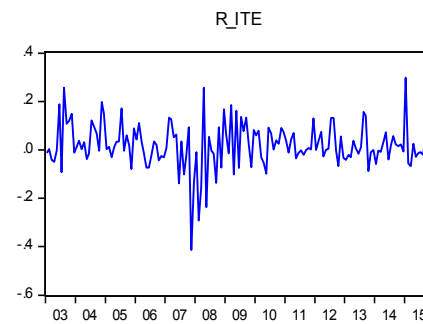
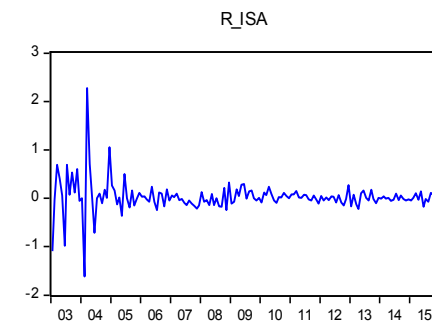
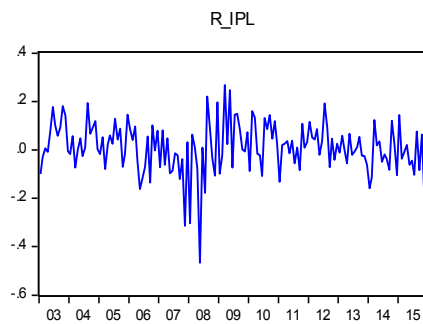
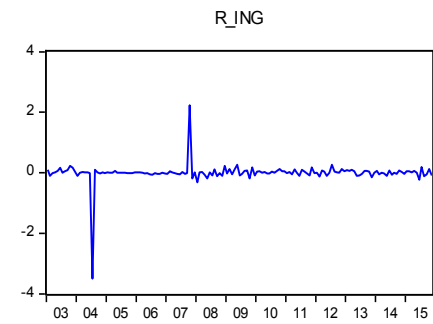
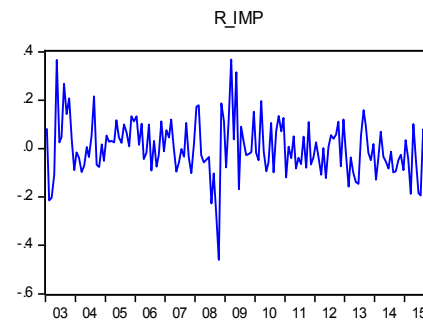
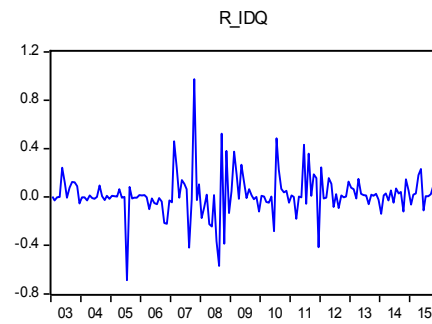
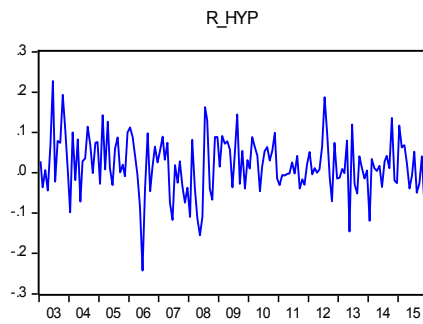
## APPENDIX A: SHARE RETURNS OF NONFINANCIAL FIRMS IN SOUTH AFRICA

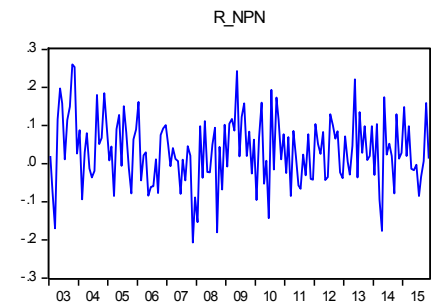
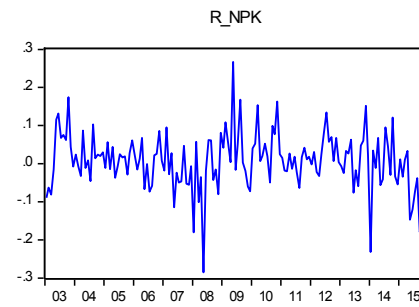
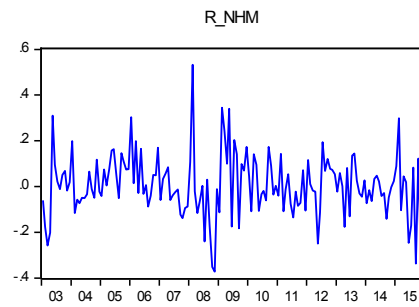
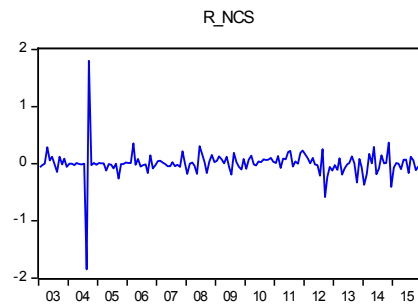
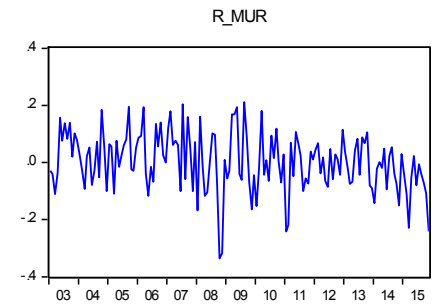
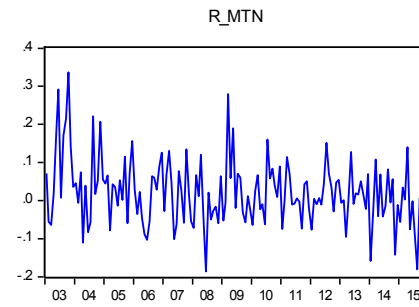
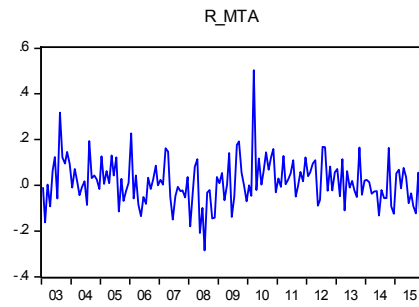
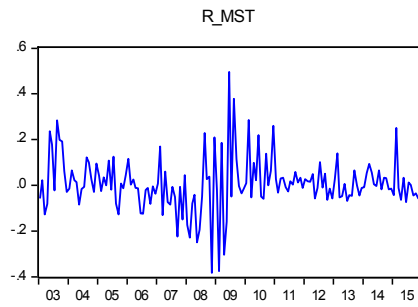
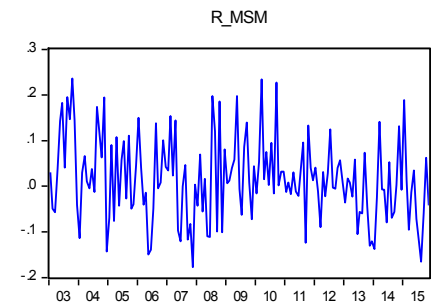
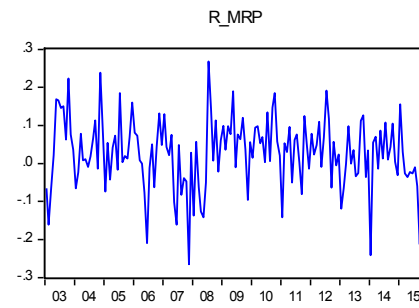
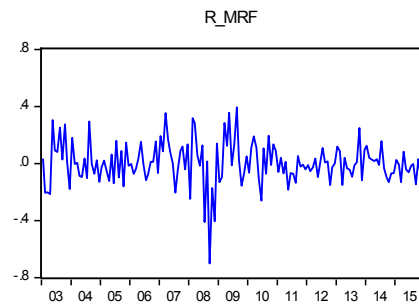
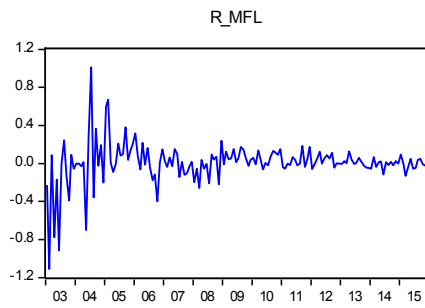


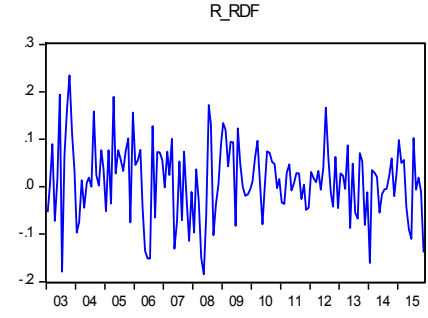
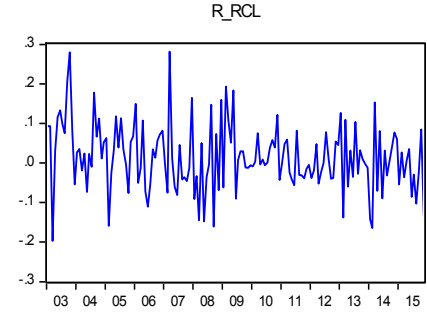
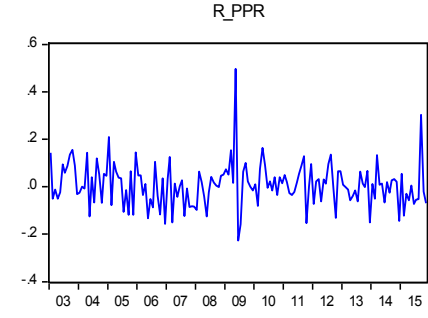
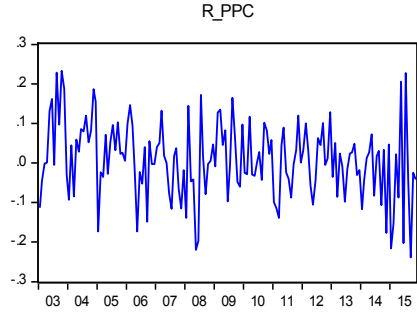
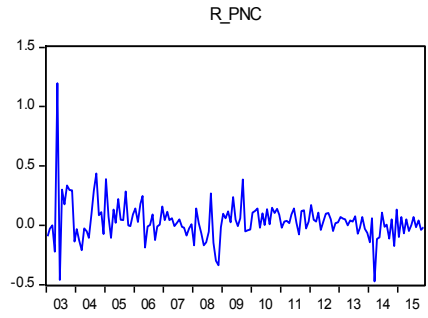
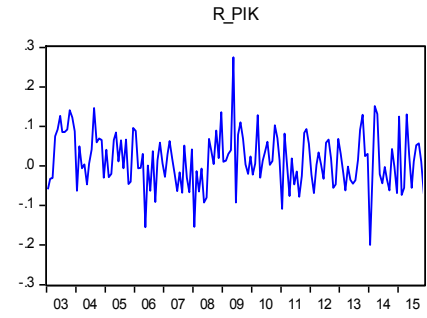
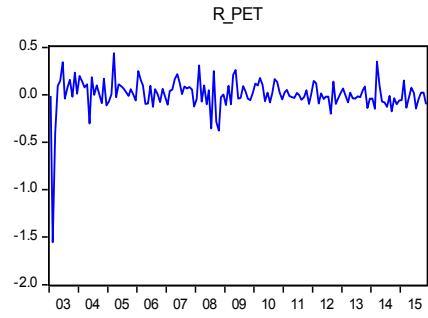
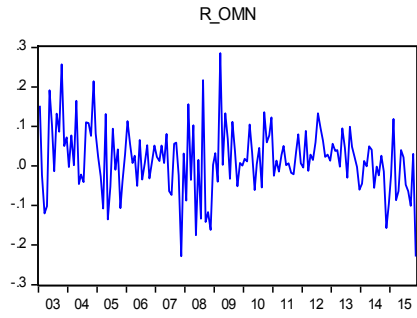
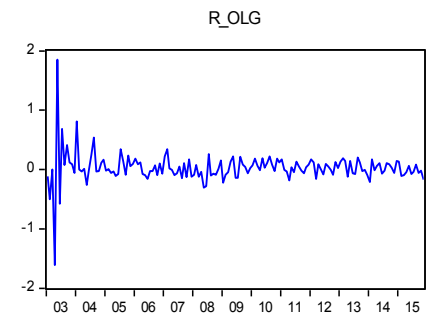
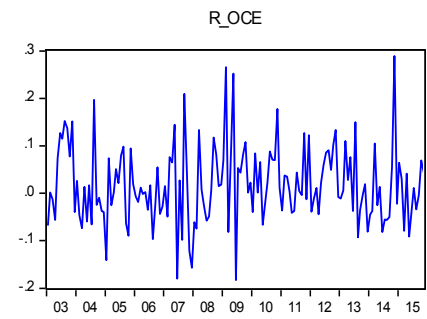
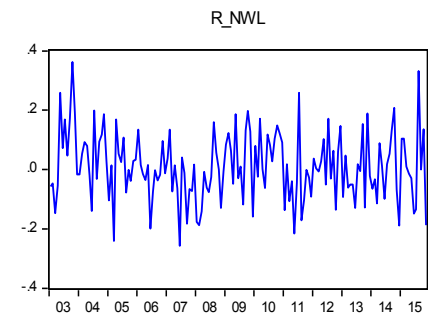
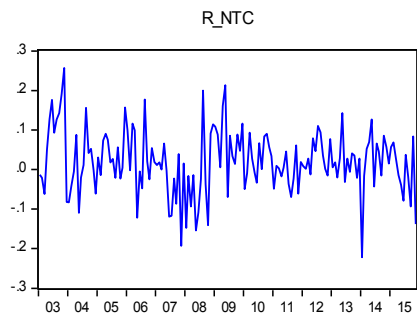


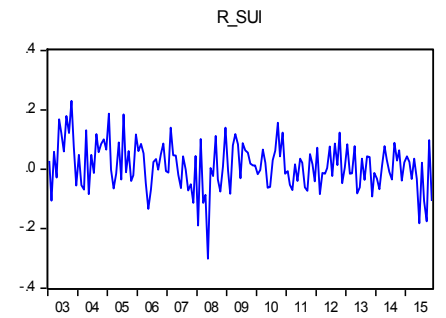
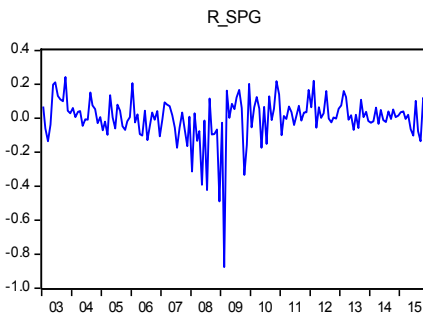
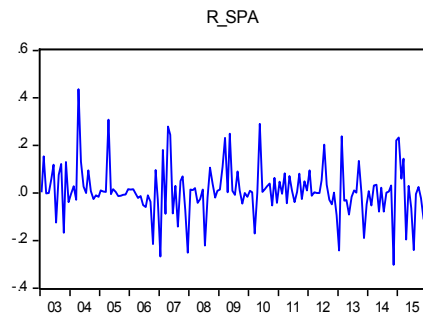
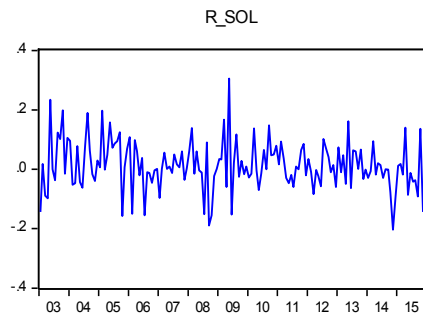
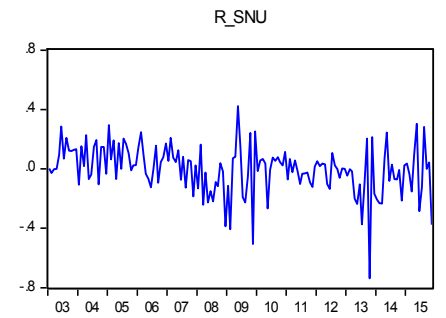
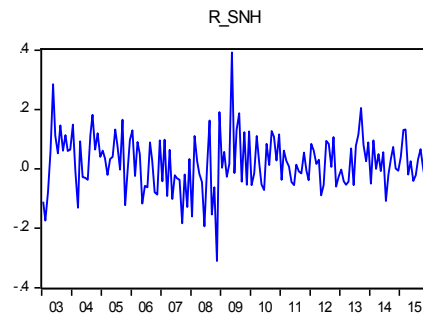
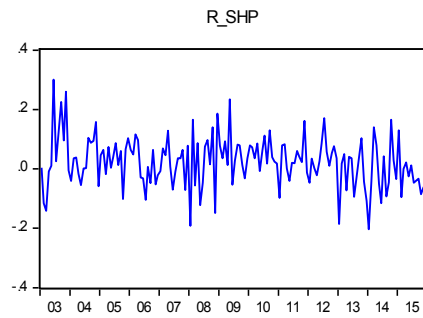
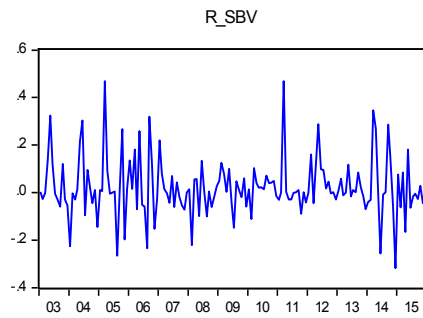
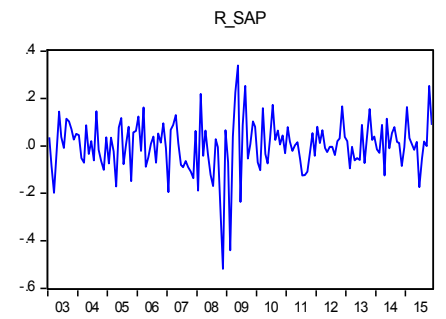
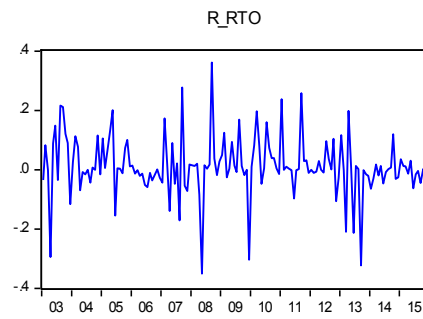
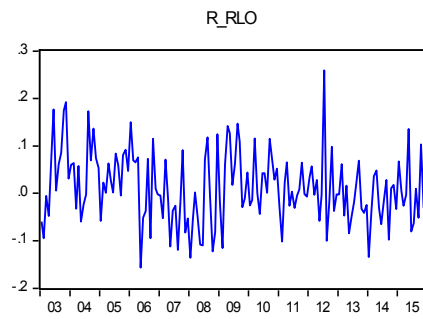
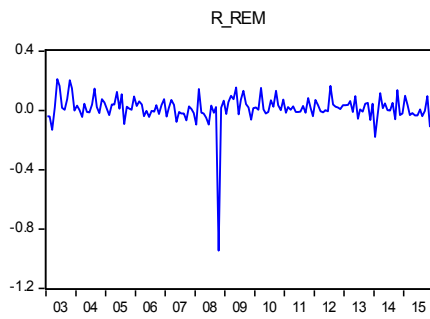


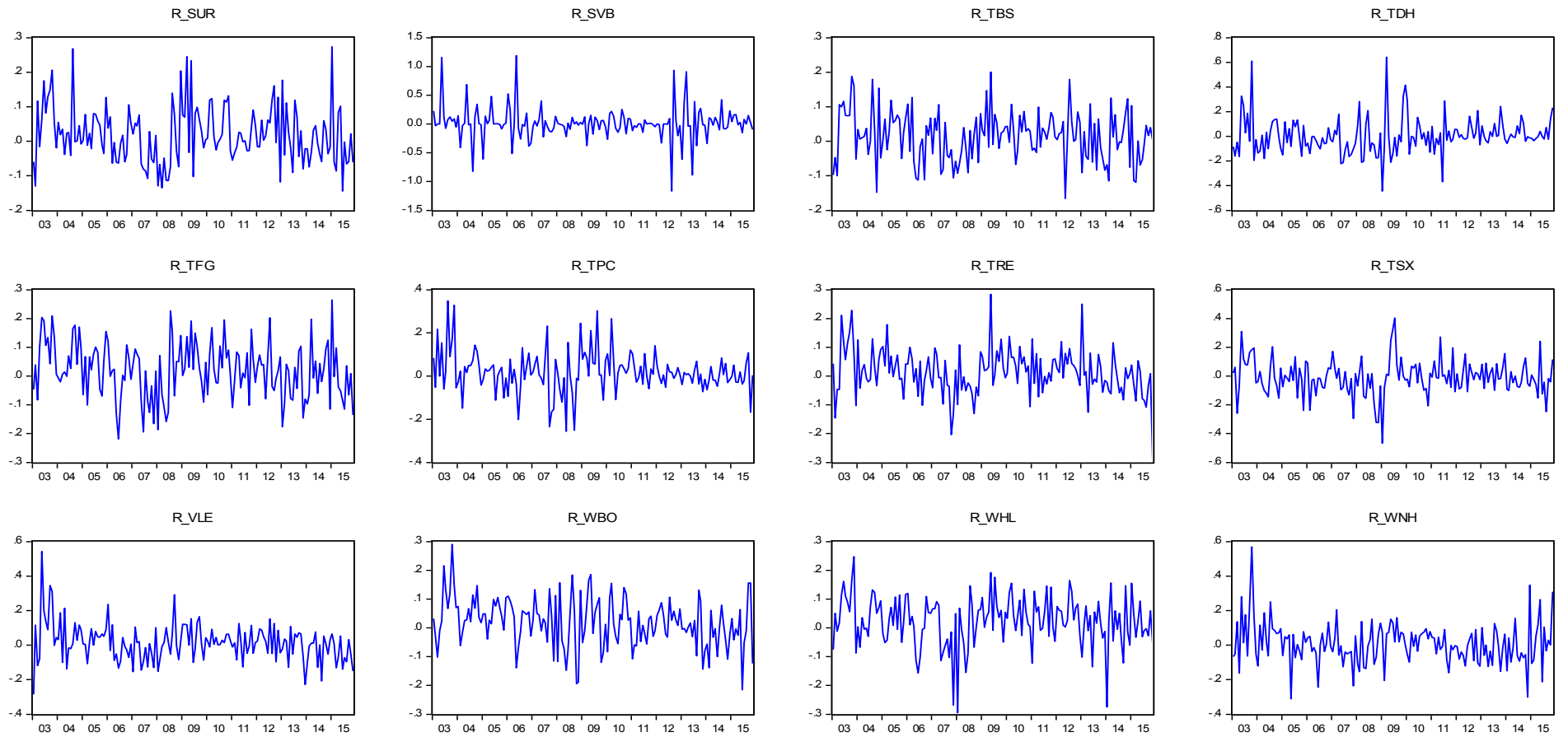












**Figure 20: Share returns of nonfinancial firms in South Africa**

## APPENDIX B: Firm-specific Results (Unconditional Exposure)

### PANEL A: CAPM-based Asset Pricing Framework

The residual foreign exchange exposure is estimated using Pooled EGLS to estimate the augmented market model of (Jorion (1990):  $R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \varepsilon_{i,t}$  (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**Table 22: (Firm Specific Results) - Residual Exposure based on the CAPM Framework**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
ACL	0.544*	0.059	-0.462**	0.015	-0.256	0.228	-0.252	0.237
ADH	0.754***	0.000	-0.398***	0.002	-0.404***	0.004	-0.529***	0.000
ADI	0.608*	0.103	-0.238	0.362	-0.433	0.113	-0.122	0.658
AEG	0.893***	0.001	-0.579***	0.001	-0.682***	0.001	-0.704***	0.000
AFE	0.500***	0.001	-0.242**	0.023	-0.311***	0.007	-0.325***	0.005
AGL	-0.046	0.801	0.047	0.711	0.116	0.387	0.159	0.236
AHL	-0.289	0.697	1.048**	0.032	1.093**	0.041	0.801	0.139
AMS	0.136	0.589	0.016	0.937	0.226	0.218	0.067*	0.716
AOO	0.001	0.997	0.070	0.642	-0.044	0.804	0.058*	0.747
APK	0.440*	0.069	-0.233	0.161	-0.117	0.513	-0.303*	0.089
APN	0.816***	0.000	-0.373*	0.013	-0.609***	0.000	-0.403***	0.014
ARI	0.087	0.721	-0.127	0.409	0.014	0.936	-0.160	0.373
ARL	0.830***	0.000	-0.425***	0.004	-0.551***	0.001	-0.562***	0.001
ART	0.435**	0.053	-0.304**	0.043	-0.356**	0.030	-0.234	0.160
ASR	0.040	0.882	-0.281	0.108	-0.028	0.888	-0.302	0.123
AVI	0.305	0.158	-0.195	0.188	-0.289*	0.066	-0.346**	0.028
BAU	-0.991	0.143	0.449	0.322	0.463	0.351	0.418	0.402
BAW	0.454**	0.036	-0.409***	0.005	-0.437***	0.005	-0.402***	0.011
BDM	-0.393	0.489	0.350	0.344	0.350	0.400	0.292	0.484
BEL	0.363	0.277	-0.255	0.250	-0.025	0.918	0.004	0.988
BIL	-0.038	0.819	0.062	0.583	0.149	0.217	0.108	0.373
BSR	0.804**	0.029	-0.604***	0.013	-0.813***	0.002	-0.649**	0.016
BVT	0.318**	0.042	-0.184*	0.085	-0.262**	0.021	-0.320***	0.005
CFR	0.370**	0.056	-0.122	0.359	0.030	0.837	-0.024	0.867
CKS	0.259	0.205	-0.032	0.840	-0.113	0.452	-0.094	0.531
CLH	0.450***	0.006	-0.291***	0.008	-0.294***	0.014	-0.319***	0.008
CLS	0.609***	0.001	-0.285**	0.023	-0.392***	0.004	-0.482***	0.000
CMH	1.208***	0.000	-0.430**	0.028	-0.351*	0.099	-0.345	0.106
COM	0.693**	0.024	-0.300	0.144	-0.517**	0.021	-0.574***	0.011
CRG	0.216	0.401	-0.239	0.166	-0.215	0.252	-0.119	0.528
CSB	0.738***	0.002	-0.409***	0.014	-0.601***	0.001	-0.513***	0.004
CUL	0.716**	0.049	0.053	0.827	-0.126	0.640	0.025	0.928
DAW	0.993***	0.000	-0.381**	0.047	-0.605***	0.004	-0.502**	0.017
DCT	0.409*	0.098	-0.335**	0.040	-0.331*	0.066	-0.290	0.110

**Table 22: (Firm Specific Results) - Residual Exposure based on the CAPM Framework**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
DST	0.141	0.452	-0.003	0.997	-0.134	0.327	-0.046	0.740
DTA	-0.178	0.604	0.248	0.275	0.158	0.529	0.299	0.234
DTC	0.420*	0.100	-0.052	0.770	-0.021	0.913	-0.075	0.690
ELR	0.383	0.124	-0.186	0.278	-0.227	0.214	-0.143	0.439
EOH	0.462**	0.024	-0.287**	0.039	-0.388***	0.009	-0.335**	0.026
EXX	0.164	0.592	0.067	0.753	0.021	0.927	0.023	0.920
FBR	0.799***	0.000	-0.383***	0.009	-0.499***	0.002	-0.446***	0.005
GND	0.610***	0.007	-0.435***	0.004	-0.430***	0.010	-0.524***	0.002
GRF	0.814***	0.001	-0.302*	0.078	-0.341*	0.068	-0.382**	0.041
GRT	0.500***	0.005	-0.383***	0.001	-0.437***	0.001	-0.450***	0.000
HCI	0.458	0.160	-0.385*	0.076	-0.361	0.129	-0.377	0.114
HDC	0.512***	0.006	-0.349***	0.005	-0.458***	0.001	-0.355***	0.009
HWA	1.006	0.209	-0.701	0.184	-0.294	0.617	-0.140	0.813
HWN	-0.058	0.864	0.087	0.690	0.130	0.601	0.117	0.641
HYP	0.678***	0.000	-0.413***	0.000	-0.496***	0.000	-0.499***	0.000
IDQ	0.172	0.710	-0.179	0.582	0.211	0.531	0.225	0.507
IMP	0.273	0.253	-0.229	0.146	0.009	0.961	-0.105	0.553
ING	-0.142	0.874	-0.723	0.223	-0.726	0.265	-0.821	0.209
IPL	0.484**	0.043	-0.506***	0.002	-0.614***	0.000	-0.768***	0.000
ISA	1.261	0.127	-0.318	0.574	-0.030	0.960	-0.526	0.389
ITE	0.607***	0.008	-0.269*	0.083	-0.428***	0.010	-0.335**	0.047
ITU	-0.178	0.362	0.218*	0.085	0.351***	0.012	0.382***	0.007
IVT	0.446**	0.034	-0.244*	0.085	-0.254*	0.100	-0.217	0.164
JSC	0.817***	0.008	-0.446**	0.031	-0.419*	0.065	-0.348	0.128
LAB	-0.798	0.406	0.621	0.332	0.968	0.167	0.865	0.220
LON	0.580	0.292	-0.311	0.392	-0.027	0.946	-0.241	0.552
MFL	0.439	0.427	0.557	0.118	0.180	0.657	0.343	0.398
MRF	-0.324	0.308	-0.052	0.786	-0.038	0.869	-0.176	0.452
MRP	0.797***	0.000	-0.463***	0.002	-0.645***	0.000	-0.521***	0.001
MSM	0.608***	0.005	-0.479***	0.001	-0.663***	0.000	-0.657***	0.000
MST	0.322	0.285	0.063	0.744	-0.090	0.685	-0.169	0.447
MTA	0.375	0.127	-0.192	0.254	-0.347**	0.052	-0.275	0.128
MTN	0.323*	0.100	-0.503***	0.000	-0.422***	0.003	-0.461***	0.001
MUR	0.705	0.003	-0.533***	0.001	-0.443***	0.011	-0.536***	0.002
NCS	0.694	0.273	-0.833**	0.045	-0.765*	0.097	-0.866**	0.061
NHM	-0.255	0.386	0.096	0.598	0.167	0.437	0.282	0.190
NPK	0.312*	0.086	-0.243**	0.049	-0.279**	0.035	-0.274**	0.039
NPN	0.248	0.192	-0.271**	0.034	-0.318**	0.021	-0.342***	0.013
NTC	0.819***	0.000	-0.274**	0.029	-0.469***	0.000	-0.426***	0.002
NWL	1.020***	0.000	-0.364*	0.062	-0.521***	0.012	-0.275	0.195
OCE	0.181	0.382	-0.095	0.513	-0.170	0.259	-0.187	0.217
OLG	-0.694	0.277	1.408***	0.001	1.352***	0.003	1.275***	0.006
OMN	0.219	0.259	-0.199	0.126	-0.198	0.162	-0.174	0.221
PET	-0.010	0.982	-0.026	0.923	-0.033	0.919	0.206	0.523
PIK	0.470***	0.004	-0.328***	0.003	-0.414***	0.000	-0.441***	0.000
PNC	0.236	0.547	0.226	0.372	0.285	0.320	0.193	0.503
PPC	0.667***	0.004	-0.489***	0.002	-0.527***	0.002	-0.628***	0.000
PPR	0.344	0.139	0.022	0.872	0.005	0.976	0.036	0.836

**Table 22: (Firm Specific Results) - Residual Exposure based on the CAPM Framework**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
RCL	0.463**	0.024	-0.226*	0.100	-0.319***	0.033	-0.408***	0.006
RDF	0.583***	0.003	-0.418***	0.001	-0.405***	0.004	-0.467***	0.001
REM	0.948***	0.000	-0.462***	0.001	-0.341**	0.034	-0.349***	0.031
RLO	0.730***	0.000	-0.472***	0.000	-0.508***	0.000	-0.500***	0.000
RTO	-0.017	0.947	0.178	0.277	0.227	0.226	0.157	0.405
SAP	0.125	0.613	-0.162	0.333	-0.195	0.279	-0.123	0.500
SBV	0.050	0.875	0.144	0.486	0.125	0.587	0.067	0.771
SHP	0.199	0.347	-0.466***	0.001	-0.587***	0.000	-0.595***	0.000
SNH	0.114	0.575	-0.059	0.695	-0.080	0.590	-0.055	0.712
SNU	0.817**	0.043	-0.153	0.567	-0.335	0.260	0.111	0.712
SOL	-0.086	0.586	0.212**	0.039	0.233**	0.041	0.200*	0.082
SPA	0.290	0.297	-0.022	0.916	-0.105	0.609	-0.061	0.768
SPG	0.189	0.555	0.027	0.893	-0.409*	0.079	0.019	0.935
SUI	0.426**	0.022	-0.203	0.107	-0.266**	0.051	-0.337***	0.013
SUR	0.430**	0.032	-0.152	0.277	-0.229	0.122	-0.309**	0.036
SVB	-0.184	0.801	0.414	0.393	0.323	0.546	0.590	0.270
TBS	0.402**	0.016	-0.258	0.024	-0.373***	0.002	-0.328***	0.007
TDH	-0.285	0.429	0.089	0.687	0.020	0.939	0.061	0.817
TFG	0.848***	0.000	-0.612***	0.000	-0.765***	0.000	-0.844***	0.000
TPC	0.457**	0.058	-0.245	0.129	-0.142	0.423	-0.229	0.200
TRE	-0.011	0.955	0.135	0.291	0.172	0.226	0.167	0.242
TSX	0.100	0.739	0.039	0.828	0.011	0.960	0.086	0.698
VLE	0.451*	0.093	0.094	0.579	-0.070	0.723	0.003	0.986
WBO	0.641***	0.001	-0.468***	0.000	-0.493***	0.001	-0.570***	0.000
WHL	0.614***	0.002	-0.450***	0.001	-0.639***	0.000	-0.593***	0.000
WNH	0.665**	0.027	-0.252	0.211	-0.131	0.556	-0.146	0.514

**PANEL B: Results based on Fama-French (1993) asset pricing model**

The residual foreign exchange exposure is estimated using Pooled EGLS to estimate the augmented model of Fama-French (1993):  $R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \varepsilon_{i,t}$  (\*\*\*) represents significance at the 1% level. while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**Table 23: (Firm Specific Results) - Residual Exposure based on the three-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
ACL	0.397	0.208	-0.376*	0.077	-0.097	0.682	-0.084	0.726
ADH	0.421**	0.027	-0.243*	0.061	-0.193	0.176	-0.360***	0.012
ADI	0.160	0.687	-0.082	0.761	-0.250	0.395	0.122	0.684
AEG	0.443	0.117	-0.258	0.179	-0.323	0.124	-0.339	0.113
AFE	0.216	0.184	-0.056	0.612	-0.100	0.409	-0.114	0.355
AGL	0.029	0.886	-0.017	0.901	0.062	0.680	0.113	0.457
AHL	-0.052	0.949	0.873	0.107	0.920	0.123	0.525	0.390
AMS	0.110	0.690	-0.010	0.958	0.262	0.201	0.057	0.787
AOO	-0.254	0.331	0.330*	0.060	0.209	0.283	0.363*	0.065
APK	0.197	0.452	-0.054	0.760	0.122	0.531	-0.102	0.609
APN	0.512**	0.027	-0.166	0.294	-0.410**	0.017	-0.151	0.395
ARI	0.034	0.900	-0.180	0.317	0.008	0.967	-0.224	0.267
ARL	0.351	0.112	-0.120	0.426	-0.207	0.211	-0.216	0.199
ART	0.099	0.676	-0.180	0.261	-0.194	0.270	-0.049	0.786
ASR	0.104	0.725	-0.397**	0.045	-0.088	0.690	-0.442**	0.045
AVI	-0.130	0.558	0.080	0.592	0.016	0.922	-0.046	0.785
BAU	-1.321*	0.071	0.379	0.448	0.434	0.430	0.345	0.538
BAW	0.159	0.484	-0.186	0.226	-0.188	0.267	-0.127	0.461
BDM	-1.361**	0.022	1.099***	0.006	1.187***	0.007	1.177***	0.008
BEL	-0.072	0.838	-0.116	0.629	0.234	0.372	0.264	0.323
BIL	0.156	0.381	-0.060	0.620	0.028	0.836	-0.028	0.834
BSR	0.210	0.589	-0.273	0.298	-0.452	0.116	-0.242	0.411
BVT	0.046	0.775	0.034	0.757	-0.031	0.794	-0.092	0.453
CFR	0.328	0.121	-0.147	0.306	0.059	0.708	-0.018	0.913
CKS	0.109	0.625	0.112	0.458	0.031	0.852	0.063	0.711
CLH	0.131	0.435	-0.130	0.249	-0.089	0.476	-0.121	0.340
CLS	0.357*	0.065	-0.075	0.570	-0.171	0.237	-0.277*	0.059
CMH	0.711***	0.013	-0.149	0.449	0.035	0.874	0.041	0.854
COM	0.261	0.425	0.000	0.999	-0.210	0.388	-0.276	0.263
CRG	0.044	0.875	-0.130	0.493	-0.081	0.699	0.048	0.823
CSB	0.495**	0.057	-0.177	0.320	-0.381**	0.049	-0.258	0.194
CUL	0.471	0.238	0.291	0.282	0.112	0.707	0.309	0.307
DAW	0.527*	0.071	-0.119	0.551	-0.321	0.142	-0.198	0.375
DCT	0.071	0.788	-0.203	0.252	-0.149	0.446	-0.104	0.602
DST	-0.140	0.480	0.152	0.255	0.026	0.862	0.137	0.361
DTA	-0.426	0.255	0.372	0.141	0.290	0.299	0.468*	0.097

**Table 23: (Firm Specific Results) - Residual Exposure based on the three-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
DTC	0.036	0.892	0.074	0.675	0.176	0.365	0.091	0.646
ELR	0.242	0.376	-0.065	0.727	-0.095	0.642	0.019	0.927
EOH	0.262	0.237	-0.146	0.330	-0.243	0.140	-0.173	0.303
EXX	0.341	0.310	-0.027	0.906	-0.099	0.694	-0.105	0.682
FBR	0.408*	0.064	-0.160	0.285	-0.242	0.140	-0.178	0.289
GND	0.352	0.148	-0.349**	0.033	-0.298*	0.099	-0.428**	0.019
GRF	0.317	0.212	-0.030	0.864	-0.001	0.998	-0.056	0.774
GRT	0.110	0.527	-0.086	0.463	-0.107	0.406	-0.105	0.424
HCI	-0.073	0.830	-0.042	0.856	0.051	0.842	0.048	0.852
HDC	0.159	0.408	-0.164	0.203	-0.249*	0.079	-0.121	0.405
HWA	0.854	0.331	-0.789	0.183	-0.236	0.719	-0.066	0.921
HWN	-0.125	0.738	0.197	0.436	0.252	0.365	0.252	0.374
HYP	0.220	0.177	-0.105	0.340	-0.147	0.226	-0.140	0.258
IDQ	0.263	0.606	-0.277	0.420	0.202	0.592	0.220	0.567
IMP	0.203	0.440	-0.211	0.236	0.098	0.619	-0.043	0.830
ING	-0.917	0.346	-0.450	0.494	-0.373	0.607	-0.496	0.501
IPL	0.017	0.943	-0.157	0.334	-0.240	0.178	-0.412**	0.021
ISA	1.371	0.131	-0.128	0.836	0.228	0.737	-0.364	0.598
ITE	0.375	0.126	-0.150	0.370	-0.306*	0.093	-0.198	0.290
ITU	-0.251	0.243	0.253*	0.080	0.426***	0.006	0.469***	0.003
IVT	0.185	0.412	-0.116	0.446	-0.089	0.596	-0.045	0.794
JSC	0.631*	0.059	-0.264	0.245	-0.200	0.425	-0.097	0.705
LAB	-1.642	0.114	0.908	0.197	1.438*	0.062	1.303*	0.097
LON	0.280	0.642	-0.029	0.944	0.359	0.422	0.119	0.794
MFL	0.541	0.370	0.514	0.207	0.060	0.894	0.240	0.600
MRF	-0.540	0.113	-0.120	0.606	-0.074	0.771	-0.275	0.289
MRP	0.319	0.135	-0.106	0.465	-0.269*	0.091	-0.097	0.551
MSM	0.302	0.187	-0.243	0.116	-0.433***	0.010	-0.414**	0.015
MST	-0.112	0.726	0.370*	0.084	0.237	0.317	0.147	0.544
MTA	0.107	0.686	-0.020	0.909	-0.176	0.371	-0.083	0.680
MTN	0.140	0.494	-0.339***	0.013	-0.224	0.140	-0.253*	0.100
MUR	0.275	0.264	-0.319**	0.054	-0.144	0.433	-0.261	0.162
NCS	0.492	0.479	-0.711	0.128	-0.601	0.244	-0.720	0.169
NHM	-0.342	0.291	0.148	0.499	0.241	0.317	0.395	0.105
NPK	0.100	0.610	-0.094	0.476	-0.113	0.438	-0.099	0.504
NPN	0.058	0.779	-0.165	0.234	-0.200	0.190	-0.228	0.142
NTC	0.542***	0.004	-0.035	0.786	-0.233*	0.099	-0.172	0.233
NWL	0.824***	0.007	-0.177	0.397	-0.332	0.148	-0.016	0.945
OCE	0.085	0.710	-0.051	0.739	-0.129	0.442	-0.155	0.365
OLG	-1.282*	0.061	1.791***	0.000	1.794***	0.000	1.706***	0.001
OMN	0.003	0.987	-0.116	0.410	-0.085	0.586	-0.059	0.710
PET	-0.205	0.671	-0.011	0.972	0.010	0.978	0.300	0.410
PIK	0.201	0.222	-0.093	0.405	-0.168	0.169	-0.187	0.133
PNC	0.072	0.866	0.286	0.320	0.394	0.214	0.268	0.406
PPC	0.261	0.278	-0.264*	0.102	-0.254	0.154	-0.380**	0.035
PPR	0.177	0.486	0.192	0.263	0.196	0.301	0.246	0.201
RCL	0.178	0.413	-0.023	0.877	-0.100	0.540	-0.206	0.210
RDF	0.150	0.439	-0.126	0.336	-0.055	0.705	-0.119	0.418
REM	0.799***	0.001	-0.350**	0.027	-0.166	0.347	-0.173	0.335

**Table 23: (Firm Specific Results) - Residual Exposure based on the three-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
RLO	0.335**	0.041	-0.162	0.146	-0.156	0.204	-0.127	0.309
RTO	-0.172	0.542	0.266	0.160	0.347*	0.094	0.261	0.218
SAP	0.015	0.957	-0.150	0.414	-0.174	0.389	-0.089	0.664
SBV	0.228	0.510	0.079	0.737	0.037	0.885	-0.036	0.890
SHP	-0.129	0.555	-0.246*	0.094	-0.366**	0.022	-0.362**	0.027
SNH	-0.051	0.819	0.051	0.735	0.044	0.789	0.080	0.631
SNU	0.275	0.523	0.207	0.478	0.061	0.850	0.632**	0.050
SOL	0.141	0.397	0.142	0.209	0.139	0.264	0.102	0.422
SPA	0.355	0.247	-0.031	0.882	-0.134	0.559	-0.081	0.728
SPG	-0.291	0.392	0.342	0.135	-0.141	0.579	0.405	0.113
SUI	-0.077	0.666	0.108	0.372	0.093	0.484	0.013	0.924
SUR	0.066	0.752	0.055	0.696	0.011	0.942	-0.091	0.566
SVB	-0.269	0.739	0.467	0.390	0.366	0.541	0.702	0.247
TBS	0.281	0.117	-0.116	0.340	-0.244*	0.066	-0.177	0.193
TDH	-0.315	0.427	0.030	0.911	-0.053	0.856	-0.014	0.963
TFG	0.351	0.105	-0.231	0.116	-0.359**	0.025	-0.440***	0.007
TPC	0.325	0.215	-0.242	0.172	-0.084	0.666	-0.206	0.299
TRE	-0.285	0.168	0.298**	0.032	0.377	0.013	0.377***	0.015
TSX	-0.034	0.919	0.101	0.650	0.087	0.723	0.179	0.474
VLE	0.233	0.425	0.361*	0.065	0.187	0.390	0.299	0.174
WBO	0.156	0.423	-0.170	0.194	-0.138	0.339	-0.226	0.123
WHL	0.202	0.314	-0.159	0.242	-0.342**	0.020	-0.273*	0.070
WNH	0.484	0.141	-0.167	0.453	0.020	0.935	-0.002	0.993

**PANEL C: Results based on Carhart (1997) asset pricing model**

The residual foreign exchange exposure is estimated using Pooled EGLS to estimate the augmented model of Carhart (1997):  $R_i = \beta_{i,0} + \beta_{i.XR}XR_t + \beta_{i.M}R_{Mkt,t} + \beta_{i.SMB}R_{SMB,t} + \beta_{i.HML}R_{HML,t} + \beta_{i.UMD}R_{UMD,t} + \varepsilon_{i,t}$ . (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**Table 24: (Firm Specific Results) - Residual Exposure based on the four-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i.TWC}$	P-value	$\beta_{i.USDZAR}$	P-value	$\beta_{i.EURZAR}$	P-value	$\beta_{i.GBPZAR}$	P-value
ACL	0.338	0.290	-0.382*	0.073	-0.102	0.668	-0.105	0.667
ADH	0.446**	0.023	-0.249*	0.060	-0.201	0.173	-0.372***	0.012
ADI	0.185	0.649	-0.133	0.624	-0.323	0.282	0.040	0.897
AEG	0.327	0.242	-0.276	0.140	-0.352*	0.088	-0.404*	0.056
AFE	0.165	0.312	-0.039	0.725	-0.077	0.525	-0.093	0.455
AGL	0.042	0.829	-0.086	0.506	-0.033	0.820	-0.013	0.927
AHL	-0.161	0.844	0.850	0.119	0.890	0.139	0.457	0.462
AMS	0.067	0.804	-0.076	0.673	0.174	0.382	-0.078	0.703
AOO	-0.285	0.283	0.324*	0.067	0.200	0.310	0.353*	0.078
APK	0.201	0.451	-0.044	0.804	0.140	0.479	-0.082	0.684
APN	0.553**	0.020	-0.187	0.248	-0.442***	0.012	-0.182	0.320
ARI	-0.007	0.979	-0.218	0.223	-0.041	0.835	-0.308	0.128
ARL	0.295	0.188	-0.119	0.429	-0.207	0.212	-0.228	0.180
ART	0.062	0.795	-0.151	0.343	-0.155	0.380	0.004	0.984
ASR	0.070	0.815	-0.408**	0.040	-0.100	0.653	-0.479**	0.033
AVI	-0.124	0.582	0.094	0.536	0.035	0.833	-0.017	0.922
BAU	-1.359*	0.069	0.355	0.482	0.404	0.468	0.307	0.592
BAW	0.098	0.672	-0.172	0.264	-0.169	0.321	-0.112	0.520
BDM	-1.518***	0.011	1.179***	0.003	1.302***	0.003	1.326***	0.003
BEL	-0.105	0.771	-0.149	0.537	0.195	0.464	0.210	0.441
BIL	0.186	0.302	-0.078	0.520	0.004	0.976	-0.059	0.670
BSR	0.194	0.625	-0.285	0.283	-0.471	0.107	-0.266	0.378
BVT	0.028	0.862	0.055	0.615	-0.003	0.981	-0.057	0.645
CFR	0.309	0.147	-0.174	0.225	0.026	0.872	-0.071	0.662
CKS	0.147	0.518	0.106	0.486	0.023	0.891	0.061	0.725
CLH	0.128	0.456	-0.140	0.224	-0.101	0.429	-0.138	0.289
CLS	0.346*	0.079	-0.068	0.608	-0.163	0.265	-0.273*	0.067
CMH	0.662**	0.022	-0.191	0.330	-0.020	0.928	-0.043	0.847
COM	0.296	0.366	0.046	0.835	-0.148	0.542	-0.186	0.454
CRG	0.002	0.993	-0.098	0.606	-0.037	0.862	0.105	0.626
CSB	0.445*	0.092	-0.147	0.408	-0.345*	0.077	-0.218	0.278
CUL	0.408	0.313	0.313	0.249	0.140	0.641	0.343	0.264
DAW	0.486*	0.098	-0.076	0.701	-0.264	0.225	-0.126	0.575
DCT	0.018	0.946	-0.207	0.244	-0.154	0.433	-0.119	0.555
DST	-0.136	0.500	0.164	0.223	0.042	0.782	0.166	0.277
DTA	-0.467	0.218	0.342	0.178	0.249	0.377	0.415	0.148
DTC	0.011	0.967	0.026	0.886	0.113	0.567	0.000	1.000
ELR	0.219	0.432	-0.064	0.734	-0.094	0.649	0.018	0.931
EOH	0.250	0.267	-0.139	0.359	-0.235	0.158	-0.164	0.339
EXX	0.299	0.384	-0.020	0.929	-0.092	0.716	-0.107	0.680
FBR	0.389*	0.079	-0.135	0.369	-0.207	0.208	-0.132	0.435

**Table 24: (Firm Specific Results) - Residual Exposure based on the four-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
GND	0.325	0.184	-0.319**	0.051	-0.256	0.157	-0.382**	0.038
GRF	0.260	0.312	-0.015	0.933	0.021	0.911	-0.036	0.853
GRT	0.089	0.617	-0.089	0.454	-0.111	0.397	-0.114	0.397
HCI	-0.146	0.673	-0.015	0.949	0.090	0.725	0.092	0.725
HDC	0.117	0.547	-0.170	0.189	-0.259*	0.069	-0.139	0.345
HWA	0.927	0.301	-0.860	0.151	-0.323	0.627	-0.170	0.803
HWN	-0.184	0.630	0.234	0.358	0.304	0.279	0.315	0.275
HYP	0.177	0.280	-0.093	0.398	-0.130	0.283	-0.125	0.317
IDQ	0.237	0.647	-0.259	0.454	0.234	0.541	0.259	0.509
IMP	0.187	0.478	-0.261	0.136	0.032	0.868	-0.141	0.479
ING	-0.929	0.348	-0.428	0.519	-0.339	0.644	-0.450	0.550
IPL	-0.024	0.923	-0.141	0.386	-0.220	0.221	-0.399**	0.029
ISA	1.334	0.149	-0.100	0.873	0.271	0.694	-0.338	0.632
ITE	0.411*	0.098	-0.131	0.434	-0.282	0.125	-0.156	0.411
ITU	-0.272	0.208	0.225	0.119	0.391***	0.013	0.424***	0.008
IVT	0.153	0.502	-0.105	0.492	-0.073	0.665	-0.027	0.876
JSC	0.559*	0.099	-0.240	0.294	-0.166	0.511	-0.065	0.803
LAB	-1.814	0.085	0.893	0.207	1.431*	0.066	1.282	0.109
LON	0.125	0.834	-0.107	0.790	0.256	0.563	-0.060	0.895
MFL	0.467	0.446	0.538	0.189	0.086	0.851	0.266	0.568
MRF	-0.662*	0.053	-0.097	0.678	-0.043	0.868	-0.257	0.326
MRP	0.307	0.161	-0.117	0.427	-0.286*	0.077	-0.119	0.477
MSM	0.324	0.166	-0.249	0.111	-0.445***	0.009	-0.429***	0.014
MST	-0.174	0.590	0.352*	0.102	0.211	0.378	0.100	0.684
MTA	0.018	0.946	0.030	0.867	-0.111	0.574	-0.006	0.975
MTN	0.148	0.479	-0.343***	0.013	-0.228	0.139	-0.260*	0.098
MUR	0.193	0.430	-0.351**	0.030	-0.187	0.303	-0.339*	0.066
NCS	0.500	0.478	-0.646	0.169	-0.511	0.326	-0.604	0.256
NHM	-0.430	0.184	0.123	0.573	0.206	0.391	0.339	0.168
NPK	0.083	0.677	-0.095	0.472	-0.115	0.433	-0.105	0.484
NPN	0.091	0.657	-0.138	0.317	-0.162	0.287	-0.170	0.275
NTC	0.526***	0.006	-0.027	0.837	-0.225	0.116	-0.164	0.264
NWL	0.806***	0.009	-0.154	0.465	-0.303	0.191	0.026	0.913
OCE	0.093	0.686	-0.048	0.755	-0.127	0.458	-0.151	0.387
OLG	-1.613**	0.015	1.709***	0.000	1.682***	0.001	1.510***	0.002
OMN	-0.061	0.769	-0.077	0.581	-0.031	0.841	0.005	0.977
PET	-0.294	0.546	0.043	0.895	0.085	0.813	0.399	0.279
PIK	0.227	0.178	-0.112	0.321	-0.195	0.116	-0.221*	0.082
PNC	-0.094	0.827	0.286	0.318	0.394	0.212	0.236	0.466
PPC	0.267	0.278	-0.268*	0.103	-0.258	0.155	-0.390**	0.035
PPR	0.197	0.447	0.161	0.353	0.154	0.422	0.195	0.320
RCL	0.148	0.502	-0.013	0.931	-0.087	0.596	-0.198	0.236
RDF	0.141	0.476	-0.127	0.338	-0.054	0.711	-0.121	0.421
REM	0.719***	0.002	-0.347**	0.027	-0.159	0.364	-0.185	0.305
RLO	0.314**	0.060	-0.173	0.124	-0.170	0.169	-0.152	0.233
RTO	-0.170	0.551	0.233	0.222	0.305	0.147	0.205	0.344
SAP	-0.052	0.849	-0.156	0.394	-0.184	0.363	-0.115	0.580
SBV	0.149	0.672	0.088	0.710	0.047	0.856	-0.043	0.873
SHP	-0.131	0.553	-0.228	0.121	-0.344**	0.033	-0.332**	0.045

**Table 24: (Firm Specific Results) - Residual Exposure based on the four-factor asset pricing model**

	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
SNH	-0.066	0.770	0.047	0.756	0.039	0.814	0.074	0.666
SNU	0.268	0.543	0.185	0.531	0.030	0.926	0.611**	0.065
SOL	0.108	0.530	0.151	0.188	0.151	0.234	0.110	0.399
SPA	0.305	0.328	-0.005	0.983	-0.100	0.665	-0.046	0.846
SPG	-0.352	0.305	0.382*	0.095	-0.092	0.718	0.482*	0.062
SUI	-0.119	0.513	0.100	0.411	0.083	0.535***	-0.007	0.961
SUR	0.044	0.838	0.046	0.749	-0.001	0.993	-0.114	0.482
SVB	-0.339	0.679	0.477	0.384	0.379	0.531	0.723	0.242
TBS	0.310*	0.089	-0.128	0.298	-0.262**	0.051	-0.197	0.155
TDH	-0.325	0.419	0.054	0.843	-0.022	0.941**	0.031	0.920
TFG	0.364*	0.103	-0.244*	0.102	-0.379**	0.021***	-0.471	0.005
TPC	0.328	0.219	-0.248	0.166	-0.090	0.652	-0.218	0.283
TRE	-0.328	0.116	0.280**	0.044	0.355**	0.020**	0.345	0.028
TSX	-0.058	0.862	0.059*	0.793	0.028	0.909	0.098	0.699
VLE	0.116	0.693	0.384**	0.049	0.215	0.322	0.321	0.148
WBO	0.111	0.573	-0.174	0.185	-0.143	0.326*	-0.243	0.101
WHL	0.221	0.284	-0.170	0.219	-0.360*	0.017*	-0.293	0.059
WNH	0.438	0.188	-0.144	0.520	-0.056	0.823	0.036	0.886

**PANEL D: Results based on Fama-French (2015) asset pricing model**

The residual foreign exchange exposure is estimated using Pooled EGLS to estimate the augmented model of Fama-French (2015):

$$R_i = \beta_{i,0} + \beta_{i,XR}XR_t + \beta_{i,M}R_{Mkt,t} + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,CMA}R_{CMA,t} + \beta_{i,RMW}R_{RMW,t} + \varepsilon_{i,t}. \quad (***)$$

represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

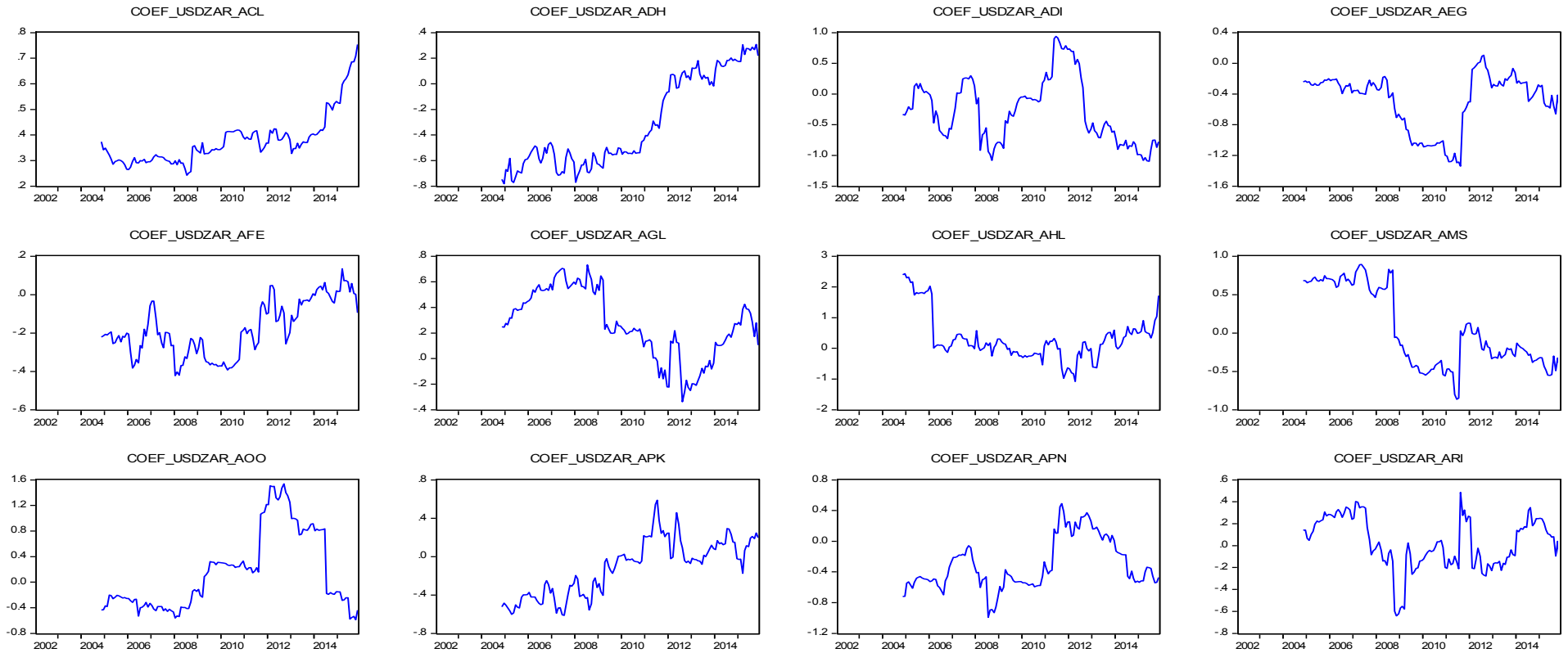
**Table 25: (Firm Specific Results) - Residual Exposure based on the five-factor asset pricing model**

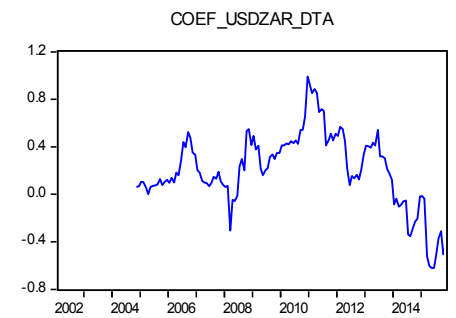
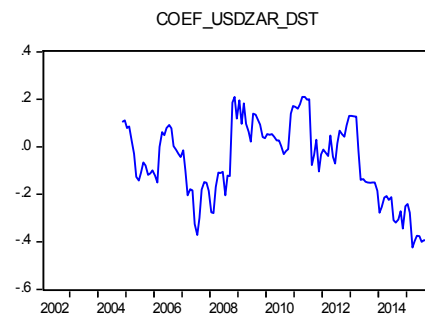
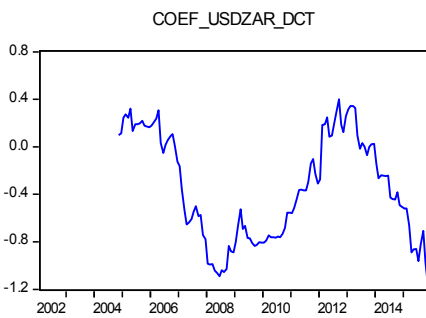
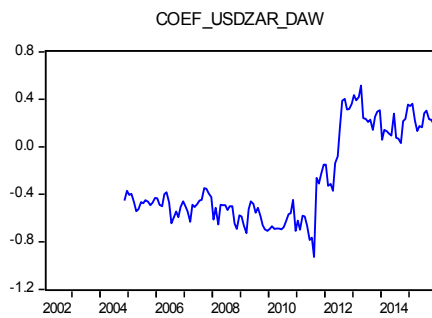
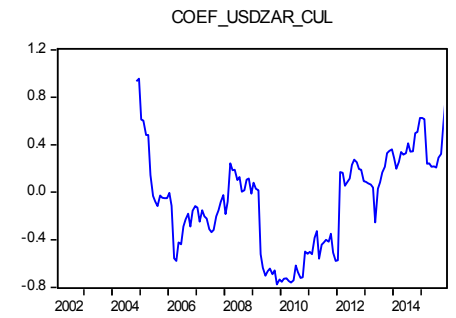
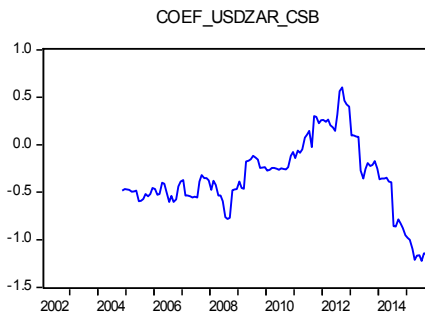
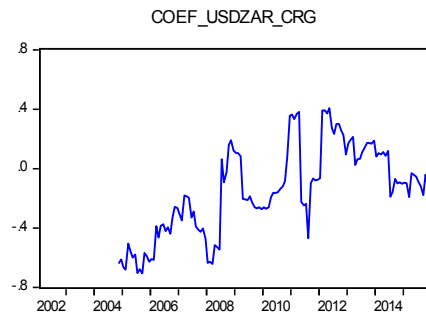
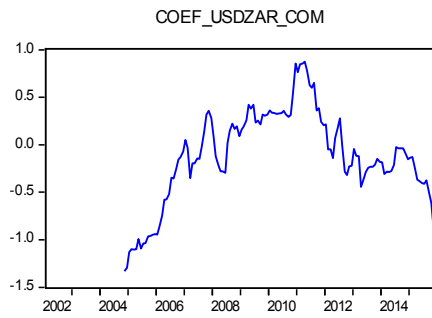
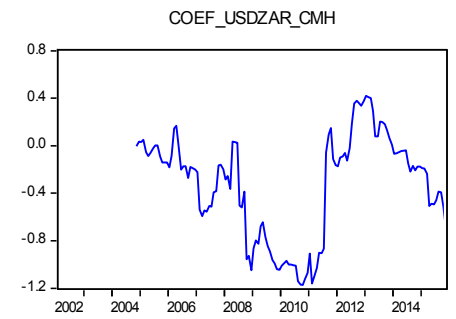
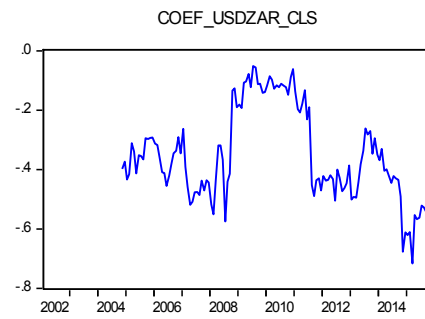
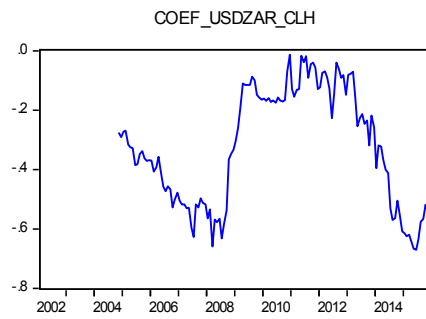
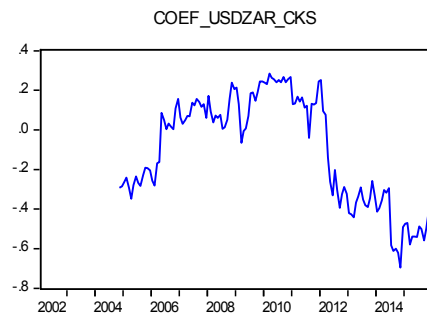
	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i,TWC}$	P-value	$\beta_{i,USDZAR}$	P-value	$\beta_{i,EURZAR}$	P-value	$\beta_{i,GBPZAR}$	P-value
ACL	0.360	0.271	-0.355	0.118	-0.051	0.837	-0.030	0.907
ADH	0.377*	0.057	-0.197	0.154	-0.137	0.366	-0.318**	0.040
ADI	0.209	0.605	-0.099	0.725	-0.254	0.410	0.173	0.587
AEG	0.553*	0.059	-0.363*	0.075	-0.422*	0.058	-0.457**	0.046
AFE	0.244	0.150	-0.070	0.558	-0.115	0.376	-0.132	0.321
AGL	0.213	0.286	-0.198	0.153	-0.113	0.458	-0.082	0.602
AHL	-0.476	0.564	1.419***	0.013	1.434**	0.021	1.081*	0.093
AMS	0.253	0.369	-0.138	0.483	0.177	0.407	-0.064	0.772
AOO	-0.183	0.497	0.285	0.129	0.142	0.490	0.307	0.145
APK	0.114	0.674	0.030	0.871	0.221	0.280	-0.016	0.940
APN	0.505**	0.032	-0.130	0.432	-0.377**	0.036	-0.078	0.676
ARI	0.200	0.460	-0.360*	0.055	-0.131	0.524	-0.415**	0.049
ARL	0.270	0.238	-0.019	0.903	-0.116	0.504	-0.112	0.532
ART	-0.020	0.933	-0.069	0.682	-0.089	0.627	0.092	0.628
ASR	0.103	0.737	-0.442**	0.037	-0.099	0.671	-0.505**	0.034
AVI	-0.130	0.573	0.086	0.589	0.021	0.903	-0.047	0.794
BAU	-1.547**	0.042	0.564	0.289	0.603	0.299	0.532	0.374
BAW	0.159	0.498	-0.202	0.216	-0.208	0.243	-0.145	0.429
BDM	-1.349**	0.027	1.143***	0.007	1.192***	0.010	1.193***	0.012
BEL	0.029	0.936	-0.215	0.399	0.192	0.490	0.226	0.430
BIL	0.153	0.408	-0.058	0.651	0.031	0.828	-0.033	0.818
BSR	0.318	0.428	-0.391	0.161	-0.589**	0.052	-0.376	0.231
BVT	-0.006	0.971	0.092	0.428	0.023	0.853	-0.036	0.781
CFR	0.415*	0.055	-0.220	0.146	0.025	0.878	-0.064	0.707
CKS	0.139	0.547	0.102	0.528	0.011	0.952	0.044	0.810
CLH	0.052	0.760	-0.060	0.615	-0.007	0.957	-0.031	0.819
CLS	0.338*	0.093	-0.047	0.738	-0.150	0.329	-0.269	0.089
CMH	0.819**	0.006	-0.207	0.326	0.016	0.946	0.025	0.915
COM	0.232	0.493	0.050	0.831	-0.191	0.457	-0.265	0.317
CRG	-0.003	0.990	-0.110	0.589	-0.053	0.811	0.095	0.678
CSB	0.360	0.178	-0.035	0.853	-0.256	0.209	-0.100	0.635
CUL	0.514	0.216	0.327	0.260	0.126	0.692	0.355	0.275
DAW	0.415	0.169	0.023	0.914	-0.191	0.407	-0.031	0.895
DCT	0.090	0.740	-0.245	0.194	-0.182	0.375	-0.139	0.513
DST	-0.088	0.669	0.121	0.399	-0.024	0.878	0.096	0.550
DTA	-0.215	0.559	0.169	0.509	0.051	0.854	0.215	0.455

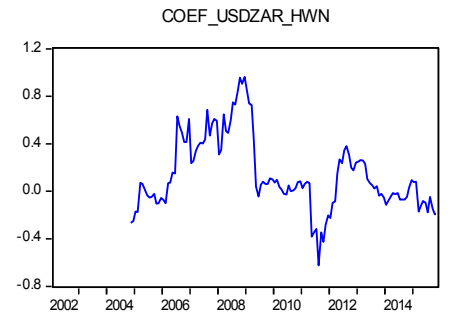
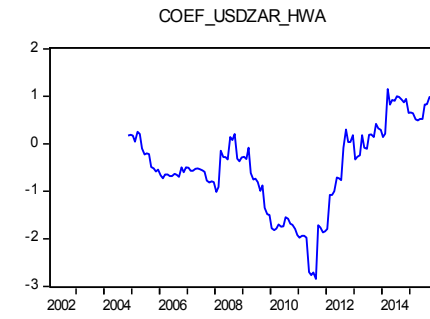
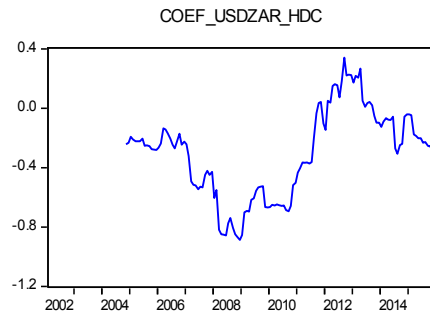
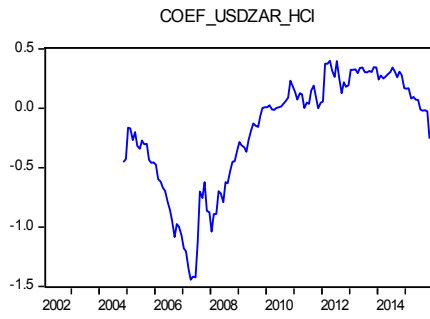
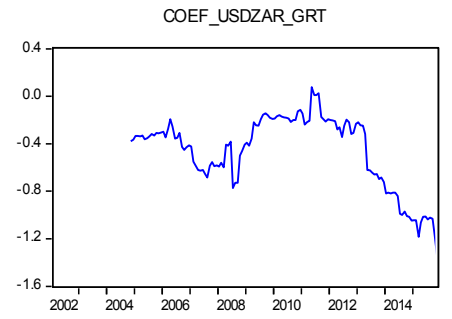
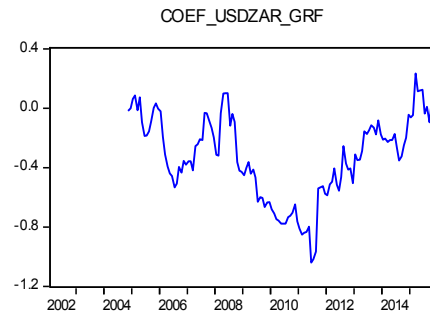
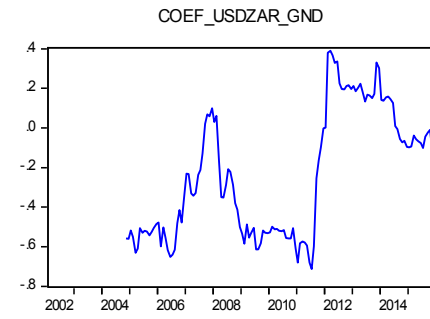
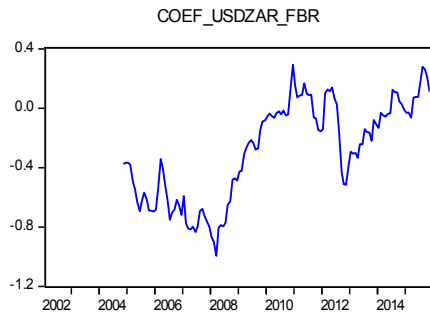
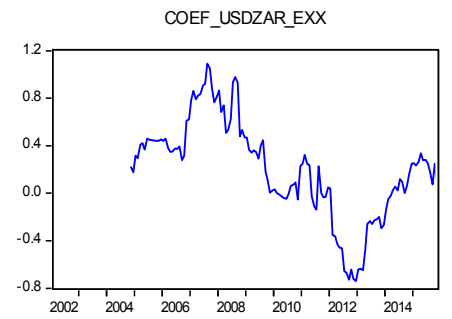
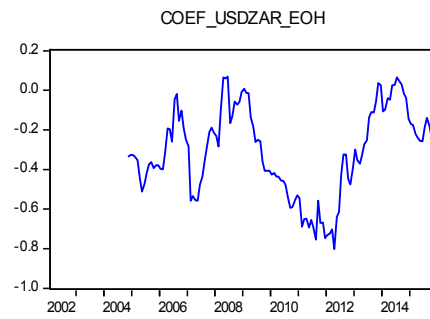
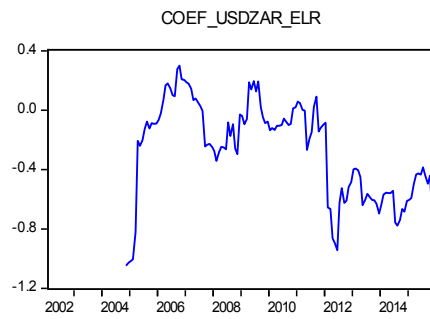
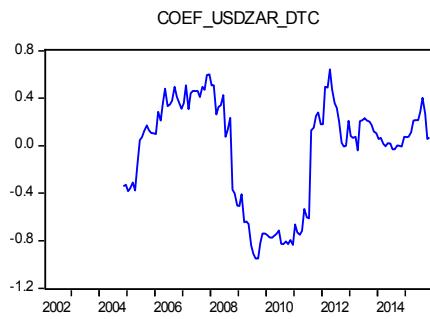
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	$\beta_{i.TWC}$	P-value	$\beta_{i.USDZAR}$	P-value	$\beta_{i.EURZAR}$	P-value	$\beta_{i.GBPZAR}$	P-value
DTC	0.145	0.589	-0.009	0.963	0.121	0.555	0.020	0.924
ELR	0.283	0.315	-0.118	0.550	-0.148	0.491	-0.031	0.890
EOH	0.265	0.249	-0.148	0.358	-0.246	0.159	-0.169	0.348
EXX	0.435	0.212	-0.105	0.667	-0.189	0.477	-0.211	0.440
FBR	0.342	0.129	-0.099	0.531	-0.187	0.275	-0.109	0.536
GND	0.355	0.162	-0.360**	0.041	-0.301	0.118	-0.451**	0.023
GRF	0.251	0.342	0.067	0.717	0.102	0.610	0.059	0.775
GRT	0.005	0.977	0.027	0.824	0.016	0.904	0.040	0.769
HCI	-0.099	0.778	-0.029	0.905	0.061	0.819	0.059	0.828
HDC	0.121	0.543	-0.132	0.341	-0.219	0.147	-0.070	0.653
HWA	1.008	0.265	-1.007	0.109	-0.408	0.554	-0.249	0.726
HWN	-0.019	0.960	0.100	0.710	0.157	0.592	0.143	0.637
HYP	0.111	0.484	0.015	0.895	-0.013	0.915	0.018	0.884
IDQ	0.208	0.691	-0.266	0.467	0.300	0.451	0.336	0.413
IMP	0.238	0.383	-0.246	0.195	0.105	0.613	-0.050	0.816
ING	-0.960	0.341	-0.570	0.417	-0.451	0.556	-0.615	0.436
IPL	-0.077	0.755	-0.089	0.605	-0.167	0.373	-0.355*	0.065
ISA	1.483	0.108	-0.151	0.816	0.167	0.813	-0.512	0.481
ITE	0.345	0.173	-0.122	0.491	-0.298	0.121	-0.177	0.372
ITU	-0.156	0.475	0.193	0.204	0.393*	0.017	0.445***	0.009
IVT	0.186	0.422	-0.125	0.438	-0.098	0.579	-0.050	0.782
JSC	0.733**	0.036	-0.341	0.162	-0.262	0.326	-0.154	0.576
LAB	-1.661	0.123	1.024	0.173	1.630**	0.046	1.539*	0.068
LON	0.718	0.240	-0.422	0.322	-0.003	0.996	-0.326	0.497
MFL	0.488	0.436	0.682	0.118	0.161	0.735	0.386	0.432
MRF	-0.510	0.150	-0.191	0.441	-0.138	0.609	-0.376	0.176
MRP	0.266	0.228	-0.032	0.838	-0.199	0.235	0.007	0.967
MSM	0.265	0.263	-0.213	0.197	-0.415**	0.020	-0.395**	0.033
MST	-0.138	0.677	0.455**	0.048	0.309	0.220	0.225	0.388
MTA	0.154	0.575	-0.058	0.761	-0.229	0.272	-0.133	0.538
MTN	0.034	0.871	-0.269*	0.065	-0.139	0.383	-0.161	0.326
MUR	0.296	0.251	-0.347*	0.052	-0.143	0.466	-0.274	0.174
NCS	0.372	0.605	-0.649	0.195	-0.526	0.336	-0.656	0.244
NHM	-0.105	0.749	-0.075	0.743	0.026	0.915	0.172	0.503
NPK	0.062	0.757	-0.054	0.700	-0.066	0.665	-0.042	0.788
NPN	0.094	0.662	-0.207	0.164	-0.241	0.139	-0.279*	0.095
NTC	0.576***	0.003	-0.039	0.773	-0.243*	0.102	-0.177	0.249
NWL	0.855***	0.007	-0.173	0.442	-0.341	0.162	0.013	0.958
OCE	0.147	0.525	-0.136	0.399	-0.219	0.211	-0.268	0.138
OLG	-1.323	0.065	2.056***	0.000	2.037***	0.000	2.010***	0.000
OMN	-0.144*	0.483	0.018	0.901	0.036	0.818	0.084	0.603
PET	-0.296	0.550	0.034	0.922	0.048	0.898	0.379	0.328
PIK	0.180	0.291	-0.074	0.531	-0.155	0.232	-0.176	0.187
PNC	0.089	0.841	0.344	0.266	0.465	0.167	0.344	0.321
PPC	0.182	0.464	-0.189	0.274	-0.168	0.373	-0.297	0.125
PPR	0.213	0.420	0.190	0.302	0.190	0.343	0.248	0.230
RCL	0.171	0.449	-0.009	0.954	-0.093	0.587	-0.215	0.224
RDF	0.103	0.605	-0.074	0.592	0.017	0.911	-0.042	0.786
REM	0.769***	0.001	-0.297*	0.069	-0.066	0.713	-0.056	0.764
RLO	0.337**	0.048	-0.161	0.177	-0.146	0.261	-0.113	0.400
RTO	-0.112	0.702	0.242	0.233	0.329	0.137	0.234	0.305

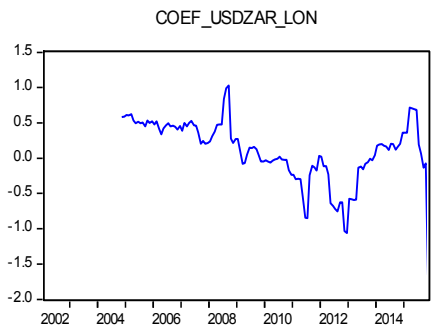
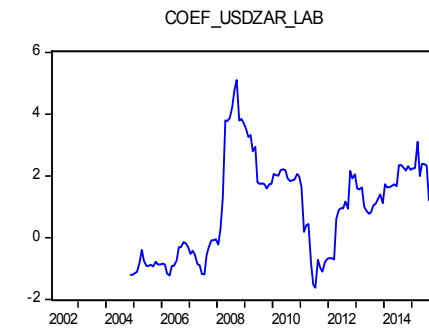
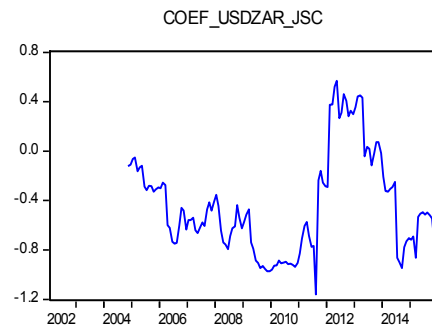
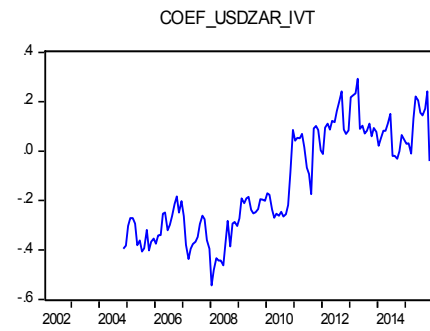
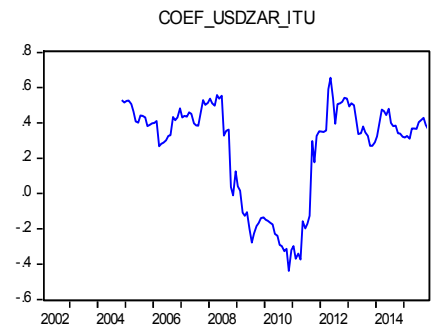
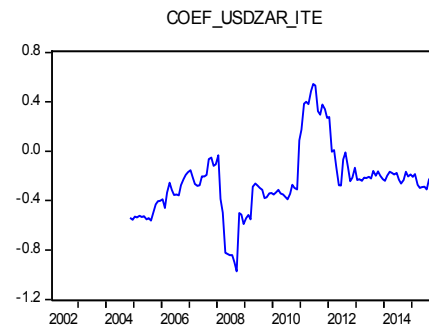
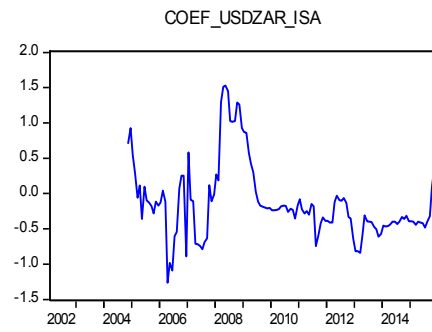
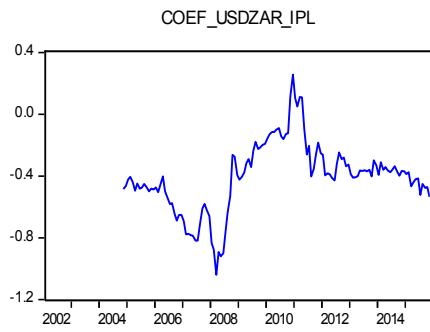
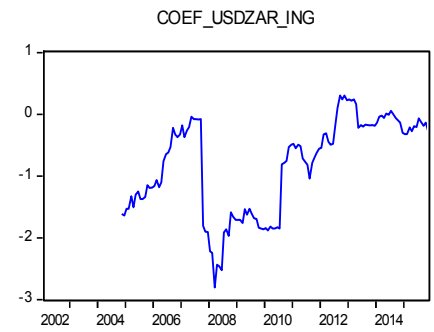
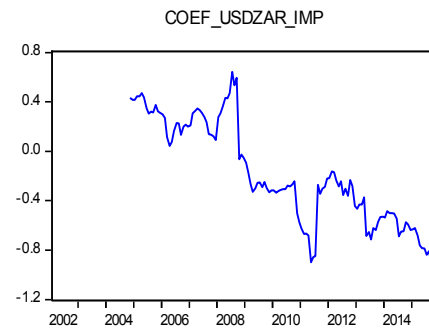
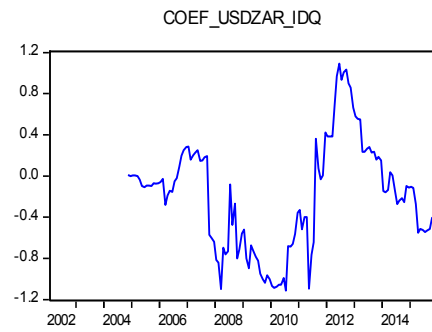
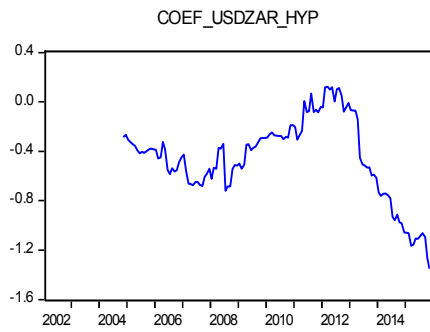
	TWC		USDZAR		EURZAR		GBPZAR	
	$\beta_{i.TWC}$	P-value	$\beta_{i.USDZAR}$	P-value	$\beta_{i.EURZAR}$	P-value	$\beta_{i.GBPZAR}$	P-value
SAP	0.147	0.597	-0.300	0.120	-0.324	0.123	-0.255	0.241
SBV	0.177	0.622	0.155	0.534	0.109	0.690	0.037	0.894
SHP	-0.213	0.344	-0.208	0.184	-0.337**	0.048	-0.333*	0.058
SNH	0.083	0.714	-0.065	0.680	-0.065	0.703	-0.039	0.827
SNU	0.257	0.565	0.275	0.376	0.103	0.761	0.762**	0.028
SOL	0.155	0.372	0.152	0.206	0.141	0.284	0.100	0.460
SPA	0.385	0.221	-0.067	0.760	-0.191	0.427	-0.146	0.556
SPG	-0.458	0.188	0.526**	0.030	-0.017	0.948	0.620**	0.022
SUI	-0.180	0.322	0.226*	0.073	0.214	0.120	0.146	0.306
SUR	0.088	0.682	0.044	0.771	0.004	0.982	-0.113	0.504
SVB	-0.110	0.895	0.369	0.526	0.256	0.686	0.627	0.336
TBS	0.316*	0.089	-0.152	0.241	-0.286**	0.043	-0.220	0.131
TDH	-0.484	0.236	0.176	0.536	0.085	0.785	0.151	0.638
TFG	0.281	0.207	-0.160	0.304	-0.285*	0.091	-0.367**	0.034
TPC	0.320	0.239	-0.229	0.227	-0.042	0.841	-0.170	0.424
TRE	-0.196	0.358	0.241	0.105	0.319**	0.048	0.316*	0.057
TSX	0.037	0.914	0.048	0.839	0.045	0.863	0.145	0.588
VLE	0.299	0.321	0.363	0.083	0.151	0.509	0.276	0.241
WBO	0.125	0.533	-0.152	0.277	-0.109	0.473	-0.205	0.190
WHL	0.201	0.330	-0.157	0.276	-0.342**	0.028	-0.265*	0.100
WNH	0.397	0.243	-0.066	0.780	0.142	0.584	0.137	0.607

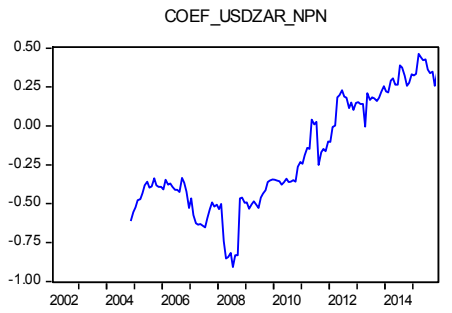
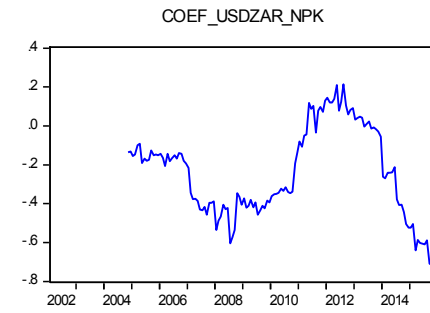
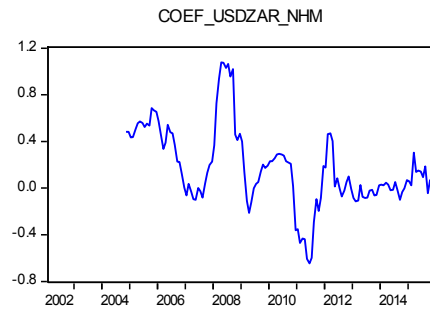
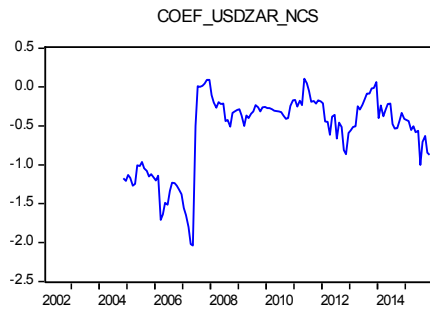
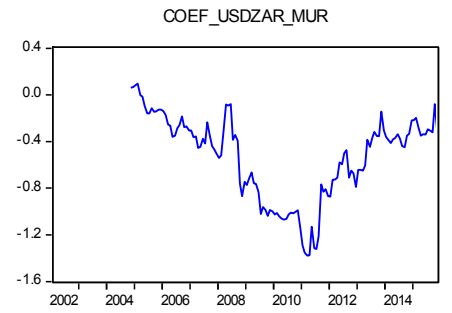
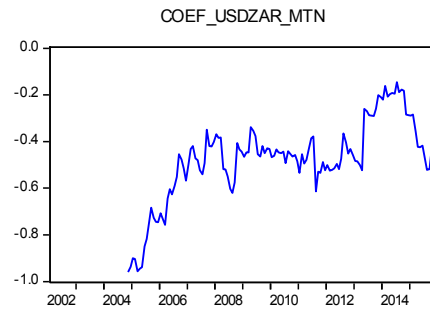
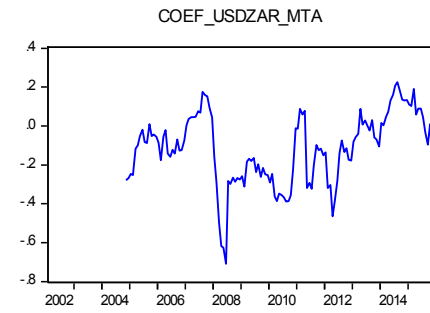
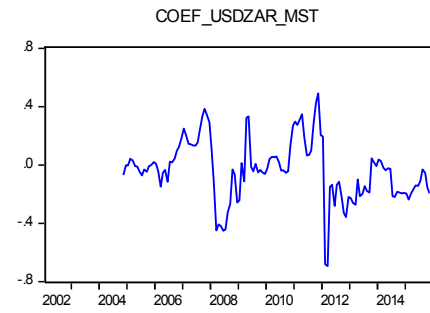
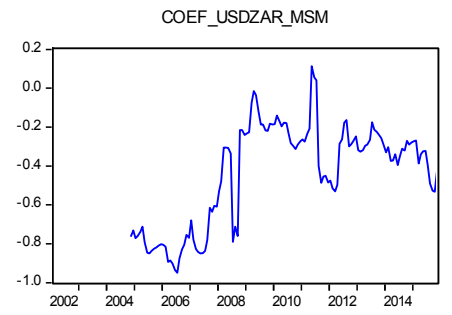
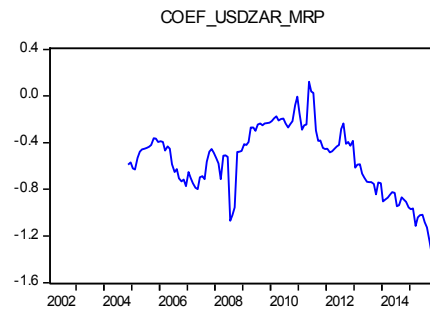
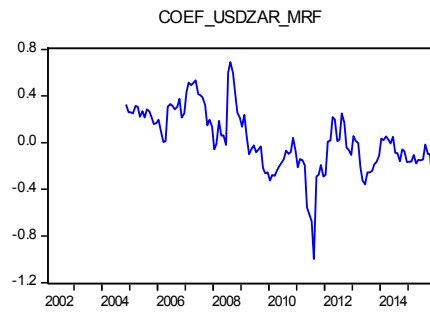
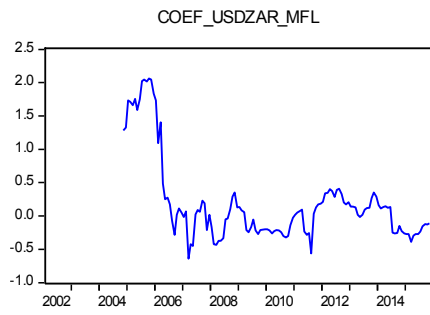
### APPENDIX C: Firm-specific results - time-varying exposure

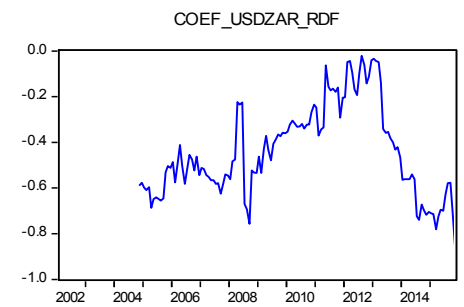
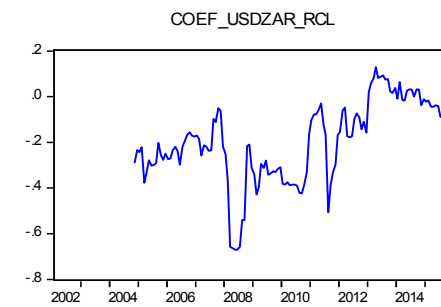
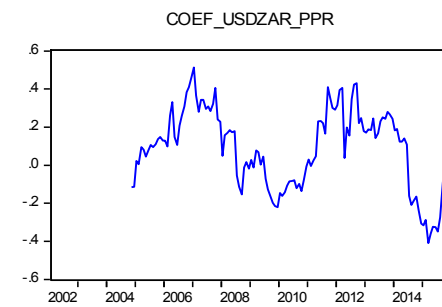
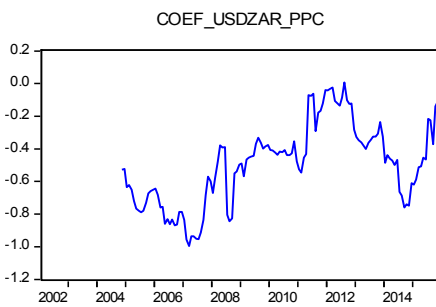
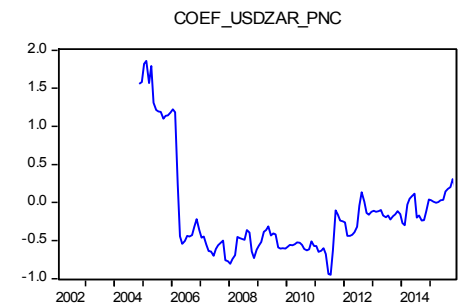
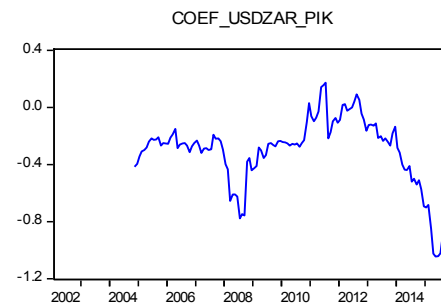
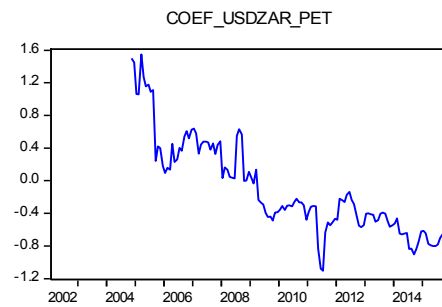
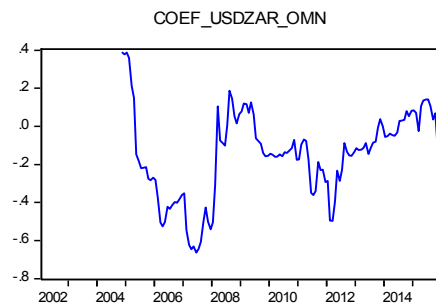
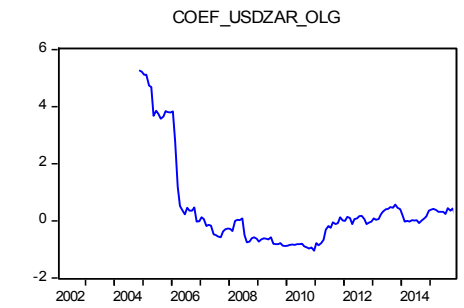
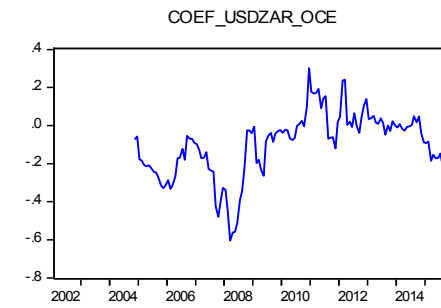
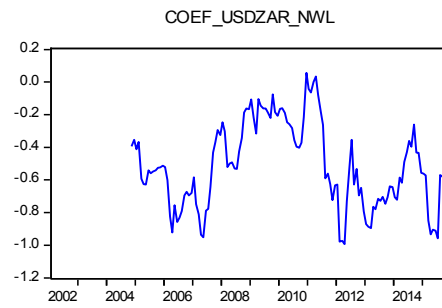
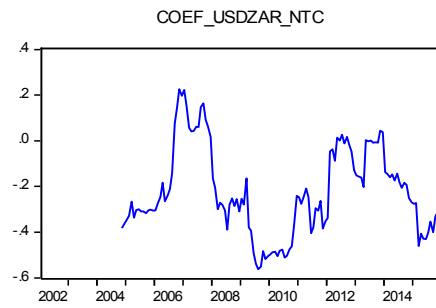


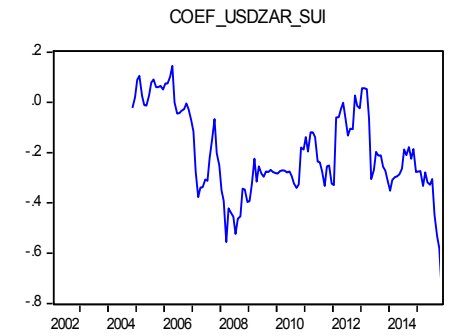
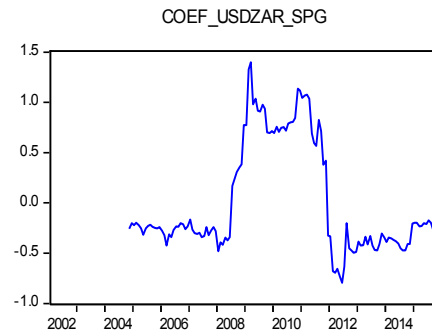
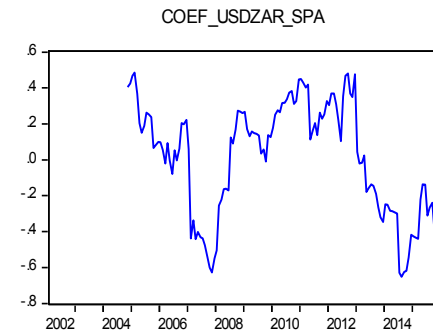
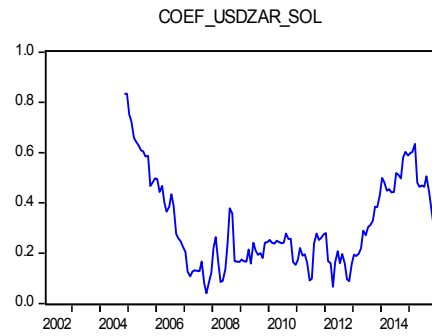
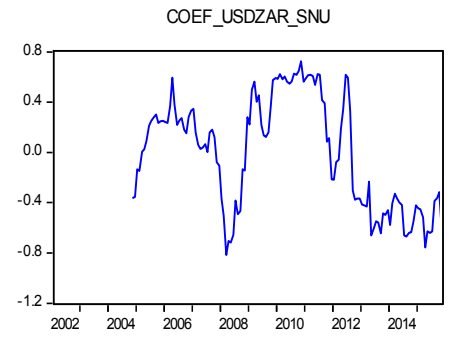
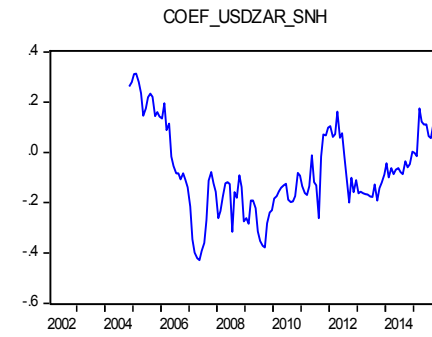
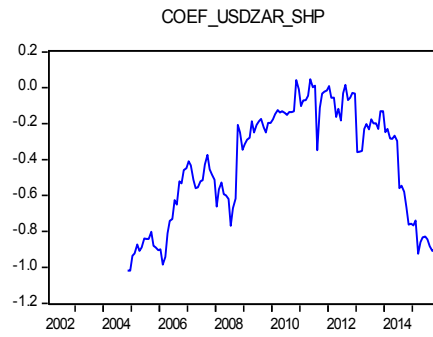
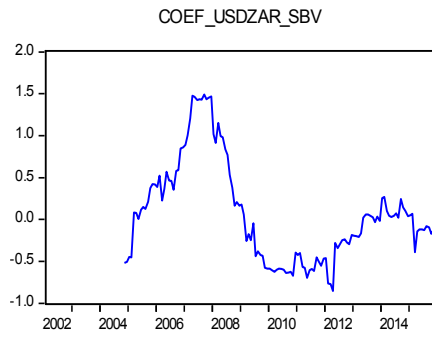
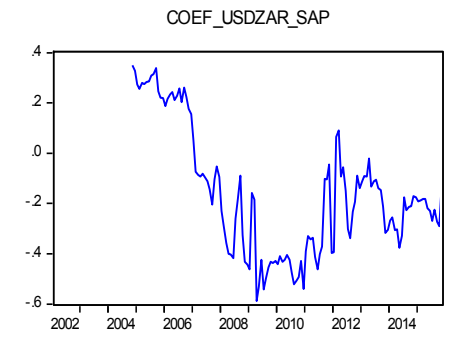
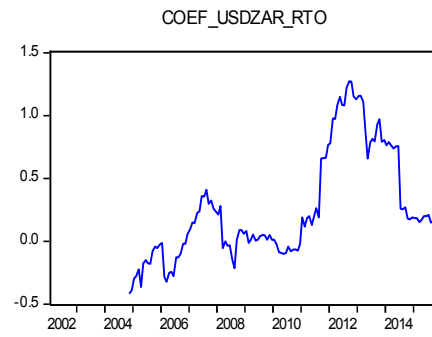
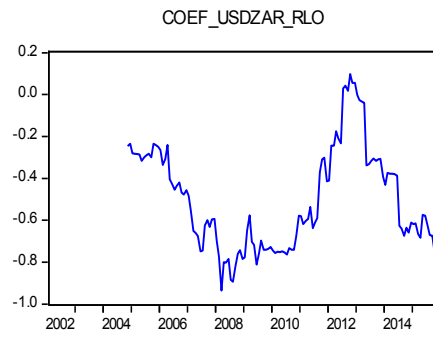
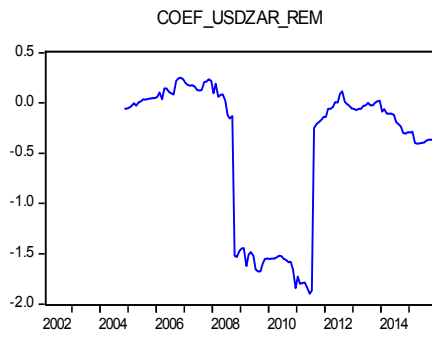


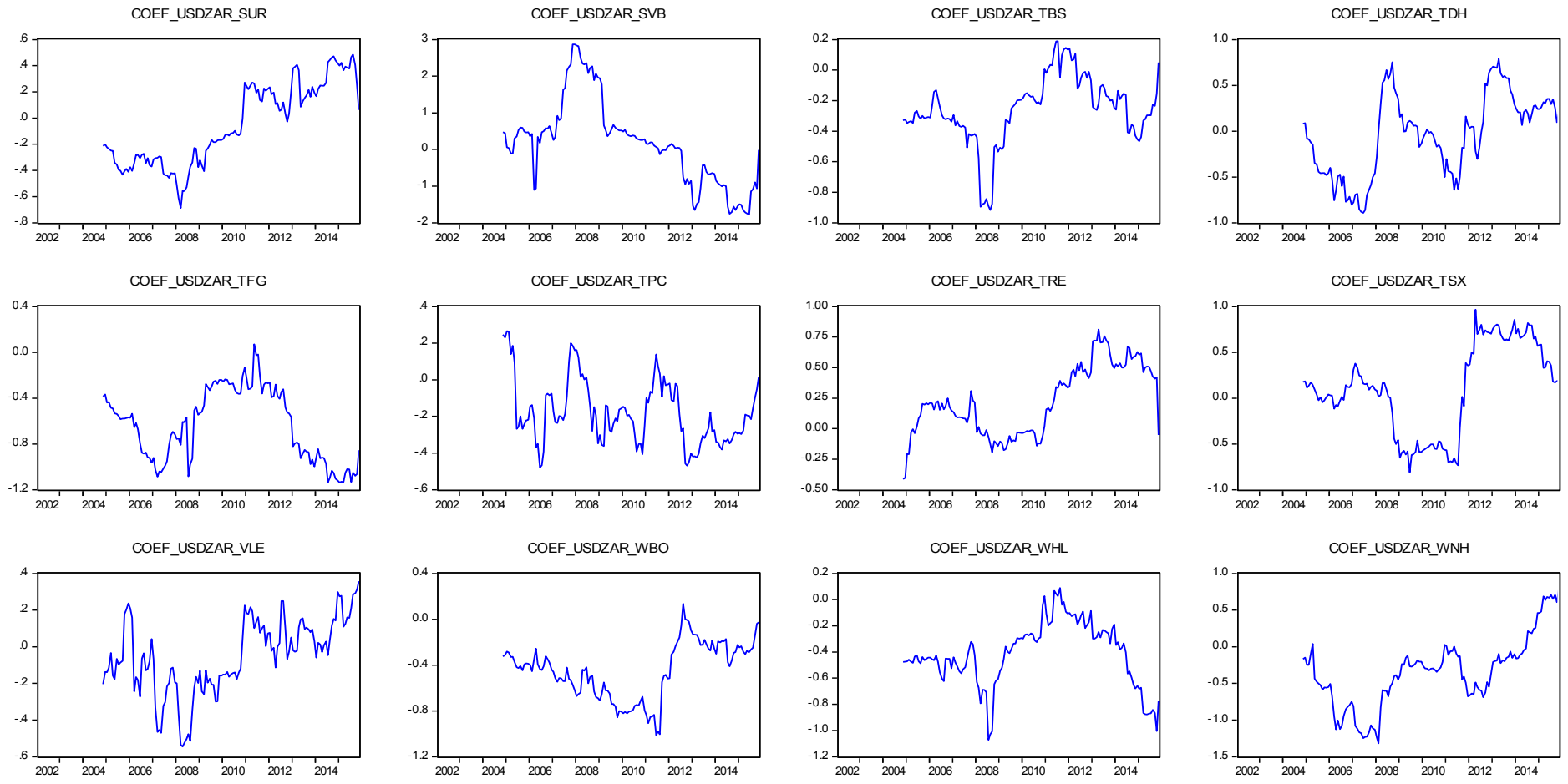












**Figure 21: Time-varying foreign exchange exposure – Firm-specific results**

## APPENDIX D: Firm-specific results - asymmetric risk exposure

Exposure coefficients are estimated using Pooled EGLS to estimate the following model:

$$R_i = \beta_0 + \beta_{i,m}R_{mkt,t} + \beta_{i,USDZAR}^+XR_{i,USDZAR}^+ + \beta_{i,USDZAR}^-XR_{i,USDZAR}^- + \varepsilon_{i,t}$$

(\*\*\*) represents significance at the 1% level. while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**Table 26: (Firm-specific results) - Asymmetric risk exposure**

### PANEL A: Results based on the Indirect test of asymmetric exposure

	$\beta_{i,USDZAR}^+$		$\beta_{i,USDZAR}^-$	
	coeff	p-value	coeff	p-value
ACL	-0.371**	0.043	-0.344*	0.062
ADH	-0.375***	0.002	-0.363***	0.003
ADI	-0.273	0.278	-0.286	0.258
AEG	-0.499***	0.004	-0.473*	0.007
AFE	-0.222**	0.036	-0.215**	0.044
AGL	0.097	0.417	0.112	0.348
AHL	1.080**	0.028	1.091**	0.028
AMS	0.059	0.724	0.070	0.676
AOO	0.100	0.542	0.110	0.503
APK	-0.181	0.260	-0.165	0.307
APN	-0.358**	0.017	-0.353**	0.019
ARI	-0.070	0.662	-0.055	0.734
ARL	-0.380***	0.010	-0.367****	0.013
ART	-0.256*	0.084	-0.241	0.107
ASR	-0.220	0.208	-0.204	0.245
AVI	-0.205	0.159	-0.207	0.158
BAU	0.458	0.314	0.468	0.306
BAW	-0.400***	0.006	-0.396***	0.006
BDM	0.475	0.204	0.515	0.171
BEL	-0.225	0.315	-0.216	0.339
BIL	0.104	0.333	0.119	0.272
BSR	-0.549**	0.025	-0.532**	0.031
BVT	-0.176*	0.094	-0.173*	0.102
CFR	-0.125	0.343	-0.126	0.344
CKS	-0.007	0.960	0.002	0.987
CLH	-0.269***	0.014	-0.262**	0.017
CLS	-0.292**	0.020	-0.293**	0.020
CMH	-0.400**	0.039	-0.391**	0.045
COM	-0.289	0.163	-0.282	0.176
CRG	-0.202	0.234	-0.194	0.256
CSB	-0.390**	0.018	-0.383**	0.021

**Table 26: (Firm-specific results) - Asymmetric risk exposure****PANEL A: Results based on the Indirect test of asymmetric exposure**

	$\beta_{i.USDZAR}^+$		$\beta_{i.USDZAR}^-$	
	coeff	p-value	coeff	p-value
CUL	0.081	0.743	0.088	0.724
DAW	-0.295	0.111	-0.269	0.150
DCT	-0.309*	0.061	-0.300*	0.070
DST	0.011	0.930	0.016	0.898
DTA	0.265	0.252	0.270	0.246
DTC	-0.026	0.881	-0.017	0.923
ELR	-0.157	0.350	-0.149	0.379
EOH	-0.294**	0.032	-0.294**	0.033
EXX	0.128	0.531	0.146	0.477
FBR	-0.354**	0.015	-0.345**	0.018
GND	-0.374***	0.010	-0.353**	0.016
GRF	-0.257	0.129	-0.243	0.154
GRT	-0.363***	0.002	-0.357***	0.002
HCI	-0.312	0.142	-0.292	0.171
HDC	-0.321***	0.00	-0.314**	0.011
HWA	-0.566	0.287	-0.531	0.321
HWN	0.137	0.549	0.152	0.506
HYP	-0.401***	0.001	-0.397***	0.001
IDQ	-0.202	0.517	-0.209	0.503
IMP	-0.168	0.279	-0.152	0.330
ING	-0.786	0.189	-0.810	0.178
IPL	-0.497***	0.002	-0.493***	0.002
ISA	-0.287	0.592	-0.255	0.635
ITE	-0.265*	0.088	-0.263*	0.092
ITU	0.234	0.074	0.239**	0.069
IVT	-0.202	0.148	-0.189	0.179
JSC	-0.423**	0.041	-0.414**	0.047
LAB	0.558	0.388	0.537	0.408
LON	-0.177	0.624	-0.134	0.712
MFL	0.486	0.186	0.467	0.206
MRF	-0.035	0.871	-0.032	0.883
MRP	-0.460***	0.002	-0.457***	0.002
MSM	-0.442***	0.002	-0.430***	0.003
MST	0.068	0.739	0.071	0.729
MTA	-0.182	0.274	-0.178	0.286
MTN	-0.452***	0.000	-0.438***	0.000

**Table 26: (Firm-specific results) - Asymmetric risk exposure****PANEL A: Results based on the Indirect test of asymmetric exposure**

	$\beta_{i.USDZAR}^+$		$\beta_{i.USDZAR}^-$	
	coeff	p-value	coeff	p-value
MUR	-0.478***	0.002	-0.461***	0.003
NCS	-0.828**	0.051	-0.825**	0.053
NHM	0.118	0.552	0.124	0.533
NPK	-0.236**	0.053	-0.232*	0.058
NPN	-0.264**	0.038	-0.263**	0.040
NTC	-0.264**	0.036	-0.260**	0.039
NWL	-0.352*	0.068	-0.347*	0.074
OCE	-0.102	0.463	-0.103	0.461
OLG	1.452***	0.00	1.466***	0.001
OMN	-0.165	0.192	-0.158	0.215
PET	-0.016	0.956	-0.015	0.960
PIK	-0.316***	0.003	-0.311***	0.004
PNC	0.300	0.248	0.324	0.214
PPC	-0.448***	0.003	-0.432***	0.004
PPR	0.041	0.795	0.045	0.776
RCL	-0.184	0.176	-0.172	0.208
RDF	-0.405***	0.002	-0.400***	0.002
REM	-0.459***	0.002	-0.459***	0.002
RLO	-0.450***	0.000	-0.442***	0.000
RTO	0.210	0.221	0.221	0.199
SAP	-0.184	0.264	-0.193	0.244
SBV	0.155	0.467	0.159	0.456
SHP	-0.438***	0.001	-0.429***	0.002
SNH	-0.063	0.642	-0.064	0.642
SNU	-0.030	0.910	0.010	0.969
SOL	0.238**	0.021	0.248**	0.017
SPA	0.011	0.955	0.022	0.908
SPG	0.024	0.913	0.020	0.927
SUI	-0.164	0.186	-0.152	0.221
SUR	-0.140	0.306	-0.135	0.327
SVB	0.477	0.330	0.493	0.317
TBS	-0.249**	0.026	-0.244**	0.030
TDH	0.055	0.821	0.045	0.855
TFG	-0.587***	0.000	-0.578***	0.000
TPC	-0.216	0.181	-0.208	0.201
TRE	0.173	0.179	0.184	0.154

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**Table 26: (Firm-specific results) - Asymmetric risk exposure**

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**PANEL A: Results based on the Indirect test of asymmetric exposure**

	$\beta_{i.USDZAR}^+$		$\beta_{i.USDZAR}^-$	
	coeff	p-value	coeff	p-value
TSX	0.046	0.822	0.046	0.823
VLE	0.150	0.386	0.173	0.319
WBO	-0.420***	0.001	-0.405***	0.002
WHL	-0.450***	0.001	-0.449***	0.001
WNH	-0.218	0.283	-0.205	0.315

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Hypothesis tests based on the Model of (Belghitar et al., 2013) as follows:  $R_{i,t} = \beta_0 + \beta_{i.m}R_{mkt.t} + \beta_{i.USDZAR}^+XR_{i.USDZAR}^+ + \beta_{i.USDZAR}^-XR_{i.USDZAR}^- + \varepsilon_{i,t}$ . (\*\*\*) represents significance at the 1% level, while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**PANEL B: Results based on the direct test of asymmetric exposure**

**Asymmetric exposure is tested based on the Nonlinear ARDL Model as follows:**

$$\Delta R_t = c + \theta_1^+ MKt_{t-1}^+ + \theta_1^- MKt_{t-1}^- + \theta_2^+ USDZAR_{t-1}^+ + \theta_2^- USDZAR_{t-1}^- + \sum_{j=1}^{p-1} \psi_j \Delta R_{t-j} + \sum_{i=0}^q \pi_{1,i}^+ \Delta MKt_{t-i}^+ + \sum_{i=0}^q \pi_{1,i}^- \Delta MKt_{t-i}^- + \sum_{i=0}^q \pi_{2,i}^+ \Delta USDZAR_{t-i}^+ + \sum_{i=0}^q \pi_{2,i}^- \Delta USDZAR_{t-i}^- + e_t.$$

(\*\*\*) represents significance at the 1% level. while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

**Direct Test based on the Nonlinear ARDL Model as follows:**

Dynamic Asymmetric estimates

Dependent Variable: D(ACL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.101690	0.044863	-2.266682	0.0251
ACL(-1)	-1.041674	0.083957	-12.40721	0.0000
MKT_P(-1)	1.709875	0.292445	5.846823	0.0000
MKT_N(-1)	1.707718	0.294810	5.792598	0.0000
USDZAR_P(-1)	-0.211733	0.277506	-0.762986	0.4469
USDZAR_N(-1)	-0.188158	0.286437	-0.656892	0.5124
ΔMKT_P	1.683907	0.261684	6.434879	0.0000
ΔMKT_N	1.587950	0.306487	5.181132	0.0000
ΔACL(-6)	0.236084	0.060613	3.894957	0.0002
ΔACL(-5)	0.221865	0.063100	3.516087	0.0006
ΔUSDZAR_P(-8)	0.815786	0.218509	3.733427	0.0003
ΔMKT_P(-8)	-0.533285	0.210158	-2.537545	0.0124
ΔUSDZAR_N	-0.656514	0.304240	-2.157880	0.0328
ΔACL(-12)	0.130935	0.054121	2.419327	0.0170
ΔUSDZAR_P(-2)	0.383748	0.214314	1.790585	0.0758
ΔACL(-10)	-0.113690	0.054998	-2.067177	0.0408
R-squared	0.731440			
F-statistic	22.87788			
Prob(F-statistic)	0.000000			

Dependent Variable: D(ADH)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.024326	0.031068	-0.782988	0.4351
ADH(-1)	-0.959918	0.082876	-11.58252	0.0000
MKT_P(-1)	0.405830	0.159976	2.536812	0.0124
MKT_N(-1)	0.437554	0.161096	2.716111	0.0076
USDZAR_P(-1)	-0.152387	0.167344	-0.910623	0.3643
USDZAR_N(-1)	-0.182199	0.170352	-1.069545	0.2869
ΔMKT_P	0.594311	0.168073	3.536026	0.0006
ΔUSDZAR_N(-1)	-0.334645	0.161735	-2.069093	0.0406
ΔUSDZAR_P	-0.276629	0.168992	-1.636938	0.1042
ΔADH(-11)	-0.101219	0.056764	-1.783158	0.0770

$\Delta$ MKT_P(-11)	0.304116	0.125159	2.429838	0.0165
$\Delta$ USDZAR_N(-11)	-0.243622	0.147729	-1.649110	0.1017
$\Delta$ MKT_N(-2)	0.481058	0.156494	3.073968	0.0026
$\Delta$ USDZAR_N(-7)	-0.246000	0.143789	-1.710838	0.0896
$\Delta$ USDZAR_P(-5)	-0.405041	0.160616	-2.521802	0.0130
$\Delta$ USDZAR_N(-12)	0.374842	0.132347	2.832259	0.0054
$\Delta$ USDZAR_P(-12)	-0.276443	0.149116	-1.853879	0.0662
$\Delta$ USDZAR_N(-4)	-0.402820	0.162280	-2.482243	0.0144
$\Delta$ USDZAR_P(-7)	0.417355	0.145721	2.864059	0.0049
R-squared	0.641081			
F-statistic	12.20530			
Prob(F-statistic)	0.000000			

Dependent Variable: D(A00)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.085994	0.046549	1.847388	0.0671
A00(-1)	-1.225301	0.140616	-8.713816	0.0000
MKT_P(-1)	-0.782187	0.274897	-2.845383	0.0052
MKT_N(-1)	-0.868359	0.286265	-3.033408	0.0029
USDZAR_P(-1)	-0.096629	0.174489	-0.553781	0.5807
USDZAR_N(-1)	-0.000763	0.175052	-0.004360	0.9965
$\Delta$ MKT_N	-0.550536	0.277890	-1.981131	0.0498
$\Delta$ MKT_P(-12)	0.472235	0.171243	2.757697	0.0067
$\Delta$ MKT_P(-4)	0.402536	0.182205	2.209250	0.0290
$\Delta$ A00(-2)	0.286124	0.086802	3.296294	0.0013
$\Delta$ A00(-1)	0.286664	0.115171	2.489016	0.0141
$\Delta$ US $\Delta$ ZAR_P(-11)	0.852281	0.239005	3.565947	0.0005
$\Delta$ US $\Delta$ ZAR_N(-10)	0.681521	0.230974	2.950636	0.0038
$\Delta$ MKT_P(-7)	0.449198	0.181591	2.473674	0.0147
$\Delta$ US $\Delta$ ZAR_N(-12)	0.404961	0.184062	2.200139	0.0296
$\Delta$ MKT_N(-2)	0.723778	0.269792	2.682728	0.0083
$\Delta$ MKT_P(-1)	0.604076	0.302578	1.996430	0.0481
$\Delta$ MKT_N(-1)	0.468204	0.275566	1.699065	0.0918
R-squared	0.633824	Mean dependent var		-0.001042
F-statistic	12.62558	Durbin-Watson stat		1.922400
Prob(F-statistic)	0.000000			

Dependent Variable: D(APK)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.052799	0.042500	-1.242354	0.2165
APK(-1)	-1.048618	0.085146	-12.31548	0.0000
MKT_P(-1)	0.039537	0.228525	0.173008	0.8629
MKT_N(-1)	0.013248	0.224161	0.059101	0.9530
USDZAR_P(-1)	-0.150264	0.174051	-0.863334	0.3897
USDZAR_N(-1)	-0.122596	0.175932	-0.696839	0.4872
$\Delta$ MKT_P	0.483428	0.236291	2.045901	0.0429
$\Delta$ MKT_P(-2)	0.417912	0.218918	1.908985	0.0586

$\Delta$ USAZAR_N(-5)	-0.533701	0.250546	-2.130155	0.0352
$\Delta$ MKT_N(-3)	0.845481	0.320669	2.636618	0.0095
$\Delta$ USDZAR_N(-4)	-0.466991	0.197722	-2.361860	0.0198
$\Delta$ APK(-4)	-0.123296	0.054382	-2.267210	0.0252
$\Delta$ MKT_P(-4)	0.762347	0.267808	2.846620	0.0052
$\Delta$ APK(-12)	-0.148799	0.060693	-2.451650	0.0156
$\Delta$ MKT_P(-12)	0.309140	0.175209	1.764411	0.0802
$\Delta$ APK(-6)	-0.090652	0.056408	-1.607059	0.1106
$\Delta$ MKT_P(-8)	0.466634	0.184321	2.531646	0.0126
$\Delta$ MKT_N(-5)	0.523558	0.250629	2.088975	0.0388
$\Delta$ USDZAR_N(-10)	-0.294943	0.171994	-1.714850	0.0889
$\Delta$ MKT_P(-3)	0.435301	0.206672	2.106240	0.0372
$\Delta$ USDZAR_P(-6)	-0.416169	0.237393	-1.753078	0.0821

R-squared	0.689671
F-statistic	13.44542
Prob(F-statistic)	0.000000

#### Dependent Variable: D(APN)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.024440	0.036141	-0.676241	0.5001
APN(-1)	-0.995052	0.083624	-11.89908	0.0000
MKT_P(-1)	0.462964	0.212089	2.182876	0.0308
MKT_N(-1)	0.417594	0.211882	1.970884	0.0508
USDZAR_P(-1)	-0.904152	0.233949	-3.864738	0.0002
USDZAR_N(-1)	-0.864007	0.242325	-3.565490	0.0005
$\Delta$ MKT_P	0.708559	0.219103	3.233910	0.0015
$\Delta$ USDZAR_N	-0.857107	0.260188	-3.294178	0.0013
$\Delta$ USDZAR_N(-8)	-0.179526	0.177498	-1.011427	0.3136
$\Delta$ USDZAR_N(-3)	-0.367640	0.179344	-2.049915	0.0423
$\Delta$ MKT_N(-3)	0.375998	0.201295	1.867899	0.0640
$\Delta$ USDZAR_P(-8)	0.164262	0.171056	0.960286	0.3386

R-squared	0.563606
F-statistic	15.73288
Prob(F-statistic)	0.000000

#### Dependent Variable: D(ARI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.085299	0.043291	-1.970374	0.0510
ARI(-1)	-0.870780	0.081493	-10.68534	0.0000
MKT_P(-1)	1.578369	0.271676	5.809750	0.0000
MKT_N(-1)	1.569705	0.275189	5.704106	0.0000
USDZAR_P(-1)	0.121278	0.175884	0.689536	0.4918
USDZAR_N(-1)	0.144052	0.176563	0.815869	0.4162
$\Delta$ MKT_P	1.740452	0.231074	7.532025	0.0000

$\Delta$ MKT_N	1.541055	0.268480	5.739933	0.0000
$\Delta$ MKT_P(-6)	0.333709	0.188459	1.770725	0.0791
$\Delta$ ARI(-8)	-0.176529	0.062694	-2.815731	0.0057
$\Delta$ ARI(-9)	-0.117836	0.062879	-1.874016	0.0633
$\Delta$ USDZAR_N(-9)	-0.401963	0.223458	-1.798835	0.0745
$\Delta$ USDZAR_P(-10)	-0.445195	0.226987	-1.961323	0.0521
$\Delta$ USDZAR_P(-7)	0.427305	0.187645	2.277201	0.0245
$\Delta$ MKT_P(-11)	0.528058	0.212394	2.486221	0.0143
$\Delta$ ARI(-5)	-0.127350	0.051199	-2.487346	0.0142
$\Delta$ MKT_N(-8)	1.064487	0.306328	3.474996	0.0007
$\Delta$ ARI(-11)	-0.103282	0.055623	-1.856821	0.0657
$\Delta$ USDZAR_P(-11)	-0.671994	0.182861	-3.674884	0.0004
$\Delta$ MKT_P(-9)	0.759022	0.245652	3.089826	0.0025
R-squared	0.765305			
F-statistic	21.10974			
Prob(F-statistic)	0.000000			

Dependent Variable: D(ARL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.001827	0.042405	-0.043077	0.9657
ARL(-1)	-0.903488	0.092767	-9.739303	0.0000
MKT_P(-1)	0.212413	0.199235	1.066140	0.2885
MKT_N(-1)	0.262522	0.207346	1.266106	0.2079
USDZAR_P(-1)	-1.023847	0.254686	-4.020030	0.0001
USDZAR_N(-1)	-1.073436	0.251065	-4.275536	0.0000
$\Delta$ USDZAR_P	-0.725109	0.210953	-3.437305	0.0008
$\Delta$ MKT_N(-4)	-0.346499	0.202485	-1.711229	0.0896
$\Delta$ MKT_N	0.759853	0.242149	3.137953	0.0021
$\Delta$ MKT_P(-6)	-0.573975	0.212650	-2.699153	0.0079
$\Delta$ MKT_N(-12)	-0.373386	0.201847	-1.849849	0.0668
$\Delta$ USDZAR_P(-9)	0.296868	0.142085	2.089376	0.0388
$\Delta$ USDZAR_P(-6)	-0.391050	0.202317	-1.932856	0.0556
$\Delta$ MKT_N(-5)	-0.634813	0.246054	-2.579971	0.0111
$\Delta$ USDZAR_N(-3)	-0.328457	0.164514	-1.996525	0.0481
$\Delta$ USDZAR_P(-1)	0.862571	0.243938	3.536033	0.0006
$\Delta$ ARL(-3)	-0.181418	0.065771	-2.758335	0.0067
$\Delta$ MKT_P(-7)	-0.360496	0.172649	-2.088020	0.0389
$\Delta$ ARL(-10)	-0.116851	0.063406	-1.842909	0.0678
$\Delta$ USDZAR_N(-5)	-0.450299	0.195326	-2.305367	0.0228
$\Delta$ MKT_P(-12)	0.312019	0.169992	1.835490	0.0689
R-squared	0.617632			
F-statistic	9.772459			
Prob(F-statistic)	0.000000			

Dependent Variable: D(ARL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.015223	0.051547	0.295321	0.7683
ART(-1)	-0.164075	0.100052	-1.639899	0.1036
MKT_P(-1)	-0.407576	0.208507	-1.954731	0.0529
MKT_N(-1)	-0.438985	0.208283	-2.107637	0.0371
USDZAR_P(-1)	0.492516	0.290796	1.693686	0.0929
USDZAR_N(-1)	0.530275	0.293396	1.807368	0.0732
$\Delta$ USDZAR_P	-0.835400	0.267885	-3.118499	0.0023
$\Delta$ USDZAR_N(-3)	-1.043657	0.326083	-3.200589	0.0018
$\Delta$ MKT_N(-7)	0.836902	0.314341	2.662400	0.0088
$\Delta$ USDZAR_N(-1)	-1.532801	0.385536	-3.975772	0.0001
$\Delta$ ART(-12)	0.144839	0.069880	2.072684	0.0403
$\Delta$ USDZAR_P(-6)	-0.585830	0.269786	-2.171467	0.0319
$\Delta$ MKT_P(-4)	0.483280	0.226875	2.130161	0.0352
$\Delta$ MKT_P(-9)	0.359050	0.215203	1.668428	0.0978
$\Delta$ USDZAR_N(-10)	-0.383044	0.204249	-1.875380	0.0632
$\Delta$ USDZAR_N(-5)	-1.006799	0.303818	-3.313826	0.0012
$\Delta$ USDZAR_P(-4)	-0.928843	0.324806	-2.859683	0.0050
$\Delta$ USDZAR_P(-2)	-1.113235	0.350117	-3.179612	0.0019
$\Delta$ MKT_P(-8)	0.683685	0.267415	2.556639	0.0118
$\Delta$ ART(-9)	-0.132565	0.071523	-1.853463	0.0663
$\Delta$ ART(-4)	-0.123114	0.069576	-1.769487	0.0794
$\Delta$ MKT_N(-6)	0.546570	0.255922	2.135690	0.0347
R-squared	0.371818			
F-statistic	3.382253			
Prob(F-statistic)	0.000013			

**Dependent Variable: D(ASR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.035181	0.047523	0.740306	0.4605
ASR(-1)	-0.898742	0.115684	-7.768971	0.0000
MKT_P(-1)	1.215311	0.308942	3.933783	0.0001
MKT_N(-1)	1.026160	0.307142	3.340994	0.0011
USDZAR_P(-1)	-0.106001	0.200217	-0.529433	0.5974
USDZAR_N(-1)	0.109012	0.199205	0.547237	0.5852
$\Delta$ MKT_P	1.442381	0.271931	5.304213	0.0000
$\Delta$ MKT_N	0.955253	0.321392	2.972240	0.0035
$\Delta$ ASR(-10)	0.134033	0.066504	2.015426	0.0460
$\Delta$ USDZAR_N(-4)	-0.638609	0.217667	-2.933888	0.0040
$\Delta$ MKT_N(-4)	0.563547	0.269825	2.088569	0.0388
$\Delta$ MKT_N(-5)	0.639135	0.327671	1.950536	0.0533
$\Delta$ MKT_P(-6)	0.672351	0.260366	2.582331	0.0110
$\Delta$ ASR(-1)	-0.137875	0.077007	-1.790408	0.0758
$\Delta$ ASR(-12)	0.173280	0.072611	2.386421	0.0185
$\Delta$ ASR(-11)	0.209425	0.083533	2.507103	0.0134
R-squared	0.674477			
F-statistic	17.40463			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(AVI)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.023569	0.042990	0.548227	0.5846
AVI(-1)	-1.561474	0.229545	-6.802462	0.0000
MKT_P(-1)	0.021346	0.246278	0.086675	0.9311
MKT_N(-1)	-0.148461	0.243315	-0.610159	0.5430
USDZAR_P(-1)	-0.815273	0.273689	-2.978835	0.0036
USDZAR_N(-1)	-0.656976	0.257307	-2.553280	0.0120
$\Delta$ AVI(-2)	0.487646	0.184044	2.649618	0.0092
$\Delta$ USDZAR_P(-5)	-0.572225	0.234580	-2.439356	0.0163
$\Delta$ MKT_P	0.573557	0.209866	2.732972	0.0073
$\Delta$ USDZAR_N(-12)	0.647618	0.160194	4.042715	0.0001
$\Delta$ USDZAR_P(-11)	0.447571	0.165959	2.696886	0.0081
$\Delta$ USDZAR_N(-4)	-0.465270	0.225934	-2.059316	0.0418
$\Delta$ MKT_N(-2)	0.779410	0.229403	3.397552	0.0009
$\Delta$ MKT_P(-1)	0.835792	0.268796	3.109389	0.0024
$\Delta$ MKT_N	0.702476	0.257803	2.724854	0.0075
$\Delta$ AVI(-5)	0.385772	0.130296	2.960737	0.0038
$\Delta$ AVI(-3)	0.546590	0.165723	3.298205	0.0013
$\Delta$ AVI(-6)	0.297922	0.108753	2.739430	0.0072
$\Delta$ MKT_P(-9)	0.434684	0.174047	2.497508	0.0140
$\Delta$ MKT_N(-9)	-0.394591	0.205145	-1.923468	0.0570
$\Delta$ USDZAR_P(-7)	-0.671638	0.229300	-2.929078	0.0041
$\Delta$ USDZAR_P	-0.416154	0.213086	-1.952988	0.0533
$\Delta$ USDZAR_N(-8)	-0.343014	0.182684	-1.877635	0.0631
$\Delta$ AVI(-4)	0.440311	0.149574	2.943764	0.0039
$\Delta$ USDZAR_N(-6)	-0.526420	0.228509	-2.303720	0.0231
$\Delta$ USDZAR_N(-3)	-0.383137	0.174370	-2.197258	0.0301
$\Delta$ AVI(-1)	0.548258	0.207510	2.642078	0.0094
$\Delta$ USDZAR_P(-1)	0.441308	0.245621	1.796706	0.0751
$\Delta$ AVI(-7)	0.233899	0.075785	3.086350	0.0026
$\Delta$ MKT_P(-12)	0.264962	0.153631	1.724665	0.0874
$\Delta$ MKT_P(-11)	0.276541	0.171797	1.609692	0.1103
R-squared	0.707186			
F-statistic	8.936029			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(BAU)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.009456	0.111406	-0.084877	0.9325
BAU(-1)	-1.203464	0.081097	-14.83983	0.0000
MKT_P(-1)	0.074452	0.471901	0.157769	0.8749
MKT_N(-1)	0.084748	0.483344	0.175336	0.8611
USDZAR_P(-1)	-0.791267	0.995076	-0.795182	0.4280
USDZAR_N(-1)	-0.792039	1.015596	-0.779876	0.4369
$\Delta$ USDZAR_P(-4)	1.225987	0.527918	2.322307	0.0218

$\Delta$ USDZAR_P(-10)	1.281690	0.464847	2.757227	0.0067
$\Delta$ MKT_P(-2)	1.016810	0.552340	1.840912	0.0680
$\Delta$ USDZAR_N	1.478516	0.766186	1.929710	0.0559
$\Delta$ MKT_P(-3)	1.480441	0.644609	2.296647	0.0233
$\Delta$ MKT_N(-4)	1.854952	0.744747	2.490716	0.0140
$\Delta$ USDZAR_N(-7)	1.098495	0.485283	2.263617	0.0253
$\Delta$ MKT_N(-5)	1.461667	0.669187	2.184244	0.0308
$\Delta$ USDZAR_P(-1)	1.857320	0.840768	2.209076	0.0290
$\Delta$ USDZAR_P(-2)	2.686483	0.752546	3.569857	0.0005
$\Delta$ USDZAR_N(-1)	2.223261	0.848654	2.619751	0.0099
$\Delta$ BAU(-8)	0.093073	0.051936	1.792085	0.0755
R-squared	0.700027			
F-statistic	17.29634			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(BAW)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.085336	0.039217	-2.175981	0.0314
BAW(-1)	-0.993403	0.078966	-12.58013	0.0000
MKT_P(-1)	1.503467	0.241057	6.236973	0.0000
MKT_N(-1)	1.354517	0.236546	5.726219	0.0000
USDZAR_P(-1)	-0.548747	0.238061	-2.305065	0.0228
USDZAR_N(-1)	-0.401055	0.238063	-1.684663	0.0945
$\Delta$ MKT_P	1.596074	0.204157	7.817862	0.0000
$\Delta$ MKT_N	0.649594	0.232991	2.788064	0.0061
$\Delta$ USDZAR_N	-0.449427	0.233568	-1.924175	0.0566
$\Delta$ MKT_N(-9)	-0.358728	0.198670	-1.805649	0.0734
$\Delta$ MKT_N(-10)	-0.946323	0.240346	-3.937343	0.0001
$\Delta$ MKT_P(-11)	-0.545588	0.194507	-2.804979	0.0058
$\Delta$ MKT_P(-6)	0.677331	0.193551	3.499493	0.0006
$\Delta$ BAW(-9)	-0.153159	0.056901	-2.691654	0.0081
$\Delta$ MKT_N(-5)	0.491249	0.225318	2.180251	0.0311
$\Delta$ USDZAR_P	-0.481470	0.206167	-2.335336	0.0211
$\Delta$ USDZAR_N(-12)	0.244986	0.147806	1.657480	0.0999
R-squared	0.666242			
F-statistic	15.59516			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(BDM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.018471	0.099626	-0.185404	0.8532
BDM(-1)	-0.939351	0.119984	-7.828934	0.0000
MKT_P(-1)	1.593675	0.594642	2.680056	0.0084
MKT_N(-1)	1.631680	0.609548	2.676867	0.0085
USDZAR_P(-1)	-1.344546	0.570267	-2.357748	0.0200

USDZAR_N(-1)	-1.355101	0.568856	-2.382150	0.0188
$\Delta$ MKT_P	1.737404	0.530427	3.275481	0.0014
$\Delta$ USDZAR_N(-2)	-1.293246	0.510098	-2.535291	0.0125
$\Delta$ USDZAR_P(-2)	1.712101	0.470117	3.641860	0.0004
$\Delta$ MKT_N(-10)	0.777793	0.479632	1.621643	0.1075
$\Delta$ MKT_N	1.523670	0.588611	2.588585	0.0108
$\Delta$ USDZAR_P(-7)	-1.338456	0.477035	-2.805785	0.0059
$\Delta$ USDZAR_P(-1)	1.925458	0.694391	2.772872	0.0064
$\Delta$ BDM(-8)	-0.156533	0.061035	-2.564631	0.0116
$\Delta$ MKT_N(-2)	1.105561	0.499180	2.214754	0.0286
$\Delta$ USDZAR_N(-11)	-0.631059	0.361729	-1.744566	0.0836
$\Delta$ BDM(-1)	-0.183829	0.083140	-2.211085	0.0289
$\Delta$ BDM(-9)	-0.126569	0.061174	-2.068991	0.0407
$\Delta$ USDZAR_P(-5)	-1.217081	0.439371	-2.770052	0.0065
$\Delta$ USDZAR_N(-6)	-1.294848	0.517290	-2.503139	0.0136
$\Delta$ MKT_N(-1)	1.429276	0.614640	2.325386	0.0217
$\Delta$ MKT_N(-9)	1.204304	0.458777	2.625033	0.0098
R-squared	0.671104			
F-statistic	11.75702			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(BEL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.006464	0.056847	-0.113716	0.9097
BEL(-1)	-1.172831	0.077678	-15.09864	0.0000
MKT_P(-1)	1.824293	0.322346	5.659433	0.0000
MKT_N(-1)	1.637645	0.322074	5.084679	0.0000
USDZAR_P(-1)	0.334593	0.217245	1.540167	0.1263
USDZAR_N(-1)	0.544040	0.211978	2.566492	0.0116
$\Delta$ MKT_P	1.009526	0.288703	3.496769	0.0007
$\Delta$ MKT_N	1.089420	0.330777	3.293519	0.0013
$\Delta$ USDZAR_N(-8)	1.116349	0.254375	4.388598	0.0000
$\Delta$ MKT_P(-5)	2.359970	0.349903	6.744643	0.0000
$\Delta$ MKT_N(-6)	1.956064	0.352783	5.544661	0.0000
$\Delta$ MKT_N(-4)	1.302490	0.367357	3.545570	0.0006
$\Delta$ MKT_P(-9)	1.037661	0.265122	3.913897	0.0002
$\Delta$ MKT_P(-10)	0.595681	0.245174	2.429621	0.0167
$\Delta$ USDZAR_N(-9)	0.684736	0.247934	2.761767	0.0067
$\Delta$ USDZAR_P(-5)	-0.810010	0.285372	-2.838441	0.0054
$\Delta$ USDZAR_N(-6)	-0.775167	0.277876	-2.789616	0.0062
$\Delta$ MKT_P(-8)	0.818845	0.327334	2.501560	0.0138
$\Delta$ USDZAR_N(-11)	-0.396857	0.209614	-1.893277	0.0609
$\Delta$ MKT_P(-2)	0.477771	0.251529	1.899464	0.0601
$\Delta$ BEL(-5)	-0.137675	0.064509	-2.134191	0.0350
$\Delta$ MKT_N(-2)	-0.579126	0.306309	-1.890659	0.0613
$\Delta$ MKT_P(-4)	0.734132	0.294742	2.490759	0.0142
$\Delta$ USDZAR_P(-8)	-0.527774	0.333632	-1.581905	0.1165
$\Delta$ MKT_N(-5)	1.591470	0.423577	3.757211	0.0003
$\Delta$ MKT_P(-6)	1.418409	0.373488	3.797739	0.0002

$\Delta$ BEL(-3)	-0.171986	0.063343	-2.715139	0.0077
$\Delta$ MKT_N(-7)	1.909792	0.433997	4.400473	0.0000
$\Delta$ USDZAR_N(-7)	-0.545103	0.314174	-1.735035	0.0855
$\Delta$ USDZAR_N(-5)	0.455708	0.273590	1.665663	0.0986
$\Delta$ BEL(-4)	-0.249753	0.073406	-3.402372	0.0009

R-squared	0.766556
F-statistic	12.25908
Prob(F-statistic)	0.000000

#### Dependent Variable: D(BIL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.020879	0.030773	-0.678470	0.4989
BIL(-1)	-1.404599	0.192401	-7.300361	0.0000
MKT_P(-1)	1.107959	0.203268	5.450731	0.0000
MKT_N(-1)	1.071420	0.200754	5.336988	0.0000
USDZAR_P(-1)	-0.766797	0.283890	-2.701035	0.0080
USDZAR_N(-1)	-0.718768	0.283722	-2.533349	0.0127
$\Delta$ MKT_P	1.285932	0.154136	8.342852	0.0000
$\Delta$ MKT_N	1.596534	0.181163	8.812672	0.0000
$\Delta$ USDZAR_N(-11)	-0.653839	0.173375	-3.771239	0.0003
$\Delta$ BIL(-6)	0.148639	0.058460	2.542557	0.0124
$\Delta$ BIL(-2)	0.371984	0.140725	2.643335	0.0094
$\Delta$ USDZAR_P	0.358206	0.156751	2.285184	0.0242
$\Delta$ MKT_P(-2)	0.283628	0.166819	1.700213	0.0918
$\Delta$ USDZAR_P(-3)	0.450293	0.186137	2.419144	0.0172
$\Delta$ USDZAR_P(-8)	-0.373451	0.138095	-2.704312	0.0079
$\Delta$ BIL(-4)	0.397638	0.108935	3.650241	0.0004
$\Delta$ BIL(-1)	0.466746	0.151228	3.086371	0.0025
$\Delta$ USDZAR_N(-10)	-0.476406	0.167451	-2.845054	0.0053
$\Delta$ BIL(-5)	0.220119	0.089506	2.459268	0.0154
$\Delta$ USDZAR_N(-9)	-0.583403	0.189371	-3.080747	0.0026
$\Delta$ USDZAR_P(-10)	-0.459376	0.174781	-2.628286	0.0098
$\Delta$ USDZAR_P(-12)	-0.280815	0.148144	-1.895549	0.0606
$\Delta$ USDZAR_P(-11)	-0.256222	0.151637	-1.689707	0.0938
$\Delta$ USDZAR_N(-3)	0.267195	0.161462	1.654844	0.1007
$\Delta$ BIL(-3)	0.411520	0.120716	3.408997	0.0009
$\Delta$ USDZAR_N(-1)	0.821613	0.259429	3.167000	0.0020
$\Delta$ USDZAR_N(-2)	0.756684	0.213924	3.537154	0.0006
$\Delta$ USDZAR_P(-1)	1.033156	0.286737	3.603151	0.0005
$\Delta$ USDZAR_P(-2)	0.736825	0.235690	3.126249	0.0023

R-squared	0.866579
F-statistic	26.21220
Prob(F-statistic)	0.000000

#### Dependent Variable: D(BSR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.113397	0.056360	-2.012029	0.0464
BSR(-1)	-0.746634	0.076507	-9.759086	0.0000
MKT_P(-1)	1.658823	0.342903	4.837587	0.0000
MKT_N(-1)	1.746457	0.345519	5.054588	0.0000
USDZAR_P(-1)	0.052195	0.245194	0.212872	0.8318
USDZAR_N(-1)	-0.021954	0.245774	-0.089328	0.9290
$\Delta$ MKT_N	1.046824	0.370524	2.825255	0.0055
$\Delta$ MKT_P	1.116131	0.318976	3.499106	0.0006
$\Delta$ USDZAR_N(-12)	1.105379	0.251347	4.397826	0.0000
$\Delta$ BSR(-9)	0.191338	0.058388	3.277039	0.0014
$\Delta$ USDZAR_P(-4)	-0.520690	0.300652	-1.731868	0.0858
$\Delta$ MKT_P(-4)	0.522989	0.267270	1.956782	0.0526
$\Delta$ USDZAR_N(-3)	-0.918308	0.310516	-2.957359	0.0037
$\Delta$ MKT_P(-12)	0.757062	0.250826	3.018274	0.0031
$\Delta$ USDZAR_N(-11)	0.582432	0.251595	2.314958	0.0222
$\Delta$ MKT_P(-11)	0.597308	0.253000	2.360903	0.0198
$\Delta$ BSR(-5)	0.162555	0.058571	2.775336	0.0064
R-squared	0.612449			
F-statistic	12.34615			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(BVT)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.048877	0.028284	-1.728091	0.0866
BVT(-1)	-1.001520	0.074316	-13.47653	0.0000
MKT_P(-1)	0.558722	0.169048	3.305105	0.0013
MKT_N(-1)	0.500621	0.169322	2.956626	0.0038
USDZAR_P(-1)	-0.420222	0.146697	-2.864562	0.0050
USDZAR_N(-1)	-0.367557	0.145230	-2.530856	0.0127
$\Delta$ MKT_P	0.729455	0.138966	5.249158	0.0000
$\Delta$ MKT_N	0.804734	0.167844	4.794545	0.0000
$\Delta$ BVT(-8)	0.187769	0.058255	3.223244	0.0016
$\Delta$ USDZAR_P(-9)	0.404051	0.111947	3.609315	0.0005
$\Delta$ MKT_N(-9)	-0.572257	0.141635	-4.040368	0.0001
$\Delta$ USDZAR_P(-6)	-0.224270	0.107943	-2.077672	0.0399
$\Delta$ BVT(-7)	0.144179	0.059377	2.428193	0.0167
$\Delta$ USDZAR_P(-1)	0.324581	0.161289	2.012416	0.0465
$\Delta$ USDZAR_N(-3)	-0.366158	0.125284	-2.922618	0.0042
$\Delta$ USDZAR_P(-3)	0.305213	0.127905	2.386249	0.0186
$\Delta$ MKT_P(-5)	0.206740	0.108002	1.914223	0.0581
$\Delta$ MKT_P(-7)	-0.390465	0.142440	-2.741260	0.0071
$\Delta$ MKT_N(-8)	-0.298290	0.166739	-1.788966	0.0762
$\Delta$ USDZAR_P(-11)	0.530427	0.140265	3.781609	0.0002
$\Delta$ MKT_P(-6)	0.213290	0.124445	1.713923	0.0892
$\Delta$ MKT_P(-1)	0.487760	0.173780	2.806771	0.0059
$\Delta$ MKT_N(-2)	0.530265	0.148402	3.573153	0.0005
$\Delta$ USDZAR_N(-12)	0.276304	0.112231	2.461924	0.0153
$\Delta$ USDZAR_N(-10)	0.328382	0.149475	2.196906	0.0300
$\Delta$ MKT_P(-8)	-0.295955	0.136760	-2.164036	0.0325

R-squared	0.794835
F-statistic	17.97595
Prob(F-statistic)	0.000000

**Dependent Variable: D(CFR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.066389	0.031727	-2.092467	0.0383
CFR(-1)	-1.154262	0.081509	-14.16123	0.0000
MKT_P(-1)	1.994766	0.227848	8.754800	0.0000
MKT_N(-1)	1.826794	0.224425	8.139875	0.0000
USDZAR_P(-1)	-0.869884	0.227658	-3.821021	0.0002
USDZAR_N(-1)	-0.707427	0.231662	-3.053697	0.0027
$\Delta$ MKT_P	1.585016	0.179025	8.853605	0.0000
$\Delta$ MKT_N	1.148830	0.215596	5.328620	0.0000
$\Delta$ USDZAR_P(-1)	0.642692	0.216753	2.965084	0.0036
$\Delta$ MKT_P(-7)	-0.473135	0.142132	-3.328838	0.0011
$\Delta$ MKT_P(-8)	-0.340716	0.142980	-2.382966	0.0186
$\Delta$ USDZAR_N	-0.349286	0.209046	-1.670862	0.0971
$\Delta$ MKT_P(-3)	-0.280239	0.159358	-1.758554	0.0810
$\Delta$ CFR(-3)	0.095925	0.052595	1.823849	0.0704
R-squared	0.747725			
F-statistic	30.09532			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(CKS)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.106337	0.040134	-2.649558	0.0093
CKS(-1)	-1.397132	0.174628	-8.000615	0.0000
MKT_P(-1)	0.296304	0.192312	1.540747	0.1264
MKT_N(-1)	0.206102	0.186622	1.104382	0.2719
USDZAR_P(-1)	1.571823	0.593683	2.647581	0.0093
USDZAR_N(-1)	1.665873	0.615054	2.708496	0.0079
$\Delta$ USDZAR_P(-8)	-1.107014	0.354132	-3.125990	0.0023
$\Delta$ USDZAR_N(-10)	-0.607016	0.254929	-2.381119	0.0190
$\Delta$ USDZAR_N(-5)	-1.562635	0.479315	-3.260142	0.0015
$\Delta$ MKT_P	0.398709	0.202604	1.967928	0.0517
$\Delta$ USDZAR_N(-11)	-0.622627	0.178173	-3.494512	0.0007
$\Delta$ USDZAR_P(-1)	-1.577973	0.588577	-2.680995	0.0085
$\Delta$ USDZAR_N(-8)	-1.385855	0.353015	-3.925763	0.0002
$\Delta$ USDZAR_N(-9)	-1.286877	0.316115	-4.070918	0.0001
$\Delta$ USDZAR_P(-10)	-1.073220	0.266150	-4.032381	0.0001
$\Delta$ MKT_P(-4)	0.693760	0.169112	4.102376	0.0001
$\Delta$ USDZAR_P(-11)	-0.591137	0.214028	-2.761958	0.0068
$\Delta$ USDZAR_N(-6)	-1.723739	0.439285	-3.923967	0.0002
$\Delta$ USDZAR_N(-3)	-1.484033	0.548978	-2.703267	0.0080

ΔUSDZAR_P(-6)	-1.447251	0.434655	-3.329651	0.0012
ΔUSDZAR_P(-4)	-1.493197	0.512250	-2.914975	0.0043
ΔCKS(-3)	0.186603	0.081381	2.292952	0.0238
ΔUSDZAR_N(-7)	-1.139832	0.387047	-2.944944	0.0040
ΔUSDZAR_P(-3)	-1.831824	0.553294	-3.310759	0.0013
ΔMKT_N(-7)	-0.462467	0.200827	-2.302806	0.0232
ΔUSDZAR_P(-9)	-0.754224	0.313356	-2.406925	0.0178
ΔUSDZAR_P(-2)	-1.417065	0.573915	-2.469122	0.0151
ΔMKT_N(-10)	-0.444909	0.191605	-2.322004	0.0221
ΔUSDZAR_N(-1)	-1.741501	0.612408	-2.843694	0.0054
ΔUSDZAR_P(-5)	-1.834631	0.489016	-3.751682	0.0003
ΔCKS(-10)	0.113584	0.054626	2.079306	0.0400
ΔCKS(-1)	0.378279	0.147079	2.571937	0.0115
ΔMKT_N(-8)	-0.470029	0.194890	-2.411768	0.0176
ΔUSDZAR_N(-4)	-1.807146	0.534780	-3.379232	0.0010
ΔCKS(-2)	0.229609	0.113909	2.015721	0.0464
ΔUSDZAR_P(-7)	-1.409597	0.405525	-3.475981	0.0007
ΔUSDZAR_N(-2)	-1.751539	0.580227	-3.018713	0.0032

R-squared	0.718583
F-statistic	7.518488
Prob(F-statistic)	0.000000

**Dependent Variable: D(CLH)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.062017	0.034456	1.799904	0.0745
CLH(-1)	-0.902598	0.078771	-11.45858	0.0000
MKT_P(-1)	0.150001	0.215671	0.695509	0.4881
MKT_N(-1)	0.102357	0.219999	0.465262	0.6426
USDZAR_P(-1)	-0.336481	0.144187	-2.333643	0.0213
USDZAR_N(-1)	-0.282549	0.141395	-1.998295	0.0480
ΔMKT_P	0.678591	0.155994	4.350115	0.0000
ΔMKT_N	0.531675	0.180815	2.940439	0.0040
ΔCLH(-6)	0.171093	0.054244	3.154143	0.0020
ΔUSDZAR_N(-12)	0.432346	0.127830	3.382182	0.0010
ΔUSDZAR_P	-0.480607	0.153800	-3.124888	0.0022
ΔUSDZAR_N(-3)	-0.407044	0.129939	-3.132580	0.0022
ΔMKT_N(-3)	0.439038	0.170596	2.573546	0.0113
ΔMKT_N(-2)	0.575526	0.186940	3.078669	0.0026
ΔMKT_N(-1)	0.621268	0.236803	2.623569	0.0099
ΔUSDZAR_P(-11)	0.424641	0.164581	2.580128	0.0111
ΔUSDZAR_N(-4)	-0.485660	0.165811	-2.928999	0.0041
ΔUSDZAR_N(-9)	0.249164	0.152392	1.635019	0.1047
ΔMKT_P(-1)	0.471435	0.208247	2.263828	0.0254
ΔUSDZAR_N(-6)	-0.386352	0.134281	-2.877181	0.0048
ΔMKT_P(-2)	0.562258	0.189948	2.960064	0.0037
ΔUSDZAR_P(-5)	-0.559210	0.165145	-3.386179	0.0010
ΔUSDZAR_N(-10)	0.260368	0.152870	1.703201	0.0912
ΔMKT_N(-9)	0.244541	0.142094	1.720976	0.0879
ΔUSDZAR_P(-10)	0.271831	0.152001	1.788348	0.0763

R-squared	0.689259
F-statistic	10.81330

Prob(F-statistic) 0.000000

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**Dependent Variable: D(CLS)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.005748	0.034892	-0.164743	0.8694
CLS(-1)	-0.947833	0.075457	-12.56116	0.0000
MKT_P(-1)	9.21E-05	0.203494	0.000452	0.9996
MKT_N(-1)	0.036174	0.207444	0.174380	0.8619
USDZAR_P(-1)	-0.896392	0.184712	-4.852928	0.0000
USDZAR_N(-1)	-0.941387	0.185253	-5.081622	0.0000
ΔMKT_P	0.800294	0.170726	4.687601	0.0000
ΔUSDZAR_N(-8)	0.508749	0.171770	2.961797	0.0037
ΔMKT_N	0.882070	0.194765	4.528899	0.0000
ΔCLS(-9)	-0.157605	0.056498	-2.789572	0.0062
ΔUSDZAR_N	-0.488655	0.189975	-2.572208	0.0114
ΔMKT_N(-1)	0.625377	0.205557	3.042347	0.0029
ΔCLS(-10)	-0.224232	0.064200	-3.492742	0.0007
ΔUSDZAR_P(-10)	0.241813	0.129085	1.873276	0.0635
ΔUSDZAR_P(-11)	0.423291	0.124534	3.398989	0.0009
ΔMKT_P(-1)	0.748110	0.210796	3.548976	0.0006
ΔMKT_N(-2)	0.582012	0.204661	2.843785	0.0053
ΔMKT_N(-3)	-0.317519	0.168105	-1.888818	0.0614
ΔUSDZAR_P	-0.385944	0.159609	-2.418055	0.0172
ΔUSDZAR_N(-12)	0.350848	0.123842	2.833036	0.0054
ΔCLS(-11)	-0.222725	0.058529	-3.805400	0.0002
ΔMKT_P(-8)	0.292141	0.123382	2.367775	0.0195
ΔMKT_N(-5)	-0.332136	0.155473	-2.136298	0.0348
ΔUSDZAR_N(-7)	0.357118	0.140269	2.545951	0.0122
ΔMKT_N(-4)	-0.397828	0.164706	-2.415381	0.0173
ΔUSDZAR_P(-9)	0.556418	0.165937	3.353185	0.0011
R-squared	0.755553			
F-statistic	14.34158			
Prob(F-statistic)	0.000000			

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**Dependent Variable: D(CMH)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.023033	0.057748	0.398858	0.6908
CMH(-1)	-0.346441	0.171649	-2.018308	0.0460
MKT_P(-1)	-0.477020	0.493074	-0.967442	0.3355
MKT_N(-1)	-0.414269	0.489415	-0.846456	0.3992
USDZAR_P(-1)	-1.378009	0.316065	-4.359895	0.0000
USDZAR_N(-1)	-1.449787	0.323531	-4.481139	0.0000
ΔUSDZAR_P(-3)	-0.468403	0.231610	-2.022378	0.0456
ΔMKT_P	0.801145	0.268404	2.984846	0.0035

ΔMKT_P(-11)	0.942862	0.218596	4.313263	0.0000
ΔCMH(-11)	-0.177921	0.054689	-3.253312	0.0015
ΔCMH(-3)	-0.569881	0.122550	-4.650178	0.0000
ΔUSDZAR_N	-0.843151	0.293208	-2.875604	0.0049
ΔMKT_N(-1)	1.806153	0.493308	3.661312	0.0004
ΔCMH(-4)	-0.374900	0.099787	-3.757001	0.0003
ΔMKT_N	0.705374	0.315259	2.237444	0.0273
ΔUSDZAR_P(-8)	0.722331	0.230673	3.131404	0.0022
ΔMKT_N(-2)	1.853823	0.455006	4.074283	0.0001
ΔUSDZAR_P(-1)	0.824854	0.304960	2.704791	0.0079
ΔMKT_N(-12)	0.478034	0.259619	1.841289	0.0683
ΔUSDZAR_N(-12)	0.310906	0.193456	1.607117	0.1109
ΔMKT_N(-6)	-0.529303	0.285884	-1.851460	0.0668
ΔMKT_P(-7)	-0.553293	0.257160	-2.151551	0.0337
ΔCMH(-2)	-0.604354	0.148514	-4.069351	0.0001
ΔCMH(-1)	-0.622414	0.166006	-3.749343	0.0003
ΔMKT_P(-2)	0.983852	0.385130	2.554597	0.0120
ΔCMH(-5)	-0.234303	0.074900	-3.128227	0.0023
ΔMKT_P(-1)	1.356380	0.447717	3.029548	0.0031
ΔMKT_N(-3)	0.822508	0.411663	1.998011	0.0482
ΔMKT_P(-3)	0.576838	0.303572	1.900173	0.0601
ΔUSDZAR_P(-7)	0.422067	0.232120	1.818311	0.0718
ΔMKT_P(-8)	-0.578217	0.216860	-2.666313	0.0088
ΔUSDZAR_P(-5)	-0.768788	0.264314	-2.908612	0.0044
ΔMKT_P(-4)	0.640403	0.286941	2.231829	0.0277
ΔUSDZAR_N(-4)	-0.531565	0.290166	-1.831933	0.0697

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R-squared	0.750429
F-statistic	9.840707
Prob(F-statistic)	0.000000

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**Dependent Variable: D(COM)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.129554	0.054065	-2.396253	0.0181
COM(-1)	-1.077918	0.081782	-13.18032	0.0000
MKT_P(-1)	1.445900	0.360294	4.013113	0.0001
MKT_N(-1)	1.534937	0.363455	4.223180	0.0000
USDZAR_P(-1)	-0.620859	0.308973	-2.009430	0.0467
USDZAR_N(-1)	-0.715995	0.307473	-2.328648	0.0215
ΔMKT_N	1.272148	0.360624	3.527633	0.0006
ΔMKT_P	0.824925	0.294663	2.799550	0.0060
ΔCOM(-5)	0.202550	0.069383	2.919317	0.0042
ΔMKT_N(-9)	-0.538934	0.303536	-1.775519	0.0783
ΔMKT_P(-8)	-0.539998	0.324995	-1.661560	0.0992
ΔUSDZAR_N(-7)	-0.486197	0.230164	-2.112390	0.0367
ΔMKT_N(-7)	-0.730587	0.331638	-2.202963	0.0295
ΔCOM(-4)	0.154146	0.069462	2.219141	0.0283
ΔUSDZAR_P(-1)	0.802253	0.376189	2.132582	0.0350
ΔUSDZAR_P(-2)	0.578552	0.256777	2.253132	0.0260
ΔUSDZAR_N(-12)	0.536351	0.236308	2.269708	0.0250
ΔUSDZAR_P(-12)	-0.468530	0.218107	-2.148164	0.0337

$\Delta$ USDZAR_N(-10)	-0.422305	0.216700	-1.948799	0.0536
$\Delta$ MKT_P(-1)	-0.606958	0.320055	-1.896420	0.0603

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R-squared	0.669775
F-statistic	13.02344
Prob(F-statistic)	0.000000

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**Dependent Variable: D(CRG)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.037425	0.038539	-0.971098	0.3333
CRG(-1)	-1.074858	0.081577	-13.17602	0.0000
MKT_P(-1)	0.028299	0.171967	0.164558	0.8695
MKT_N(-1)	-0.043621	0.176568	-0.247052	0.8053
USDZAR_P(-1)	0.162593	0.173540	0.936920	0.3505
USDZAR_N(-1)	0.235807	0.175998	1.339823	0.1826
$\Delta$ USDZAR_N(-6)	-0.556826	0.213435	-2.608879	0.0101
$\Delta$ USDZAR_N(-7)	-0.550282	0.199105	-2.763781	0.0065
$\Delta$ MKT_N(-11)	-0.593539	0.207873	-2.855294	0.0050
$\Delta$ USDZAR_N(-4)	-0.630234	0.204770	-3.077768	0.0025
$\Delta$ USDZAR_N(-5)	-0.704497	0.252604	-2.788938	0.0061
$\Delta$ USDZAR_P(-6)	-0.627181	0.265845	-2.359196	0.0198

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R-squared	0.624116
F-statistic	19.77378
Prob(F-statistic)	0.000000

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**Dependent Variable: D(CSB)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.082975	0.049281	1.683718	0.0948
CSB(-1)	-0.951879	0.080926	-11.76227	0.0000
MKT_P(-1)	-0.419471	0.308327	-1.360474	0.1762
MKT_N(-1)	-0.480457	0.313834	-1.530924	0.1284
USDZAR_P(-1)	-0.405483	0.205648	-1.971730	0.0509
USDZAR_N(-1)	-0.340944	0.202993	-1.679583	0.0956
$\Delta$ MKT_P	0.767331	0.229347	3.345729	0.0011
$\Delta$ USDZAR_P(-4)	0.398198	0.179058	2.223849	0.0280
$\Delta$ CSB(-6)	0.099129	0.054260	1.826941	0.0702
$\Delta$ CSB(-10)	-0.096390	0.055969	-1.722212	0.0876
$\Delta$ MKT_P(-12)	0.388233	0.164206	2.364300	0.0197
$\Delta$ MKT_P(-1)	0.575920	0.291155	1.978053	0.0502
$\Delta$ USDZAR_P(-11)	0.802110	0.237043	3.383811	0.0010
$\Delta$ USDZAR_P	-0.577166	0.226181	-2.551792	0.0120
$\Delta$ MKT_N(-2)	0.444340	0.270859	1.640482	0.1035
$\Delta$ USDZAR_N(-12)	0.446352	0.182552	2.445068	0.0159
$\Delta$ MKT_N(-1)	1.044715	0.353868	2.952278	0.0038
$\Delta$ MKT_P(-2)	0.973854	0.285706	3.408590	0.0009
$\Delta$ MKT_N(-3)	0.813224	0.256836	3.166313	0.0020
$\Delta$ USDZAR_N(-10)	0.702243	0.245280	2.863026	0.0049

$\Delta$ USDZAR_P(-9)	0.375644	0.180876	2.076806	0.0399
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R-squared	0.620629
F-statistic	9.897451
Prob(F-statistic)	0.000000

**Dependent Variable: D(DAW)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.061755	0.046604	-1.325098	0.1877
DAW(-1)	-1.283691	0.133069	-9.646793	0.0000
MKT_P(-1)	1.423342	0.300931	4.729786	0.0000
MKT_N(-1)	1.321730	0.295551	4.472087	0.0000
USDZAR_P(-1)	-0.230335	0.177255	-1.299455	0.1963
USDZAR_N(-1)	-0.112742	0.177449	-0.635350	0.5264
$\Delta$ MKT_P	0.625764	0.250794	2.495129	0.0140
$\Delta$ USDZAR_N(-3)	-0.481124	0.232815	-2.066553	0.0410
$\Delta$ DAW(-2)	0.235914	0.076621	3.078982	0.0026
$\Delta$ MKT_N(-7)	0.929381	0.230724	4.028113	0.0001
$\Delta$ MKT_P(-5)	0.612151	0.236315	2.590407	0.0108
$\Delta$ MKT_P(-12)	0.573393	0.181858	3.152974	0.0020
$\Delta$ USDZAR_P(-9)	0.337817	0.187728	1.799506	0.0745
$\Delta$ USDZAR_N(-9)	-0.734447	0.197814	-3.712814	0.0003
$\Delta$ USDZAR_N(-7)	-0.603293	0.209988	-2.872985	0.0048
$\Delta$ MKT_P(-1)	-0.926106	0.270637	-3.421945	0.0009
$\Delta$ DAW(-1)	0.193584	0.110269	1.755560	0.0818
$\Delta$ USDZAR_P(-2)	0.532813	0.232077	2.295850	0.0234
$\Delta$ USDZAR_N(-4)	-0.942165	0.285385	-3.301381	0.0013
$\Delta$ MKT_N(-4)	0.661774	0.273699	2.417887	0.0171
$\Delta$ USDZAR_N(-2)	-0.803557	0.263231	-3.052673	0.0028
$\Delta$ USDZAR_P(-6)	-0.649323	0.237362	-2.735581	0.0072
$\Delta$ USDZAR_P(-3)	-0.457209	0.273088	-1.674216	0.0967
$\Delta$ USDZAR_P(-5)	-0.745555	0.267084	-2.791467	0.0061
R-squared	0.705277			
F-statistic	12.27720			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(DCT)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.007752	0.045548	0.170197	0.8651
DCT(-1)	-0.993926	0.082898	-11.98967	0.0000
MKT_P(-1)	0.203611	0.281566	0.723136	0.4710
MKT_N(-1)	0.170164	0.281706	0.604046	0.5469
USDZAR_P(-1)	-0.577831	0.276483	-2.089932	0.0387
USDZAR_N(-1)	-0.543811	0.287577	-1.891010	0.0610
$\Delta$ USDZAR_P(-11)	0.822499	0.175051	4.698626	0.0000
$\Delta$ MKT_P(-1)	0.808892	0.295491	2.737447	0.0071

$\Delta$ MKT_P(-2)	0.457105	0.234831	1.946524	0.0539
$\Delta$ USDZAR_N(-1)	0.458252	0.246678	1.857691	0.0656
$\Delta$ USDZAR_N	-0.560408	0.270932	-2.068444	0.0407
$\Delta$ USDZAR_N(-12)	0.490244	0.180549	2.715293	0.0076
$\Delta$ MKT_P	0.573208	0.235640	2.432559	0.0165
$\Delta$ MKT_N(-11)	0.429111	0.207883	2.064202	0.0411
$\Delta$ DCT(-5)	0.184484	0.060761	3.036242	0.0029
$\Delta$ USDZAR_N(-2)	0.440634	0.242012	1.820708	0.0711
$\Delta$ DCT(-6)	0.154397	0.061902	2.494224	0.0140
$\Delta$ MKT_N(-3)	0.683282	0.248265	2.752235	0.0068
$\Delta$ USDZAR_N(-7)	-0.300878	0.174806	-1.721214	0.0878
$\Delta$ MKT_N(-2)	0.790978	0.279135	2.833674	0.0054
$\Delta$ USDZAR_P(-3)	0.372513	0.231327	1.610326	0.1099

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R-squared	0.695367
F-statistic	13.80995
Prob(F-statistic)	0.000000

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#### Dependent Variable: D(DST)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.048416	0.036965	1.309777	0.1928
DST(-1)	-1.052201	0.080474	-13.07504	0.0000
MKT_P(-1)	-0.302926	0.273122	-1.109123	0.2696
MKT_N(-1)	-0.296740	0.276954	-1.071441	0.2861
USDZAR_P(-1)	-0.402759	0.187581	-2.147121	0.0338
USDZAR_N(-1)	-0.407041	0.187517	-2.170695	0.0319
$\Delta$ MKT_N	0.979230	0.222103	4.408910	0.0000
$\Delta$ MKT_P(-4)	0.773692	0.197394	3.919526	0.0001
$\Delta$ USDZAR_N(-6)	-0.781012	0.195420	-3.996571	0.0001
$\Delta$ USDZAR_P(-5)	-0.521975	0.158621	-3.290704	0.0013
$\Delta$ MKT_P(-2)	0.734468	0.256306	2.865591	0.0049
$\Delta$ USDZAR_P(-10)	-0.498659	0.167269	-2.981178	0.0035
$\Delta$ MKT_P	0.327795	0.185576	1.766370	0.0799
$\Delta$ USDZAR_N(-9)	-0.350525	0.182185	-1.924009	0.0567
$\Delta$ USDZAR_P(-1)	0.460826	0.211833	2.175417	0.0316
$\Delta$ USDZAR_P(-7)	-0.478787	0.197494	-2.424308	0.0168
$\Delta$ USDZAR_N(-8)	-0.267975	0.156304	-1.714449	0.0890
$\Delta$ MKT_N(-3)	0.917298	0.277052	3.310928	0.0012
$\Delta$ MKT_P(-3)	0.545391	0.206405	2.642331	0.0093
$\Delta$ MKT_P(-12)	0.339596	0.131427	2.583908	0.0110
$\Delta$ MKT_P(-1)	1.036452	0.279241	3.711673	0.0003
$\Delta$ MKT_N(-2)	1.055580	0.294279	3.587000	0.0005
$\Delta$ MKT_N(-1)	0.765971	0.318852	2.402274	0.0178

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R-squared	0.705609
F-statistic	12.96476
Prob(F-statistic)	0.000000

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#### Dependent Variable: D(DTA)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.079114	0.052954	-1.494017	0.1375
DTA(-1)	-1.213737	0.078316	-15.49788	0.0000
MKT_P(-1)	0.366249	0.245949	1.489124	0.1388
MKT_N(-1)	0.371308	0.250760	1.480729	0.1410
USDZAR_P(-1)	-0.870191	0.355339	-2.448906	0.0156
USDZAR_N(-1)	-0.886578	0.356507	-2.486843	0.0141
$\Delta$ USDZAR_N(-9)	0.530330	0.250243	2.119257	0.0359
$\Delta$ DTA(-10)	0.165336	0.059493	2.779096	0.0062
$\Delta$ USAZAR_P(-1)	1.366996	0.415596	3.289239	0.0013
$\Delta$ USAZAR_P(-2)	1.029979	0.289275	3.560558	0.0005
$\Delta$ MKT_P(-7)	-0.499007	0.255653	-1.951893	0.0531
R-squared	0.671578			
F-statistic	27.19674			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(DTC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.159648	0.043799	-3.644993	0.0004
DTC(-1)	-1.510333	0.211312	-7.147404	0.0000
MKT_P(-1)	1.796017	0.266403	6.741725	0.0000
MKT_N(-1)	1.766766	0.261692	6.751308	0.0000
USDZAR_P(-1)	-0.828592	0.235269	-3.521896	0.0006
USDZAR_N(-1)	-0.807460	0.236108	-3.419877	0.0009
$\Delta$ MKT_P	1.868033	0.236138	7.910783	0.0000
$\Delta$ MKT_P(-10)	0.697816	0.205084	3.402593	0.0009
$\Delta$ MKT_N	0.851892	0.273989	3.109218	0.0024
$\Delta$ USDZAR_P(-1)	0.615962	0.268372	2.295186	0.0235
$\Delta$ USDZAR_N(-11)	0.409442	0.171328	2.389813	0.0184
$\Delta$ MKT_P(-11)	0.783754	0.216075	3.627224	0.0004
$\Delta$ MKT_P(-12)	0.500132	0.193477	2.584972	0.0110
$\Delta$ DTC(-2)	0.394066	0.172138	2.289240	0.0238
$\Delta$ DTC(-4)	0.378513	0.157324	2.405954	0.0177
$\Delta$ DTC(-6)	0.316474	0.132618	2.386359	0.0186
$\Delta$ DTC(-3)	0.395866	0.163780	2.417053	0.0172
$\Delta$ DTC(-5)	0.354008	0.144616	2.447922	0.0158
$\Delta$ DTC(-7)	0.421191	0.122845	3.428639	0.0008
$\Delta$ DTC(-1)	0.414841	0.185818	2.232507	0.0275
$\Delta$ DTC(-8)	0.331011	0.109756	3.015879	0.0031
$\Delta$ MKT_P(-7)	-0.416800	0.199627	-2.087895	0.0390
$\Delta$ DTC(-10)	0.226062	0.073639	3.069894	0.0027
$\Delta$ DTC(-9)	0.294440	0.094284	3.122898	0.0023
R-squared	0.741294			
F-statistic	14.70068			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(ELR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.044127	0.049556	-0.890444	0.3752
ELR(-1)	-0.899577	0.088249	-10.19364	0.0000
MKT_P(-1)	1.239614	0.292555	4.237199	0.0000
MKT_N(-1)	1.120460	0.291263	3.846896	0.0002
USDZAR_P(-1)	-0.306818	0.227260	-1.350073	0.1798
USDZAR_N(-1)	-0.184277	0.225229	-0.818176	0.4150
$\Delta$ MKT_P(-1)	-1.309843	0.304842	-4.296796	0.0000
$\Delta$ MKT_P	0.932922	0.239614	3.893430	0.0002
$\Delta$ USDZAR_P(-8)	-1.091880	0.379306	-2.878628	0.0048
$\Delta$ USDZAR_N(-7)	-0.965119	0.364183	-2.650090	0.0092
$\Delta$ USDZAR_N(-8)	-0.576373	0.359319	-1.604071	0.1116
$\Delta$ MKT_N(-11)	-0.631064	0.260561	-2.421939	0.0171
$\Delta$ USDZAR_P	-0.569622	0.248068	-2.296238	0.0236
$\Delta$ USDZAR_P(-9)	-0.798962	0.352539	-2.266306	0.0254
$\Delta$ USDZAR_N(-9)	-1.117635	0.346415	-3.226290	0.0017
$\Delta$ MKT_N(-10)	-0.928958	0.282256	-3.291190	0.0013
$\Delta$ USDZAR_N(-4)	-0.777556	0.307468	-2.528901	0.0129
$\Delta$ USDZAR_N(-6)	-0.946283	0.367079	-2.577869	0.0113
$\Delta$ USDZAR_N(-3)	-0.497603	0.222789	-2.233510	0.0275
$\Delta$ USDZAR_P(-7)	-1.117909	0.369902	-3.022178	0.0031
$\Delta$ MKT_P(-3)	-0.480909	0.255764	-1.880285	0.0627
$\Delta$ USDZAR_N(-10)	-0.942110	0.308256	-3.056257	0.0028
$\Delta$ MKT_P(-11)	-0.544400	0.256622	-2.121404	0.0361
$\Delta$ USDZAR_P(-6)	-0.995746	0.340660	-2.922986	0.0042
$\Delta$ USDZAR_N(-5)	-1.081221	0.309919	-3.488726	0.0007
$\Delta$ USDZAR_P(-5)	-0.636344	0.312966	-2.033268	0.0444
$\Delta$ MKT_N(-2)	-0.782649	0.344686	-2.270617	0.0251
$\Delta$ USDZAR_P(-10)	-0.961690	0.338317	-2.842575	0.0053
$\Delta$ USDZAR_P(-12)	-0.716783	0.258605	-2.771730	0.0065
$\Delta$ USDZAR_N(-11)	-0.765381	0.280556	-2.728087	0.0074
$\Delta$ USDZAR_P(-11)	-0.830308	0.288181	-2.881207	0.0048
$\Delta$ ELR(-10)	-0.107461	0.057758	-1.860533	0.0655
R-squared	0.668607			
F-statistic	7.159111			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(EOH)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.024402	0.040403	0.603952	0.5471
EOH(-1)	-1.017295	0.083380	-12.20074	0.0000
MKT_P(-1)	0.557672	0.211497	2.636789	0.0095
MKT_N(-1)	0.460916	0.214570	2.148095	0.0338
USDZAR_P(-1)	-1.705108	0.394399	-4.323311	0.0000
USDZAR_N(-1)	-1.621805	0.394319	-4.112930	0.0001
$\Delta$ USDZAR_P(-11)	0.488892	0.161331	3.030362	0.0030
$\Delta$ MKT_P(-6)	-0.353786	0.193401	-1.829290	0.0700
$\Delta$ MKT_P(-8)	-0.435296	0.207311	-2.099722	0.0380

ΔUSDZAR_P(-2)	1.152932	0.334693	3.444743	0.0008
ΔMKT_P(-9)	-0.667584	0.231047	-2.889382	0.0046
ΔMKT_P(-1)	-0.378576	0.211236	-1.792191	0.0758
ΔUSDZAR_P(-1)	1.857247	0.389326	4.770419	0.0000
ΔUSDZAR_N(-12)	0.370012	0.151250	2.446362	0.0160
ΔMKT_N	0.518734	0.232364	2.232424	0.0276
ΔMKT_P(-7)	-0.411965	0.189285	-2.176432	0.0316
ΔUSDZAR_N(-1)	0.983429	0.346995	2.834132	0.0054
ΔEOH(-11)	-0.108160	0.058431	-1.851078	0.0668
ΔUSDZAR_P(-4)	0.679692	0.231764	2.932687	0.0041
ΔUSDZAR_N(-2)	0.974422	0.314551	3.097824	0.0025
ΔMKT_N(-8)	-0.685466	0.286306	-2.394169	0.0183
ΔUSDZAR_N(-3)	0.697879	0.269627	2.588312	0.0109
ΔMKT_P(-10)	-0.347948	0.175600	-1.981484	0.0500
ΔEOH(-8)	0.167547	0.058127	2.882422	0.0047
ΔMKT_N(-10)	-0.409447	0.219247	-1.867517	0.0644
ΔMKT_N(-7)	-0.612090	0.268981	-2.275592	0.0248
ΔUSDZAR_P(-10)	0.425293	0.157029	2.708372	0.0078
ΔUSDZAR_P	-0.333769	0.196584	-1.697842	0.0923
ΔUSDZAR_P(-3)	0.890677	0.267580	3.328646	0.0012
R-squared	0.655637			
F-statistic	7.683632			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(EXX)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.038373	0.057828	0.663564	0.5082
EXX(-1)	-0.988816	0.084706	-11.67344	0.0000
MKT_P(-1)	1.427238	0.341324	4.181480	0.0001
MKT_N(-1)	1.421787	0.347696	4.089170	0.0001
USDZAR_P(-1)	-2.353375	0.676091	-3.480856	0.0007
USDZAR_N(-1)	-2.335471	0.697532	-3.348190	0.0011
ΔMKT_P	1.145974	0.313612	3.654113	0.0004
ΔMKT_N	1.535394	0.374387	4.101086	0.0001
ΔMKT_N(-9)	0.834243	0.277548	3.005762	0.0032
ΔMKT_N(-5)	-0.778434	0.293073	-2.656112	0.0090
ΔUSDZAR_P(-11)	-0.596328	0.226768	-2.629688	0.0096
ΔUSDZAR_N(-3)	1.239059	0.535102	2.315558	0.0223
ΔUSDZAR_N(-1)	1.875545	0.654465	2.865770	0.0049
ΔUSDZAR_P(-4)	1.140470	0.475419	2.398873	0.0180
ΔUSDZAR_N(-2)	1.396438	0.588959	2.371028	0.0193
ΔUSDZAR_P(-2)	1.814560	0.622702	2.914013	0.0042
ΔUSDZAR_P(-5)	0.762187	0.350448	2.174895	0.0316
ΔUSDZAR_N(-4)	1.041168	0.411524	2.530033	0.0127
ΔUSDZAR_P(-1)	1.743108	0.674790	2.583188	0.0110
ΔUSDZAR_P(-3)	1.188455	0.524207	2.267149	0.0251
ΔUSDZAR_N(-5)	0.604526	0.311952	1.937881	0.0549
R-squared	0.700135			
F-statistic	14.24250			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(FBR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.078414	0.041968	1.868436	0.0644
FBR(-1)	-0.746496	0.100952	-7.394577	0.0000
MKT_P(-1)	-0.002574	0.247965	-0.010379	0.9917
MKT_N(-1)	-0.034313	0.253771	-0.135211	0.8927
USDZAR_P(-1)	-0.969336	0.202266	-4.792373	0.0000
USDZAR_N(-1)	-0.934091	0.202648	-4.609430	0.0000
ΔMKT_N	0.718705	0.213941	3.359364	0.0011
ΔFBR(-4)	-0.132718	0.052934	-2.507225	0.0136
ΔMKT_P	0.730425	0.181097	4.033328	0.0001
ΔUSDZAR_N	-0.586972	0.206906	-2.836906	0.0054
ΔMKT_N(-10)	0.546295	0.263125	2.076180	0.0402
ΔUSDZAR_N(-12)	0.412304	0.141944	2.904699	0.0044
ΔMKT_N(-8)	0.508406	0.254402	1.998437	0.0481
ΔFBR(-10)	-0.087918	0.050205	-1.751199	0.0827
ΔMKT_N(-2)	0.635438	0.220479	2.882086	0.0048
ΔMKT_N(-3)	0.517569	0.215340	2.403501	0.0179
ΔMKT_P(-10)	0.248650	0.145208	1.712374	0.0896
ΔMKT_P(-11)	0.549240	0.196309	2.797830	0.0061
ΔUSDZAR_P(-5)	-0.329071	0.143271	-2.296845	0.0235
ΔMKT_P(-9)	0.449029	0.208650	2.152067	0.0336
ΔMKT_N(-12)	0.406655	0.182043	2.233840	0.0275
ΔMKT_P(-7)	0.281271	0.169350	1.660891	0.0996
ΔMKT_P(-6)	0.266263	0.146837	1.813325	0.0725
ΔMKT_N(-1)	1.020407	0.294203	3.468379	0.0007
ΔMKT_P(-2)	0.830888	0.225922	3.677762	0.0004
ΔUSDZAR_P	-0.379624	0.177268	-2.141534	0.0344
ΔMKT_P(-1)	0.829613	0.250679	3.309471	0.0013
ΔFBR(-1)	-0.180971	0.078650	-2.300971	0.0233
ΔUSDZAR_P(-2)	-0.313764	0.153639	-2.042213	0.0435
ΔUSDZAR_P(-11)	0.229986	0.140796	1.633468	0.1052
ΔUSDZAR_P(-9)	0.264356	0.135198	1.955334	0.0531
ΔUSDZAR_N(-3)	-0.376007	0.159245	-2.361186	0.0200
R-squared	0.760669			
F-statistic	11.27791			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(GND)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
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C	-0.005496	0.038688	-0.142055	0.8873
GND(-1)	-1.582329	0.191279	-8.272359	0.0000
MKT_P(-1)	1.504151	0.234913	6.403014	0.0000
MKT_N(-1)	1.292232	0.229297	5.635635	0.0000
USDZAR_P(-1)	-0.666341	0.226551	-2.941237	0.0040
USDZAR_N(-1)	-0.433053	0.219418	-1.973646	0.0510
ΔMKT_N	1.154331	0.228494	5.051912	0.0000
ΔMKT_P	0.972879	0.201263	4.833865	0.0000
ΔUSDZAR_P(-9)	0.603701	0.161724	3.732904	0.0003
ΔUSDZAR_N(-9)	-0.784853	0.202531	-3.875222	0.0002
ΔGND(-8)	0.117661	0.068533	1.716850	0.0890
ΔMKT_P(-7)	-0.989823	0.185948	-5.323118	0.0000
ΔUSDZAR_P(-7)	0.777156	0.184609	4.209749	0.0001
ΔGND(-12)	0.094417	0.052802	1.788116	0.0766
ΔMKT_P(-8)	-0.408625	0.169586	-2.409548	0.0177
ΔGND(-7)	0.223972	0.098032	2.284674	0.0243
ΔUSDZAR_N(-7)	-0.501980	0.179962	-2.789374	0.0063
ΔMKT_P(-6)	-0.808925	0.221341	-3.654653	0.0004
ΔGND(-6)	0.284595	0.108585	2.620933	0.0101
ΔUSDZAR_P(-10)	-0.425401	0.199300	-2.134473	0.0351
ΔMKT_N(-5)	-0.826537	0.287693	-2.872984	0.0049
ΔUSDZAR_P(-1)	0.642223	0.260040	2.469710	0.0151
ΔMKT_P(-11)	0.317814	0.197457	1.609537	0.1105
ΔMKT_P(-4)	-0.356998	0.198208	-1.801128	0.0746
ΔGND(-2)	0.337164	0.152903	2.205077	0.0296
ΔMKT_P(-12)	0.311801	0.165008	1.889612	0.0616
ΔGND(-5)	0.287798	0.123422	2.331821	0.0216
ΔUSDZAR_N(-5)	-0.418483	0.186218	-2.247272	0.0267
ΔUSDZAR_N(-12)	-0.261526	0.152525	-1.714643	0.0894
ΔGND(-1)	0.441127	0.168302	2.621040	0.0101
ΔUSDZAR_P(-2)	0.312535	0.186817	1.672946	0.0973
ΔUSDZAR_P(-3)	0.388560	0.202000	1.923566	0.0571
ΔUSDZAR_N(-4)	0.553465	0.236973	2.335560	0.0214
ΔMKT_N(-10)	0.694486	0.229848	3.021499	0.0032
ΔGND(-3)	0.270773	0.141620	1.911975	0.0586
ΔUSDZAR_P(-5)	0.414559	0.213392	1.942713	0.0547
ΔGND(-4)	0.228550	0.132905	1.719650	0.0884
R-squared	0.805451			
F-statistic	12.07528			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(GRF)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.138002	0.045365	-3.042003	0.0029
GRF(-1)	-1.554601	0.144225	-10.77899	0.0000
MKT_P(-1)	1.855530	0.281134	6.600172	0.0000
MKT_N(-1)	1.773595	0.280392	6.325407	0.0000
USDZAR_P(-1)	0.139343	0.237549	0.586585	0.5587
USDZAR_N(-1)	0.235601	0.244211	0.964745	0.3367
ΔMKT_P	0.713873	0.246755	2.893048	0.0046

ΔUSDZAR_P(-3)	-1.087219	0.313888	-3.463715	0.0008
ΔMKT_N	1.087663	0.272889	3.985731	0.0001
ΔGRF(-10)	0.149243	0.052092	2.865005	0.0050
ΔUSDZAR_N(-3)	-1.078580	0.338092	-3.190200	0.0018
ΔUSDZAR_N(-4)	-1.635469	0.327994	-4.986281	0.0000
ΔUSDZAR_P(-4)	-0.642269	0.341319	-1.881727	0.0624
ΔGRF(-7)	0.125022	0.059456	2.102768	0.0377
ΔGRF(-8)	0.144647	0.061953	2.334784	0.0213
ΔUSDZAR_P(-6)	-0.743331	0.298343	-2.491530	0.0142
ΔUSDZAR_P(-5)	-1.227655	0.329930	-3.720960	0.0003
ΔGRF(-1)	0.463241	0.112499	4.117739	0.0001
ΔGRF(-2)	0.302734	0.078653	3.848964	0.0002
ΔUSDZAR_N(-5)	-0.851217	0.303555	-2.804165	0.0059
ΔUSDZAR_N(-7)	-0.509497	0.234366	-2.173938	0.0318
ΔUSDZAR_N(-2)	-0.812274	0.288379	-2.816688	0.0057
ΔMKT_N(-1)	-0.846378	0.288807	-2.930597	0.0041
ΔUSDZAR_N(-1)	-1.047662	0.352133	-2.975190	0.0036
ΔUSDZAR_N(-8)	-0.376696	0.182432	-2.064859	0.0412
ΔUSDZAR_N(-6)	-0.682824	0.237503	-2.875006	0.0048
ΔMKT_P(-8)	-0.315339	0.189662	-1.662634	0.0992
ΔUSDZAR_P(-2)	-0.869743	0.314933	-2.761675	0.0067
ΔMKT_P(-12)	0.323211	0.170869	1.891576	0.0611
R-squared	0.731608			
F-statistic	11.00094			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(GRT)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.032223	0.032069	1.004832	0.3171
GRT(-1)	-0.887945	0.078239	-11.34917	0.0000
MKT_P(-1)	0.023277	0.179846	0.129430	0.8972
MKT_N(-1)	-0.019882	0.183683	-0.108241	0.9140
USDZAR_P(-1)	-0.654753	0.185072	-3.537823	0.0006
USDZAR_N(-1)	-0.609864	0.186830	-3.264280	0.0014
ΔUSDZAR_N	-0.472665	0.186510	-2.534258	0.0126
ΔMKT_P	0.568793	0.160624	3.541138	0.0006
ΔUSDZAR_P	-0.617317	0.170733	-3.615686	0.0004
ΔMKT_N(-1)	0.500570	0.182632	2.740858	0.0071
ΔUSDZAR_P(-11)	0.810736	0.172007	4.713392	0.0000
ΔGRT(-3)	0.146749	0.055274	2.654958	0.0091
ΔMKT_N(-8)	-0.442187	0.154288	-2.865988	0.0050
ΔUSDZAR_N(-12)	0.437363	0.132738	3.294931	0.0013
ΔGRT(-6)	0.135313	0.065497	2.065947	0.0411
ΔUSDZAR_N(-10)	0.673359	0.179001	3.761767	0.0003
ΔUSDZAR_P(-9)	0.321075	0.132847	2.416877	0.0172
ΔUSDZAR_N(-5)	0.261592	0.141644	1.846825	0.0674
ΔUSDZAR_P(-5)	-0.553529	0.180299	-3.070062	0.0027
ΔUSDZAR_N(-2)	-0.324827	0.139688	-2.325368	0.0218
ΔUSDZAR_N(-3)	-0.303496	0.143983	-2.107853	0.0372
ΔGRT(-7)	0.164845	0.070310	2.344535	0.0208
ΔGRT(-8)	0.106202	0.065230	1.628108	0.1063

$\Delta$ MKT_P(-3)	-0.405707	0.150661	-2.692837	0.0082
$\Delta$ USDZAR_N(-4)	-0.532697	0.179113	-2.974079	0.0036
$\Delta$ USDZAR_N(-6)	-0.244409	0.146375	-1.669748	0.0977
$\Delta$ MKT_N(-4)	-0.335790	0.166391	-2.018075	0.0459
$\Delta$ MKT_N	0.308727	0.180784	1.707709	0.0904

R-squared	0.713491
F-statistic	10.51458
Prob(F-statistic)	0.000000

**Dependent Variable: D(HCI)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.050446	0.054268	-0.929563	0.3544
HCI(-1)	-0.710901	0.077791	-9.138646	0.0000
MKT_P(-1)	1.175656	0.280517	4.191038	0.0001
MKT_N(-1)	1.210707	0.291593	4.152043	0.0001
USDZAR_P(-1)	-0.346543	0.340170	-1.018735	0.3103
USDZAR_N(-1)	-0.374221	0.340336	-1.099565	0.2737
$\Delta$ USDZAR_P(-8)	0.406647	0.259277	1.568390	0.1193
$\Delta$ USDZAR_N(-2)	0.620983	0.291386	2.131132	0.0351
$\Delta$ MKT_N	1.236203	0.355953	3.472937	0.0007
$\Delta$ MKT_P(-11)	0.462885	0.231766	1.997203	0.0480
$\Delta$ MKT_N(-9)	-0.684481	0.315240	-2.171299	0.0318
$\Delta$ MKT_P(-6)	-0.485532	0.283751	-1.711117	0.0896
$\Delta$ USDZAR_N(-9)	0.536783	0.255232	2.103118	0.0375
$\Delta$ USDZAR_N(-8)	0.556200	0.311090	1.787909	0.0762
$\Delta$ MKT_N(-7)	-0.774048	0.413761	-1.870761	0.0637
$\Delta$ USDZAR_P(-9)	0.867154	0.292538	2.964241	0.0036
$\Delta$ USDZAR_P(-1)	0.932301	0.417366	2.233774	0.0273
$\Delta$ MKT_P(-8)	-1.025799	0.347120	-2.955174	0.0037
$\Delta$ USDZAR_P(-2)	0.569165	0.274847	2.070841	0.0404

R-squared	0.572979
F-statistic	9.243537
Prob(F-statistic)	0.000000

**Dependent Variable: D(HDC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.041886	0.029096	-1.439573	0.1523
HDC(-1)	-1.054674	0.082651	-12.76057	0.0000
MKT_P(-1)	1.091138	0.205185	5.317827	0.0000
MKT_N(-1)	1.003208	0.205242	4.887933	0.0000
USDZAR_P(-1)	-0.128872	0.138244	-0.932210	0.3529
USDZAR_N(-1)	-0.034617	0.137978	-0.250889	0.8023
$\Delta$ MKT_P	0.946355	0.179311	5.277740	0.0000
$\Delta$ MKT_N	0.459185	0.209313	2.193765	0.0300
$\Delta$ HDC(-5)	0.108066	0.055255	1.955777	0.0525

$\Delta$ MKT_N(-5)	-0.378939	0.202135	-1.874683	0.0630
$\Delta$ USDZAR_P(-4)	0.244816	0.127534	1.919617	0.0570
$\Delta$ MKT_P(-6)	-0.166245	0.172044	-0.966295	0.3356

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R-squared	0.607850
F-statistic	19.16421
Prob(F-statistic)	0.000000

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**Dependent Variable: D(HWA)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.101696	0.122117	0.832775	0.4065
HWA(-1)	-1.415304	0.076512	-18.49790	0.0000
MKT_P(-1)	1.289197	0.540230	2.386387	0.0184
MKT_N(-1)	1.269600	0.552188	2.299218	0.0231
USDZAR_P(-1)	-0.365963	0.545271	-0.671157	0.5033
USDZAR_N(-1)	-0.298837	0.552004	-0.541367	0.5892
$\Delta$ HWA(-9)	-0.274206	0.103377	-2.652497	0.0090
$\Delta$ HWA(-10)	-0.157707	0.070665	-2.231739	0.0273
$\Delta$ MKT_N(-9)	1.996309	0.698399	2.858409	0.0050
$\Delta$ HWA(-8)	-0.298192	0.103271	-2.887469	0.0045
$\Delta$ HWA(-7)	-0.132769	0.071738	-1.850759	0.0665
$\Delta$ MKT_N(-8)	1.134419	0.683649	1.659358	0.0994
$\Delta$ MKT_P(-2)	1.176023	0.575910	2.042024	0.0432

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R-squared	0.730470
F-statistic	29.58600
Prob(F-statistic)	0.000000

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**Dependent Variable: D(HWN)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.022704	0.055305	0.410524	0.6821
HWN(-1)	-0.990816	0.080970	-12.23681	0.0000
MKT_P(-1)	0.947160	0.286543	3.305475	0.0012
MKT_N(-1)	0.882152	0.283593	3.110627	0.0023
USDZAR_P(-1)	-1.642840	0.547372	-3.001322	0.0033
USDZAR_N(-1)	-1.575486	0.557979	-2.823558	0.0055
$\Delta$ MKT_N(-9)	0.671757	0.280518	2.394704	0.0182
$\Delta$ USDZAR_N(-1)	1.346510	0.488534	2.756224	0.0067
$\Delta$ USDZAR_P(-3)	0.736552	0.380267	1.936934	0.0551
$\Delta$ USDZAR_P(-1)	2.361226	0.512832	4.604288	0.0000
$\Delta$ MKT_P	0.598895	0.307212	1.949451	0.0535
$\Delta$ MKT_N(-2)	0.965341	0.358353	2.693829	0.0081
$\Delta$ USDZAR_P(-2)	1.399350	0.418102	3.346911	0.0011
$\Delta$ USDZAR_P(-10)	-0.511187	0.254196	-2.010993	0.0465
$\Delta$ USDZAR_N(-11)	-0.599643	0.248402	-2.414003	0.0173
$\Delta$ HWN(-2)	0.097532	0.058674	1.662280	0.0990
$\Delta$ USDZAR_N(-10)	-0.453967	0.248320	-1.828154	0.0700
$\Delta$ MKT_P(-3)	0.612248	0.345596	1.771573	0.0790

$\Delta$ USDZAR_N	0.539202	0.348639	1.546588	0.1246
$\Delta$ MKT_N(-4)	0.962767	0.328496	2.930830	0.0040
$\Delta$ USDZAR_N(-2)	1.202916	0.433052	2.777763	0.0063

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R-squared	0.656350
F-statistic	11.65062
Prob(F-statistic)	0.000000

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**Dependent Variable: D(HYP)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.009198	0.032470	0.283279	0.7774
HYP(-1)	-0.846555	0.080851	-10.47056	0.0000
MKT_P(-1)	-0.113829	0.166291	-0.684516	0.4949
MKT_N(-1)	-0.106689	0.167161	-0.638245	0.5245
USDZAR_P(-1)	-0.636588	0.193531	-3.289329	0.0013
USDZAR_N(-1)	-0.646767	0.193684	-3.339285	0.0011
$\Delta$ USDZAR_N	-0.699505	0.187675	-3.727204	0.0003
$\Delta$ USDZAR_N(-4)	-0.271506	0.165350	-1.642010	0.1031
$\Delta$ MKT_N(-1)	0.578097	0.189555	3.049750	0.0028
$\Delta$ USDZAR_N(-3)	-0.240154	0.142283	-1.687866	0.0939
$\Delta$ MKT_P(-5)	0.336132	0.128902	2.607653	0.0102
$\Delta$ MKT_P	0.351031	0.164520	2.133669	0.0348
$\Delta$ USDZAR_P	-0.431380	0.165718	-2.603088	0.0104
$\Delta$ USDZAR_P(-11)	0.281659	0.114806	2.453340	0.0155
$\Delta$ MKT_P(-9)	0.217268	0.120117	1.808802	0.0729
$\Delta$ HYP(-10)	-0.123022	0.062919	-1.955238	0.0528
$\Delta$ USDZAR_P(-5)	-0.403930	0.161009	-2.508748	0.0134
$\Delta$ HYP(-9)	-0.151056	0.062652	-2.411031	0.0174

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R-squared	0.608834
F-statistic	11.44457
Prob(F-statistic)	0.000000

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**Dependent Variable: D(IDQ)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.411350	0.110873	3.710106	0.0003
IDQ(-1)	-1.869114	0.322579	-5.794292	0.0000
MKT_P(-1)	-1.198184	0.539125	-2.222462	0.0285
MKT_N(-1)	-1.461004	0.553936	-2.637498	0.0097
USDZAR_P(-1)	-3.290114	0.636207	-5.171450	0.0000
USDZAR_N(-1)	-3.028919	0.624569	-4.849615	0.0000
$\Delta$ IDQ(-4)	0.628692	0.236226	2.661395	0.0091
$\Delta$ IDQ(-10)	0.201835	0.117123	1.723279	0.0879
$\Delta$ IDQ(-3)	0.591271	0.256658	2.303735	0.0233
$\Delta$ MKT_N(-3)	0.983183	0.492282	1.997193	0.0485
$\Delta$ MKT_N(-12)	-0.788751	0.462722	-1.704591	0.0913
$\Delta$ USDZAR_N(-3)	0.644368	0.376219	1.712749	0.0898
$\Delta$ MKT_N(-2)	2.252968	0.588296	3.829650	0.0002

ΔIDQ(-6)	0.597312	0.201656	2.962030	0.0038
ΔUSDZAR_P(-1)	2.574076	0.610964	4.213141	0.0001
ΔIDQ(-8)	0.597625	0.163758	3.649449	0.0004
ΔIDQ(-2)	0.633758	0.276039	2.295902	0.0237
ΔMKT_P(-1)	1.762216	0.616302	2.859341	0.0052
ΔUSDZAR_N(-7)	-1.231671	0.401381	-3.068582	0.0028
ΔUSDZAR_P	-1.197883	0.441430	-2.713646	0.0078
ΔUSDZAR_N(-6)	-1.326402	0.389128	-3.408651	0.0009
ΔMKT_N(-1)	0.998820	0.581177	1.718616	0.0887
ΔMKT_N(-11)	1.615338	0.624455	2.586795	0.0111
ΔMKT_N(-9)	2.314368	0.591045	3.915721	0.0002
ΔMKT_P(-5)	-1.598315	0.427584	-3.738015	0.0003
ΔUSDZAR_N(-1)	1.138969	0.449574	2.533438	0.0128
ΔIDQ(-11)	0.203096	0.081212	2.500795	0.0140
ΔIDQ(-5)	0.737147	0.218512	3.373483	0.0011
ΔMKT_N(-6)	-1.207357	0.465174	-2.595495	0.0109
ΔMKT_N(-8)	1.278469	0.516178	2.476797	0.0149
ΔIDQ(-9)	0.502921	0.145601	3.454101	0.0008
ΔUSDZAR_N(-2)	1.716527	0.488067	3.516990	0.0007
ΔMKT_P(-12)	1.095895	0.464946	2.357038	0.0203
ΔUSDZAR_N(-12)	0.614565	0.380911	1.613410	0.1098
ΔUSDZAR_P(-12)	-0.894857	0.365894	-2.445671	0.0162
ΔMKT_P(-9)	0.897534	0.469137	1.913160	0.0586
ΔIDQ(-7)	0.563585	0.183157	3.077063	0.0027
ΔUSDZAR_P(-11)	-0.881440	0.363609	-2.424146	0.0171
ΔUSDZAR_N(-8)	-1.313057	0.362358	-3.623650	0.0005
ΔIDQ(-1)	0.678713	0.300566	2.258118	0.0261
ΔMKT_P(-10)	1.721780	0.538599	3.196773	0.0019
R-squared	0.794947			
F-statistic	9.788868			
Prob(F-statistic)	0.000000			

Dependent Variable: D(IMP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.124177	0.038307	-3.241664	0.0015
IMP(-1)	-0.894538	0.080566	-11.10322	0.0000
MKT_P(-1)	1.081170	0.254546	4.247436	0.0000
MKT_N(-1)	1.167093	0.260465	4.480810	0.0000
USDZAR_P(-1)	0.042539	0.158074	0.269109	0.7883
USDZAR_N(-1)	-0.034713	0.161060	-0.215525	0.8297
ΔMKT_P	1.426626	0.213047	6.696289	0.0000
ΔMKT_N	1.255306	0.240740	5.214357	0.0000
ΔMKT_N(-8)	-1.229058	0.241418	-5.090994	0.0000
ΔIMP(-7)	-0.149819	0.056566	-2.648587	0.0091
ΔMKT_N(-9)	-0.491064	0.197670	-2.484265	0.0143
ΔUSDZAR_P(-9)	-0.273465	0.154705	-1.767651	0.0795
ΔUSDZAR_P(-4)	-0.356290	0.172540	-2.064973	0.0410
ΔIMP(-4)	0.153740	0.055003	2.795143	0.0060
ΔIMP(-3)	0.207068	0.061319	3.376876	0.0010
ΔMKT_N(-3)	-0.491077	0.231362	-2.122548	0.0357
ΔUSDZAR_N(-6)	-0.160747	0.160921	-0.998921	0.3197

$\Delta$ MKT_N(-6)	-0.424627	0.235117	-1.806028	0.0733
$\Delta$ MKT_P(-7)	-0.676397	0.257415	-2.627652	0.0097

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R-squared	0.746251
F-statistic	20.58634
Prob(F-statistic)	0.000000

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**Dependent Variable: D(ING)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.156309	0.127695	-1.224084	0.2230
ING(-1)	-1.014239	0.081681	-12.41712	0.0000
MKT_P(-1)	1.454436	0.649615	2.238921	0.0268
MKT_N(-1)	1.560337	0.669818	2.329495	0.0213
USDZAR_P(-1)	0.448792	0.648296	0.692264	0.4899
USDZAR_N(-1)	0.324150	0.659443	0.491551	0.6238
$\Delta$ USDZAR_N(-2)	1.895546	0.652143	2.906641	0.0043
$\Delta$ USDZAR_N(-5)	1.936813	0.718363	2.696148	0.0079
$\Delta$ USDZAR_P(-4)	1.076500	0.684263	1.573227	0.1180
DMKT_P(-6)	1.335887	0.684350	1.952053	0.0530

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R-squared	0.589025
F-statistic	21.97629
Prob(F-statistic)	0.000000

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**Dependent Variable: D(IPL)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.010605	0.038265	-0.277147	0.7822
IPL(-1)	-0.765724	0.104990	-7.293296	0.0000
MKT_P(-1)	0.650105	0.224781	2.892166	0.0046
MKT_N(-1)	0.533191	0.222161	2.400022	0.0180
USDZAR_P(-1)	-0.783422	0.263363	-2.974683	0.0036
USDZAR_N(-1)	-0.667299	0.258330	-2.583124	0.0110
$\Delta$ MKT_P	1.132293	0.216102	5.239627	0.0000
$\Delta$ USDZAR_P(-6)	-0.641111	0.249636	-2.568188	0.0115
$\Delta$ USDZAR_N(-5)	-0.431053	0.228711	-1.884708	0.0620
$\Delta$ USDZAR_N(-10)	0.316479	0.197030	1.606247	0.1109
$\Delta$ USDZAR_P	-0.941655	0.207806	-4.531420	0.0000
$\Delta$ USDZAR_N(-3)	-0.820801	0.176028	-4.662894	0.0000
$\Delta$ USDZAR_P(-1)	0.662786	0.238838	2.775045	0.0064
$\Delta$ MKT_P(-3)	-0.661885	0.167864	-3.942977	0.0001
$\Delta$ IPL(-6)	0.334044	0.063597	5.252510	0.0000
$\Delta$ MKT_N	0.487552	0.239579	2.035034	0.0441
$\Delta$ USDZAR_P(-5)	-0.422392	0.226255	-1.866887	0.0644
$\Delta$ IPL(-1)	-0.180460	0.071926	-2.508953	0.0135
$\Delta$ USDZAR_N(-4)	-0.898038	0.239952	-3.742577	0.0003
$\Delta$ MKT_P(-9)	0.458156	0.166689	2.748566	0.0069
$\Delta$ USDZAR_N(-1)	-0.405239	0.200813	-2.017992	0.0459

$\Delta$ USDZAR_N(-7)	0.377399	0.186098	2.027962	0.0449
$\Delta$ IPL(-7)	0.292691	0.080938	3.616215	0.0004
$\Delta$ IPL(-8)	0.206414	0.061559	3.353106	0.0011
$\Delta$ USDZAR_P(-11)	0.518498	0.200266	2.589050	0.0109
$\Delta$ USDZAR_N(-12)	0.329152	0.172705	1.905868	0.0591

R-squared	0.797728
F-statistic	18.29944
Prob(F-statistic)	0.000000

**Dependent Variable: D(ISA)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.049424	0.100937	-0.489646	0.6253
ISA(-1)	-1.259139	0.080946	-15.55530	0.0000
MKT_P(-1)	-0.039059	0.432837	-0.090239	0.9283
MKT_N(-1)	-0.269057	0.444366	-0.605487	0.5461
USDZAR_P(-1)	-1.852121	0.686978	-2.696042	0.0081
USDZAR_N(-1)	-1.631957	0.688469	-2.370413	0.0194
$\Delta$ ISA(-3)	-0.498426	0.118105	-4.220199	0.0000
$\Delta$ MKT_N(-9)	-1.422578	0.568346	-2.503015	0.0137
$\Delta$ ISA(-9)	-0.300885	0.173417	-1.735044	0.0854
$\Delta$ MKT_N(-5)	2.957886	0.780242	3.790986	0.0002
$\Delta$ USDZAR_P(-10)	2.235772	0.497865	4.490716	0.0000
$\Delta$ USDZAR_P(-11)	1.471394	0.633424	2.322923	0.0220
$\Delta$ MKT_P(-6)	1.687640	0.589203	2.864276	0.0050
$\Delta$ USDZAR_P(-5)	0.919020	0.500234	1.837180	0.0688
$\Delta$ ISA(-8)	-0.475095	0.192566	-2.467187	0.0151
$\Delta$ USDZAR_N(-10)	-1.193907	0.651222	-1.833335	0.0694
$\Delta$ USDZAR_N(-12)	0.852340	0.517661	1.646522	0.1024
$\Delta$ ISA(-12)	-0.144836	0.064656	-2.240098	0.0270
$\Delta$ ISA(-6)	-0.689739	0.201322	-3.426045	0.0009
$\Delta$ ISA(-5)	-0.696114	0.187629	-3.710051	0.0003
$\Delta$ USDZAR_N(-2)	1.457175	0.650633	2.239625	0.0271
$\Delta$ ISA(-2)	-0.212075	0.076124	-2.785902	0.0063
$\Delta$ ISA(-10)	-0.320892	0.133656	-2.400883	0.0180
$\Delta$ MKT_P(-4)	0.903973	0.548423	1.648314	0.1020
$\Delta$ ISA(-7)	-0.681071	0.199419	-3.415283	0.0009
$\Delta$ ISA(-4)	-0.500044	0.157394	-3.177029	0.0019
$\Delta$ USDZAR_P(-1)	1.896529	0.845129	2.244070	0.0268
$\Delta$ ISA(-11)	-0.212756	0.100706	-2.112656	0.0368

R-squared	0.819684
F-statistic	19.19344
Prob(F-statistic)	0.000000

**Dependent Variable: D(ITE)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.032605	0.037210	-0.876233	0.3828
ITE(-1)	-0.707363	0.135463	-5.221831	0.0000
MKT_P(-1)	-0.023188	0.223603	-0.103701	0.9176
MKT_N(-1)	-0.059313	0.223425	-0.265472	0.7911

USDZAR_P(-1)	-0.217813	0.151345	-1.439182	0.1529
USDZAR_N(-1)	-0.188629	0.150745	-1.251308	0.2134
$\Delta$ MKT_P(-2)	0.783902	0.200094	3.917678	0.0002
$\Delta$ MKT_N	0.911811	0.241776	3.771310	0.0003
$\Delta$ MKT_N(-3)	0.582705	0.276725	2.105716	0.0374
$\Delta$ USDZAR_N(-9)	-0.570443	0.201127	-2.836235	0.0054
$\Delta$ USDZAR_N(-3)	-0.494112	0.174768	-2.827238	0.0056
$\Delta$ MKT_P(-10)	0.424073	0.178396	2.377140	0.0191
$\Delta$ ITE(-10)	-0.316941	0.090489	-3.502536	0.0007
$\Delta$ ITE(-2)	-0.295415	0.074676	-3.955942	0.0001
$\Delta$ USDZAR_N(-2)	-0.334099	0.175354	-1.905279	0.0593
$\Delta$ ITE(-9)	-0.136970	0.066777	-2.051144	0.0426
$\Delta$ USDZAR_P(-6)	-0.330275	0.175927	-1.877339	0.0631
$\Delta$ USDZAR_N(-7)	-0.302956	0.188362	-1.608376	0.1105
$\Delta$ USDZAR_N(-8)	-0.360620	0.171320	-2.104954	0.0375
$\Delta$ USDZAR_P(-10)	-0.634157	0.190832	-3.323125	0.0012
$\Delta$ MKT_P(-11)	0.568845	0.205236	2.771664	0.0065
$\Delta$ MKT_N(-8)	0.511934	0.241692	2.118125	0.0364
$\Delta$ ITE(-12)	-0.200923	0.069488	-2.891476	0.0046
$\Delta$ ITE(-1)	-0.326578	0.110452	-2.956749	0.0038
$\Delta$ MKT_P(-1)	0.621187	0.235500	2.637742	0.0095
$\Delta$ MKT_N(-10)	0.693406	0.284215	2.439723	0.0163
$\Delta$ ITE(-11)	-0.187084	0.092273	-2.027499	0.0450
$\Delta$ MKT_P(-9)	0.573627	0.237040	2.419956	0.0171
$\Delta$ MKT_P(-4)	0.367705	0.203598	1.806037	0.0736
R-squared	0.756944			
F-statistic	12.56832			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(ITU)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.014139	0.035329	-0.400224	0.6897
ITU(-1)	-1.028953	0.082017	-12.54557	0.0000
MKT_P(-1)	0.952622	0.207688	4.586797	0.0000
MKT_N(-1)	0.856528	0.205171	4.174710	0.0001
USDZAR_P(-1)	-0.872708	0.253073	-3.448438	0.0008
USDZAR_N(-1)	-0.778476	0.255081	-3.051878	0.0028
$\Delta$ MKT_P	0.767171	0.191587	4.004288	0.0001
$\Delta$ USDZAR_N(-1)	0.470172	0.245926	1.911844	0.0583
$\Delta$ MKT_N(-4)	0.421074	0.220271	1.911612	0.0583
$\Delta$ USDZAR_P(-7)	-0.409845	0.156532	-2.618284	0.0100
$\Delta$ MKT_N(-3)	0.595513	0.213788	2.785532	0.0062
$\Delta$ USDZAR_N(-10)	-0.341451	0.139722	-2.443786	0.0160
$\Delta$ ITU(-4)	-0.178940	0.057582	-3.107580	0.0024
$\Delta$ MKT_P(-4)	0.666399	0.198147	3.363157	0.0010
$\Delta$ MKT_P(-11)	-0.337903	0.144573	-2.337253	0.0211
$\Delta$ MKT_P(-10)	-0.496944	0.141175	-3.520059	0.0006
$\Delta$ USDZAR_N(-11)	-0.482213	0.141277	-3.413254	0.0009
$\Delta$ MKT_N	0.617321	0.213902	2.886001	0.0046
$\Delta$ USDZAR_P(-2)	0.718407	0.220532	3.257610	0.0015
$\Delta$ MKT_P(-5)	0.670666	0.181770	3.689646	0.0003

$\Delta$ USDZAR_P(-5)	-0.517310	0.164407	-3.146530	0.0021
$\Delta$ USDZAR_P(-6)	-0.473505	0.164798	-2.873248	0.0048
$\Delta$ USDZAR_P(-1)	0.765863	0.238798	3.207164	0.0017

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R-squared	0.684162
F-statistic	11.81555
Prob(F-statistic)	0.000000

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**Dependent Variable: D(IVT)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.080246	0.038124	2.104863	0.0375
IVT(-1)	-0.985781	0.080589	-12.23216	0.0000
MKT_P(-1)	0.245398	0.265371	0.924734	0.3570
MKT_N(-1)	0.022012	0.267037	0.082432	0.9344
USDZAR_P(-1)	-0.459935	0.137875	-3.335879	0.0011
USDZAR_N(-1)	-0.224000	0.138617	-1.615964	0.1088
$\Delta$ MKT_P	0.462511	0.192332	2.404756	0.0178
$\Delta$ IVT(-12)	0.164363	0.054008	3.043291	0.0029
$\Delta$ MKT_N(-2)	0.417894	0.228172	1.831485	0.0696
$\Delta$ USDZAR_P(-9)	0.793933	0.200309	3.963536	0.0001
$\Delta$ IVT(-4)	-0.120429	0.052191	-2.307461	0.0228
$\Delta$ MKT_P(-1)	0.692251	0.261855	2.643646	0.0093
$\Delta$ USDZAR_N(-11)	-0.345187	0.148581	-2.323223	0.0219
$\Delta$ MKT_N(-11)	0.539397	0.202701	2.661051	0.0089
$\Delta$ MKT_N	0.622289	0.223022	2.790254	0.0062
$\Delta$ USDZAR_N(-12)	0.410187	0.158422	2.589197	0.0109
$\Delta$ USDZAR_P(-11)	0.603874	0.195276	3.092412	0.0025
$\Delta$ MKT_N(-1)	0.631596	0.290152	2.176774	0.0315
$\Delta$ USDZAR_N(-10)	0.656761	0.214626	3.060030	0.0027
$\Delta$ USDZAR_N(-8)	0.375130	0.204922	1.830600	0.0697
$\Delta$ USDZAR_P(-7)	0.392786	0.165362	2.375310	0.0192
$\Delta$ MKT_P(-12)	0.406822	0.172799	2.354305	0.0202
$\Delta$ MKT_P(-2)	0.823370	0.247314	3.329254	0.0012
$\Delta$ USDZAR_P(-8)	0.373327	0.163006	2.290267	0.0238
$\Delta$ MKT_P(-4)	0.483224	0.186081	2.596850	0.0106
$\Delta$ MKT_N(-3)	0.789503	0.276763	2.852633	0.0051

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R-squared	0.727310
F-statistic	12.37563
Prob(F-statistic)	0.000000

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**Dependent Variable: D(JSC)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.151605	0.052537	2.885666	0.0046
JSC(-1)	-1.101871	0.080930	-13.61519	0.0000
MKT_P(-1)	0.053835	0.304318	0.176904	0.8599
MKT_N(-1)	-0.057741	0.312185	-0.184959	0.8536
USDZAR_P(-1)	-0.709694	0.219181	-3.237929	0.0016

USDZAR_N(-1)	-0.573527	0.222183	-2.581323	0.0110
ΔMKT_P(-12)	0.402539	0.215795	1.865378	0.0646
ΔUSDZAR_P(-6)	-0.638462	0.315109	-2.026160	0.0450
ΔMKT_N	1.136696	0.345067	3.294128	0.0013
ΔUSDZAR_N(-9)	-1.250038	0.302813	-4.128089	0.0001
ΔUSDZAR_N(-8)	-0.672188	0.247320	-2.717886	0.0075
ΔUSDZAR_P(-2)	-0.859326	0.259262	-3.314506	0.0012
ΔMKT_P(-1)	1.401868	0.391423	3.581469	0.0005
ΔMKT_N(-2)	0.875307	0.355188	2.464349	0.0151
ΔUSDZAR_P(-4)	-0.575409	0.272196	-2.113951	0.0366
ΔUSDZAR_P(-10)	-0.908250	0.274764	-3.305568	0.0013
ΔUSDZAR_N(-4)	-0.510730	0.277027	-1.843611	0.0677
ΔUSDZAR_P(-3)	-0.562979	0.281417	-2.000515	0.0477
ΔMKT_P(-2)	0.746720	0.290177	2.573323	0.0113
ΔMKT_N(-3)	1.051939	0.319314	3.294376	0.0013
ΔUSDZAR_N(-5)	-0.829697	0.333819	-2.485469	0.0143
ΔUSDZAR_P(-7)	-0.650513	0.280431	-2.319693	0.0220
R-squared	0.714058			
F-statistic	14.26979			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(LAB)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.429379	0.172279	-2.492354	0.0141
LAB(-1)	-0.973587	0.075968	-12.81569	0.0000
MKT_P(-1)	-0.720315	0.895555	-0.804322	0.4228
MKT_N(-1)	-0.110031	0.910998	-0.120780	0.9041
USDZAR_P(-1)	0.093077	0.782831	0.118898	0.9056
USDZAR_N(-1)	-0.588925	0.805461	-0.731165	0.4661
ΔMKT_N(-9)	-2.685738	0.941016	-2.854084	0.0051
ΔMKT_N(-11)	-1.946142	0.870808	-2.234869	0.0273
ΔMKT_P(-6)	3.987308	0.851129	4.684730	0.0000
ΔUSDZAR_P(-3)	2.760115	0.873815	3.158695	0.0020
ΔMKT_N	-4.899639	1.103377	-4.440585	0.0000
ΔLAB(-8)	-0.105194	0.058820	-1.788409	0.0763
ΔMKT_P(-9)	1.955120	0.764842	2.556240	0.0119
ΔLAB(-4)	-0.142679	0.056578	-2.521818	0.0130
ΔUSDZAR_N(-1)	1.652973	0.965226	1.712524	0.0894
ΔMKT_P(-2)	-1.518712	0.779722	-1.947761	0.0538
ΔMKT_N(-5)	4.956901	1.146651	4.322940	0.0000
ΔMKT_N(-4)	3.693520	1.078401	3.424997	0.0008
ΔMKT_P(-11)	1.795555	0.802429	2.237650	0.0271
ΔMKT_P(-1)	-2.077080	0.999316	-2.078502	0.0398
ΔUSDZAR_N(-6)	2.812622	0.880649	3.193808	0.0018
ΔUSDZAR_P(-7)	2.468428	0.872262	2.829917	0.0055
ΔMKT_P(-3)	2.431095	0.904855	2.686724	0.0083
ΔUSDZAR_N(-2)	1.703891	0.962049	1.771107	0.0791
ΔMKT_N(-12)	1.538352	0.884310	1.739608	0.0846
R-squared	0.739838			

F-statistic	13.86331
Prob(F-statistic)	0.000000

**Dependent Variable: D(LON)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.142444	0.092946	-1.532549	0.1279
LON(-1)	-0.481108	0.210290	-2.287825	0.0238
MKT_P(-1)	1.973273	0.593888	3.322636	0.0012
MKT_N(-1)	2.090167	0.598613	3.491682	0.0007
USDZAR_P(-1)	-1.290465	0.554220	-2.328436	0.0215
USDZAR_N(-1)	-1.394404	0.553227	-2.520489	0.0130
$\Delta$ MKT_P	2.026374	0.539336	3.757163	0.0003
$\Delta$ LON(-1)	-0.632735	0.169417	-3.734784	0.0003
$\Delta$ MKT_N	1.786886	0.646720	2.762999	0.0066
$\Delta$ LON(-3)	-0.512401	0.129843	-3.946313	0.0001
$\Delta$ MKT_N(-3)	1.172899	0.556445	2.107843	0.0370
$\Delta$ USDZAR_P(-1)	1.509440	0.610376	2.472969	0.0147
$\Delta$ MKT_P(-7)	-0.782766	0.431884	-1.812444	0.0723
$\Delta$ LON(-2)	-0.304870	0.153346	-1.988123	0.0490
$\Delta$ LON(-5)	-0.217310	0.088344	-2.459813	0.0153
$\Delta$ USDZAR_P(-11)	-0.701400	0.393958	-1.780392	0.0774
$\Delta$ MKT_P(-11)	1.234486	0.443776	2.781779	0.0062
$\Delta$ USDZAR_N(-8)	-0.742706	0.402655	-1.844522	0.0675
R-squared	0.646089			
F-statistic	13.42328			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(MFL)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.141506	0.062947	2.248020	0.0265
MFL(-1)	-0.400772	0.169060	-2.370591	0.0194
MKT_P(-1)	-0.146867	0.277818	-0.528646	0.5981
MKT_N(-1)	-0.262981	0.282337	-0.931444	0.3536
USDZAR_P(-1)	-0.975288	0.319284	-3.054605	0.0028
USDZAR_N(-1)	-0.843602	0.331892	-2.541796	0.0124
$\Delta$ USDZAR_N(-5)	-1.823478	0.410051	-4.446953	0.0000
$\Delta$ MFL(-10)	-0.209311	0.055688	-3.758624	0.0003
$\Delta$ MFL(-3)	-0.415002	0.143348	-2.895064	0.0045
$\Delta$ USDZAR_P(-10)	-1.314189	0.386297	-3.402019	0.0009
$\Delta$ USDZAR_P(-8)	-0.957795	0.457651	-2.092849	0.0386
$\Delta$ MFL(-12)	0.178348	0.043127	4.135378	0.0001
$\Delta$ MFL(-5)	-0.400295	0.098892	-4.047804	0.0001
$\Delta$ USDZAR_N(-4)	-0.913321	0.325490	-2.805990	0.0059

$\Delta$ MKT_N(-6)	1.117120	0.437186	2.555250	0.0119
$\Delta$ MFL(-1)	-0.636442	0.164145	-3.877311	0.0002
$\Delta$ MFL(-4)	-0.397728	0.121412	-3.275846	0.0014
$\Delta$ USDZAR_N(-7)	-1.341553	0.471994	-2.842308	0.0053
$\Delta$ USDZAR_P(-6)	-1.165190	0.419981	-2.774390	0.0065
$\Delta$ MFL(-6)	-0.284472	0.071439	-3.982015	0.0001
$\Delta$ USDZAR_N(-9)	-0.978342	0.476326	-2.053935	0.0423
$\Delta$ MKT_N(-3)	0.668009	0.356373	1.874462	0.0634
$\Delta$ MFL(-9)	-0.187031	0.057921	-3.229084	0.0016
$\Delta$ MKT_N(-8)	0.710543	0.394478	1.801222	0.0743
$\Delta$ MKT_P(-7)	0.703649	0.420489	1.673406	0.0970
$\Delta$ USDZAR_N(-1)	0.757439	0.368603	2.054891	0.0422
$\Delta$ USDZAR_N(-8)	-0.585424	0.323640	-1.808873	0.0731
$\Delta$ MFL(-2)	-0.523656	0.150629	-3.476459	0.0007
R-squared	0.768464	Mean dependent var		-0.000154
F-statistic	14.01345	Durbin-Watson stat		1.885230
Prob(F-statistic)	0.000000			

**Dependent Variable: D(MRF)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.218550	0.056229	-3.886788	0.0002
MRF(-1)	-0.694909	0.107274	-6.477895	0.0000
MKT_P(-1)	2.199984	0.412546	5.332699	0.0000
MKT_N(-1)	2.273403	0.413768	5.494387	0.0000
USDZAR_P(-1)	-0.039022	0.224228	-0.174028	0.8621
USDZAR_N(-1)	-0.121282	0.223286	-0.543169	0.5881
$\Delta$ MKT_P	1.944066	0.300428	6.470994	0.0000
$\Delta$ MKT_N	1.616467	0.353455	4.573327	0.0000
$\Delta$ USDZAR_N(-3)	-0.516436	0.293214	-1.761294	0.0808
$\Delta$ MKT_N(-2)	0.855366	0.327958	2.608161	0.0103
$\Delta$ MRF(-7)	-0.197193	0.080299	-2.455722	0.0155
$\Delta$ MRF(-1)	-0.342135	0.073848	-4.632948	0.0000
$\Delta$ MKT_P(-12)	0.359403	0.216611	1.659208	0.0998
$\Delta$ MRF(-5)	-0.244585	0.090406	-2.705420	0.0079
$\Delta$ USDZAR_P(-11)	0.437328	0.216719	2.017949	0.0459
$\Delta$ MKT_N(-5)	1.702099	0.430942	3.949722	0.0001
$\Delta$ MKT_P(-6)	1.255039	0.299199	4.194664	0.0001
$\Delta$ MRF(-8)	-0.173308	0.079184	-2.188661	0.0306
$\Delta$ MKT_P(-4)	0.550037	0.299816	1.834579	0.0691
$\Delta$ MKT_P(-9)	0.902196	0.262033	3.443057	0.0008
$\Delta$ MKT_N(-10)	1.094235	0.302238	3.620438	0.0004
$\Delta$ MRF(-6)	-0.140687	0.083694	-1.680970	0.0955
$\Delta$ MRF(-9)	-0.134305	0.064372	-2.086388	0.0391
$\Delta$ MKT_P(-1)	0.789421	0.412274	1.914795	0.0580
$\Delta$ USDZAR_P(-4)	-0.610473	0.290335	-2.102650	0.0377
$\Delta$ MRF(-4)	-0.195799	0.073513	-2.663469	0.0088
R-squared	0.772425			
F-statistic	15.74886			
Prob(F-statistic)	0.000000			

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**Dependent Variable: D(MRP)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.005208	0.037824	0.137689	0.8907
MRP(-1)	-0.770072	0.081697	-9.425964	0.0000
MKT_P(-1)	0.161355	0.209610	0.769784	0.4430
MKT_N(-1)	0.105840	0.211443	0.500560	0.6176
USDZAR_P(-1)	-0.848452	0.230612	-3.679137	0.0004
USDZAR_N(-1)	-0.797742	0.233387	-3.418105	0.0009
$\Delta$ USDZAR_P	-0.483647	0.204248	-2.367940	0.0195
$\Delta$ MKT_P	0.535854	0.197990	2.706463	0.0078
$\Delta$ USDZAR_P(-8)	0.423212	0.201859	2.096575	0.0382
$\Delta$ USDZAR_N	-0.824322	0.235064	-3.506791	0.0006
$\Delta$ USDZAR_N(-11)	0.341839	0.164683	2.075738	0.0401
$\Delta$ USDZAR_N(-3)	-0.518169	0.171091	-3.028608	0.0030
$\Delta$ MRP(-11)	-0.181174	0.078132	-2.318817	0.0221
$\Delta$ MKT_N	0.493115	0.233878	2.108424	0.0371
$\Delta$ USDZAR_N(-4)	-0.425850	0.171564	-2.482160	0.0145
$\Delta$ USDZAR_P(-11)	0.389787	0.148603	2.623007	0.0099
$\Delta$ USDZAR_N(-7)	0.777655	0.199077	3.906308	0.0002
$\Delta$ MKT_P(-12)	0.318580	0.161772	1.969314	0.0513
$\Delta$ MRP(-9)	-0.129658	0.066254	-1.956998	0.0527
$\Delta$ MRP(-5)	0.146557	0.060706	2.414200	0.0173
$\Delta$ USDZAR_P(-9)	0.462204	0.193873	2.384058	0.0187
$\Delta$ USDZAR_N(-8)	0.418475	0.203942	2.051933	0.0424
$\Delta$ MRP(-10)	-0.218615	0.078800	-2.774311	0.0064
$\Delta$ MRP(-12)	-0.148211	0.069009	-2.147705	0.0338
R-squared	0.688899			
F-statistic	11.36078			
Prob(F-statistic)	0.000000			

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**Dependent Variable: D(MSM)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.025415	0.044064	0.576766	0.5653
MSM(-1)	-1.330300	0.223047	-5.964212	0.0000
MKT_P(-1)	0.473967	0.212861	2.226651	0.0281
MKT_N(-1)	0.366468	0.213438	1.716980	0.0889
USDZAR_P(-1)	-0.939843	0.289984	-3.241021	0.0016
USDZAR_N(-1)	-0.824749	0.281792	-2.926800	0.0042
$\Delta$ MKT_N	0.908323	0.239569	3.791481	0.0002
$\Delta$ USDZAR_N(-6)	0.527947	0.227728	2.318317	0.0223
$\Delta$ USDZAR_N	-0.538156	0.233564	-2.304105	0.0231

ΔUSDZAR_N(-7)	0.669042	0.225944	2.961097	0.0038
ΔUSDZAR_P(-7)	0.603334	0.243448	2.478290	0.0148
ΔMSM(-4)	0.434970	0.158148	2.750392	0.0070
ΔMKT_P	0.661623	0.203859	3.245490	0.0016
ΔMKT_N(-11)	-0.646856	0.205624	-3.145822	0.0021
ΔMKT_P(-11)	0.576920	0.196694	2.933083	0.0041
ΔMSM(-1)	0.441468	0.204052	2.163504	0.0327
ΔUSDZAR_N(-10)	0.794661	0.237767	3.342180	0.0011
ΔUSDZAR_P	-0.453668	0.199460	-2.274487	0.0249
ΔUSDZAR_N(-12)	0.484779	0.167296	2.897742	0.0046
ΔMSM(-5)	0.304425	0.137985	2.206227	0.0295
ΔUSDZAR_N(-8)	0.826816	0.238495	3.466807	0.0008
ΔMSM(-2)	0.400484	0.187912	2.131231	0.0354
ΔMKT_N(-4)	-0.437508	0.209102	-2.092323	0.0388
ΔUSDZAR_P(-9)	0.859304	0.232229	3.700239	0.0003
ΔUSDZAR_P(-11)	0.886704	0.228192	3.885785	0.0002
ΔMSM(-8)	0.229805	0.075673	3.036826	0.0030
ΔUSDZAR_P(-1)	0.546397	0.267901	2.039544	0.0439
ΔUSDZAR_P(-2)	0.445778	0.183454	2.429915	0.0168
ΔMSM(-7)	0.367881	0.101545	3.622825	0.0004
ΔMKT_N(-10)	0.465062	0.224427	2.072217	0.0406
ΔUSDZAR_P(-8)	0.669334	0.231854	2.886875	0.0047
ΔUSDZAR_P(-3)	0.313248	0.174884	1.791177	0.0761
ΔMSM(-6)	0.454600	0.122076	3.723900	0.0003
ΔMSM(-3)	0.425982	0.177336	2.402113	0.0180
ΔMKT_N	0.439776	0.214900	2.046419	0.0432

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R-squared	0.752231
F-statistic	9.554543
Prob(F-statistic)	0.000000

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**Dependent Variable: D(MST)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.134695	0.050167	-2.684908	0.0083
MST(-1)	-0.998488	0.079462	-12.56567	0.0000
MKT_P(-1)	0.564587	0.228564	2.470148	0.0149
MKT_N(-1)	0.465251	0.235417	1.976282	0.0505
USDZAR_P(-1)	-0.391122	0.190255	-2.055776	0.0420
USDZAR_N(-1)	-0.312909	0.192766	-1.623261	0.1072
ΔUSDZAR_P(-2)	0.510671	0.214569	2.379981	0.0189
ΔMKT_N(-9)	-0.963769	0.273024	-3.529976	0.0006
ΔMKT_P(-11)	0.487169	0.204994	2.376505	0.0191
ΔMKT_N(-1)	-0.524113	0.297039	-1.764461	0.0803
ΔUSDZAR_P(-6)	-0.735720	0.216388	-3.399997	0.0009
ΔMST(-9)	-0.176095	0.051336	-3.430234	0.0008
ΔUSDZAR_P(-9)	0.572807	0.223873	2.558621	0.0118
ΔUSDZAR_P(-8)	0.792894	0.247400	3.204915	0.0017
ΔMST(-7)	-0.121444	0.049694	-2.443834	0.0160
ΔMST(-12)	0.113265	0.053486	2.117672	0.0363
ΔUSDZAR_P(-11)	0.825965	0.279671	2.953348	0.0038
ΔUSDZAR_N(-11)	0.629660	0.288896	2.179537	0.0313
ΔMKT_P(-8)	-0.474078	0.240150	-1.974089	0.0507

$\Delta$ USDZAR_N(-9)	0.774934	0.309848	2.501014	0.0138
$\Delta$ MKT_P(-6)	0.358480	0.214602	1.670438	0.0975
$\Delta$ MST(-4)	-0.153528	0.053837	-2.851701	0.0051
$\Delta$ USDZAR_P(-10)	0.787614	0.297977	2.643203	0.0093
$\Delta$ USDZAR_P(-12)	0.536935	0.258857	2.074251	0.0402
$\Delta$ USDZAR_N(-10)	0.677620	0.303493	2.232733	0.0275
R-squared	0.746137			
F-statistic	14.32825			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(MTA)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.038305	0.043434	-0.881911	0.3795
MTA(-1)	-1.004779	0.083796	-11.99075	0.0000
MKT_P(-1)	1.504656	0.272761	5.516381	0.0000
MKT_N(-1)	1.290638	0.270858	4.765000	0.0000
USDZAR_P(-1)	-0.161472	0.172008	-0.938743	0.3496
USDZAR_N(-1)	0.055485	0.171692	0.323163	0.7471
$\Delta$ MKT_N	0.998999	0.266838	3.743841	0.0003
$\Delta$ MKT_P	0.876823	0.231822	3.782320	0.0002
$\Delta$ MKT_P(-12)	0.584898	0.171636	3.407775	0.0009
$\Delta$ USDZAR_P(-8)	0.437708	0.181646	2.409671	0.0174
$\Delta$ MKT_P(-3)	-0.370483	0.189129	-1.958893	0.0523
$\Delta$ MKT_P(-4)	-0.358653	0.187804	-1.909726	0.0584
$\Delta$ MKT_N(-1)	-0.448257	0.259648	-1.726405	0.0867
R-squared	0.636724			
F-statistic	18.84180			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(MTN)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.056062	0.032194	1.741378	0.0843
MTN(-1)	-1.332525	0.195503	-6.815895	0.0000
MKT_P(-1)	0.763787	0.188179	4.058831	0.0001
MKT_N(-1)	0.676287	0.187634	3.604291	0.0005
USDZAR_P(-1)	-0.822621	0.188624	-4.361179	0.0000
USDZAR_N(-1)	-0.721313	0.188604	-3.824488	0.0002
$\Delta$ MKT_P	1.083093	0.153060	7.076254	0.0000
$\Delta$ MKT_N	0.766407	0.183017	4.187623	0.0001
$\Delta$ MTN(-5)	0.506758	0.106570	4.755148	0.0000
$\Delta$ USDZAR_N	-0.776573	0.184168	-4.216652	0.0000
$\Delta$ MTN(-3)	0.537537	0.129268	4.158327	0.0001
$\Delta$ USDZAR_P	-0.597069	0.165041	-3.617711	0.0004
$\Delta$ MTN(-2)	0.313495	0.141493	2.215615	0.0287
$\Delta$ MKT_P(-3)	-0.465354	0.151121	-3.079346	0.0026

$\Delta$ MKT_P(-11)	-0.382933	0.124861	-3.066884	0.0027
$\Delta$ MKT_P(-5)	-0.403728	0.166963	-2.418067	0.0172
$\Delta$ USDZAR_P(-4)	0.345708	0.135830	2.545154	0.0122
$\Delta$ MTN(-4)	0.360275	0.116446	3.093922	0.0025
$\Delta$ MTN(-1)	0.406562	0.162926	2.495376	0.0140
$\Delta$ MKT_N(-6)	-0.566815	0.181825	-3.117365	0.0023
$\Delta$ USDZAR_P(-3)	0.272324	0.139161	1.956895	0.0528
$\Delta$ MTN(-7)	0.121911	0.065358	1.865292	0.0647
$\Delta$ MTN(-11)	0.116518	0.058337	1.997336	0.0481
$\Delta$ MTN(-6)	0.364901	0.091176	4.002164	0.0001
$\Delta$ MTN(-12)	0.152331	0.053453	2.849808	0.0052
$\Delta$ MKT_P(-4)	-0.364350	0.158698	-2.295868	0.0235

R-squared	0.777662
F-statistic	16.22916
Prob(F-statistic)	0.000000

#### Dependent Variable: D(MUR)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.022948	0.042959	-0.534174	0.5942
MUR(-1)	-0.886561	0.080356	-11.03296	0.0000
MKT_P(-1)	1.077718	0.243083	4.433545	0.0000
MKT_N(-1)	1.120512	0.247014	4.536223	0.0000
USDZAR_P(-1)	-0.764990	0.264509	-2.892108	0.0045
USDZAR_N(-1)	-0.795535	0.269715	-2.949540	0.0038
$\Delta$ MKT_P	0.823776	0.224697	3.666160	0.0004
$\Delta$ MKT_N	0.879358	0.264951	3.318944	0.0012
$\Delta$ MUR(-4)	-0.166690	0.055896	-2.982122	0.0034
$\Delta$ MKT_P(-12)	0.264915	0.164210	1.613268	0.1092
$\Delta$ USDZAR_N	-0.600521	0.265247	-2.264004	0.0253
$\Delta$ USDZAR_P	-0.527908	0.226362	-2.332135	0.0213
$\Delta$ MKT_P(-8)	-0.512063	0.179802	-2.847936	0.0051
$\Delta$ MKT_P(-7)	-0.408760	0.179234	-2.280594	0.0243
$\Delta$ USDZAR_N(-3)	-0.395329	0.179743	-2.199410	0.0297
$\Delta$ MUR(-10)	-0.104655	0.057107	-1.832624	0.0692

R-squared	0.618901
F-statistic	13.64154
Prob(F-statistic)	0.000000

#### Dependent Variable: D(NCS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.174335	0.092800	1.878606	0.0625
NCS(-1)	-1.380061	0.073587	-18.75419	0.0000
MKT_P(-1)	0.357322	0.424008	0.842723	0.4009
MKT_N(-1)	0.189461	0.439712	0.430875	0.6672

USDZAR_P(-1)	-0.878653	0.516691	-1.700540	0.0913
USDZAR_N(-1)	-0.690131	0.510460	-1.351979	0.1786
$\Delta$ USDZAR_P(-4)	-1.429892	0.442505	-3.231359	0.0015
$\Delta$ USDZAR_P(-8)	-1.934461	0.505750	-3.824936	0.0002
$\Delta$ USDZAR_N(-7)	-1.683466	0.514412	-3.272602	0.0014
$\Delta$ USDZAR_P	-1.548003	0.576340	-2.685920	0.0081
$\Delta$ MKT_P(-2)	0.806305	0.435938	1.849586	0.0666
R-squared	0.760297	Mean dependent var		-0.001165
F-statistic	42.81981	Durbin-Watson stat		2.093186
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(NHM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.152182	0.055019	-2.765984	0.0065
NHM(-1)	-1.128715	0.139590	-8.085951	0.0000
MKT_P(-1)	1.913851	0.343906	5.565033	0.0000
MKT_N(-1)	2.079216	0.352958	5.890839	0.0000
USDZAR_P(-1)	-0.843508	0.301900	-2.793999	0.0060
USDZAR_N(-1)	-1.010549	0.305000	-3.313277	0.0012
$\Delta$ MKT_P	1.551303	0.300244	5.166800	0.0000
$\Delta$ MKT_N	1.658688	0.357013	4.646016	0.0000
$\Delta$ USDZAR_P(-1)	1.292216	0.339861	3.802187	0.0002
$\Delta$ NHM(-2)	0.267806	0.102335	2.616948	0.0100
$\Delta$ USDZAR_P(-8)	-0.140742	0.205752	-0.684039	0.4952
$\Delta$ USDZAR_N(-4)	0.411282	0.237131	1.734408	0.0853
$\Delta$ MKT_N(-6)	0.746418	0.311638	2.395140	0.0181
$\Delta$ MKT_N(-4)	0.779305	0.339214	2.297381	0.0232
$\Delta$ NHM(-3)	0.191344	0.079778	2.398443	0.0179
$\Delta$ NHM(-9)	-0.090431	0.059453	-1.521037	0.1308
$\Delta$ NHM(-1)	0.213978	0.116181	1.841760	0.0679
$\Delta$ MKT_P(-5)	0.880542	0.332395	2.649079	0.0091
$\Delta$ MKT_N(-5)	-0.391449	0.295335	-1.325443	0.1874
R-squared	0.685180			
F-statistic	15.23492			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(NPK)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.005431	0.031620	-0.171763	0.8639
NPK(-1)	-0.885011	0.082206	-10.76584	0.0000
MKT_P(-1)	0.256418	0.163081	1.572337	0.1183
MKT_N(-1)	0.112845	0.161534	0.698585	0.4861
USDZAR_P(-1)	-0.162235	0.155312	-1.044578	0.2982
USDZAR_N(-1)	-0.018634	0.153132	-0.121683	0.9033

ΔNPK(-9)	-0.194682	0.058877	-3.306608	0.0012
ΔMKT_P	0.504046	0.171569	2.937868	0.0039
ΔUSDZAR_N(-5)	-0.419076	0.158282	-2.647653	0.0091
ΔUSDZAR_N(-10)	-0.306204	0.121919	-2.511538	0.0133
ΔUSDZAR_P	-0.349561	0.171675	-2.036181	0.0438
ΔUSDZAR_N(-6)	-0.291460	0.146474	-1.989833	0.0487
ΔMKT_N(-2)	0.296644	0.164777	1.800281	0.0742
ΔUSDZAR_N(-4)	-0.519335	0.186642	-2.782519	0.0062
ΔUSDZAR_N(-3)	-0.315649	0.149723	-2.108215	0.0370
ΔUSDZAR_P(-5)	-0.332440	0.194918	-1.705537	0.0905

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R-squared	0.597729
F-statistic	12.67958
Prob(F-statistic)	0.000000

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**Dependent Variable: D(NPN)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.063309	0.033113	-1.911895	0.0582
NPN(-1)	-1.025634	0.085051	-12.05900	0.0000
MKT_P(-1)	0.805472	0.230149	3.499780	0.0006
MKT_N(-1)	0.785533	0.230829	3.403096	0.0009
USDZAR_P(-1)	-0.569452	0.188884	-3.014822	0.0031
USDZAR_N(-1)	-0.559985	0.187458	-2.987255	0.0034
ΔMKT_P	1.150942	0.177409	6.487516	0.0000
ΔMKT_N	1.040432	0.215712	4.823247	0.0000
ΔUSDZAR_N(-3)	-0.427089	0.152599	-2.798768	0.0059
ΔNPN(-11)	-0.102290	0.051947	-1.969132	0.0512
ΔMKT_P(-1)	0.442569	0.222282	1.991028	0.0487
ΔUSDZAR_P(-3)	0.332050	0.152051	2.183808	0.0308
ΔMKT_P(-12)	0.280791	0.136084	2.063362	0.0411
ΔMKT_P(-11)	0.322968	0.173224	1.864456	0.0646
ΔMKT_N(-10)	0.388072	0.194407	1.996181	0.0481
ΔUSDZAR_P(-1)	0.386286	0.208920	1.848969	0.0668
ΔMKT_N(-2)	0.535775	0.197552	2.712068	0.0076

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R-squared	0.755951
F-statistic	24.19946
Prob(F-statistic)	0.000000

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**Dependent Variable: D(NTC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.067382	0.029264	-2.302572	0.0231
NTC(-1)	-0.654010	0.093657	-6.983061	0.0000
MKT_P(-1)	0.313047	0.187459	1.669948	0.0976
MKT_N(-1)	0.308669	0.190164	1.623177	0.1072
USDZAR_P(-1)	0.031632	0.204667	0.154551	0.8774
USDZAR_N(-1)	0.029719	0.211168	0.140735	0.8883
ΔMKT_N	1.022941	0.189607	5.395052	0.0000

ΔMKT_P	0.363890	0.159681	2.278866	0.0245
ΔUSDZAR_N	-0.341510	0.185832	-1.837731	0.0686
ΔUSDZAR_N(-10)	-0.206141	0.119948	-1.718589	0.0883
ΔNTC(-5)	0.192228	0.055871	3.440544	0.0008
ΔNTC(-12)	0.151720	0.053112	2.856605	0.0051
ΔMKT_N(-4)	-0.532184	0.176244	-3.019584	0.0031
ΔMKT_N(-5)	-0.601749	0.161373	-3.728941	0.0003
ΔUSDZAR_P(-9)	0.218640	0.120500	1.814433	0.0722
ΔNTC(-11)	0.127766	0.054153	2.359350	0.0200
ΔUSDZAR_P(-5)	-0.340279	0.134580	-2.528445	0.0128
ΔUSDZAR_N(-6)	-0.279849	0.133637	-2.094098	0.0384
ΔMKT_P(-3)	-0.381041	0.139967	-2.722366	0.0075
ΔUSDZAR_N(-1)	-0.724376	0.205663	-3.522149	0.0006
ΔUSDZAR_P(-2)	-0.857127	0.183985	-4.658685	0.0000
ΔNTC(-8)	0.091582	0.049533	1.848892	0.0670
ΔMKT_P(-1)	0.508391	0.183595	2.769086	0.0065
ΔUSDZAR_N(-3)	-0.339805	0.145030	-2.342996	0.0208
ΔNTC(-1)	-0.195701	0.069793	-2.804029	0.0059

R-squared	0.748235
F-statistic	14.48832
Prob(F-statistic)	0.000000

#### Dependent Variable: D(NWL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.034988	0.062967	-0.555649	0.5795
NWL(-1)	-1.015634	0.086513	-11.73962	0.0000
MKT_P(-1)	-0.142253	0.316529	-0.449417	0.6540
MKT_N(-1)	-0.113659	0.328939	-0.345533	0.7303
USDZAR_P(-1)	-0.751637	0.323326	-2.324699	0.0218
USDZAR_N(-1)	-0.791742	0.327552	-2.417150	0.0172
ΔMKT_N(-1)	0.688888	0.421462	1.634518	0.1048
ΔUSDZAR_N	-0.675707	0.327192	-2.065173	0.0411
ΔUSDZAR_N(-4)	0.523743	0.225015	2.327587	0.0217
ΔUSDZAR_P	-0.607366	0.274741	-2.210682	0.0290
ΔUSDZAR_P(-10)	0.456937	0.241487	1.892183	0.0609
ΔUSDZAR_P(-9)	1.458202	0.316689	4.604521	0.0000
ΔUSDZAR_N(-8)	0.913460	0.279838	3.264243	0.0014
ΔMKT_N	0.683464	0.317567	2.152186	0.0334
ΔMKT_N(-5)	-0.748463	0.271095	-2.760893	0.0067
ΔMKT_P(-8)	-0.856480	0.330133	-2.594346	0.0107
ΔMKT_N(-6)	-0.882678	0.290437	-3.039140	0.0029
ΔMKT_N(-7)	-0.876615	0.359103	-2.441122	0.0161
ΔMKT_N(-9)	-0.699006	0.395630	-1.766818	0.0799
ΔUSDZAR_N(-10)	0.642276	0.315328	2.036854	0.0439
ΔMKT_P(-2)	0.496917	0.295737	1.680265	0.0956
ΔUSDZAR_P(-12)	0.417821	0.212300	1.968065	0.0514
ΔUSDZAR_P(-11)	0.524804	0.281874	1.861836	0.0651
ΔMKT_P(-10)	-0.524599	0.275146	-1.906623	0.0590
ΔMKT_P(-9)	-0.481898	0.250016	-1.927470	0.0563

R-squared	0.662454
F-statistic	9.567479
Prob(F-statistic)	0.000000

**Dependent Variable: D(OCE)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.002772	0.036132	-0.076717	0.9390
OCE(-1)	-1.032333	0.083317	-12.39048	0.0000
MKT_P(-1)	-0.285995	0.200718	-1.424856	0.1569
MKT_N(-1)	-0.320357	0.205754	-1.556992	0.1222
USDZAR_P(-1)	0.217939	0.175324	1.243070	0.2163
USDZAR_N(-1)	0.245737	0.180953	1.358018	0.1771
$\Delta$ MKT_P(-2)	0.441932	0.172819	2.557199	0.0118
$\Delta$ MKT_P(-1)	0.948379	0.251047	3.777687	0.0003
$\Delta$ USDZAR_P(-12)	-0.325452	0.195000	-1.668984	0.0978
$\Delta$ USDZAR_P(-3)	-0.259763	0.158651	-1.637320	0.1043
$\Delta$ USDZAR_P(-7)	-0.378409	0.201290	-1.879920	0.0626
$\Delta$ OCE(-6)	0.161296	0.058328	2.765301	0.0066
$\Delta$ USDZAR_P(-11)	-0.461482	0.195159	-2.364645	0.0197
$\Delta$ MKT_N	0.519001	0.234258	2.215514	0.0287
$\Delta$ MKT_N(-2)	0.460293	0.234510	1.962787	0.0521
$\Delta$ MKT_N(-11)	-0.345586	0.178639	-1.934553	0.0555
$\Delta$ USDZAR_N(-9)	-0.597630	0.228744	-2.612654	0.0102
$\Delta$ USDZAR_N(-1)	-0.475186	0.201401	-2.359402	0.0200
$\Delta$ OCE(-8)	0.116660	0.054310	2.148041	0.0338
$\Delta$ USDZAR_P(-8)	-0.339873	0.187416	-1.813472	0.0723
$\Delta$ USDZAR_N(-10)	-0.623954	0.204104	-3.057047	0.0028
$\Delta$ USDZAR_P(-5)	-0.559957	0.173123	-3.234455	0.0016
$\Delta$ USDZAR_N(-6)	-0.565441	0.211166	-2.677703	0.0085
$\Delta$ MKT_P(-9)	0.287766	0.150875	1.907318	0.0590
$\Delta$ USDZAR_P(-10)	-0.467822	0.212725	-2.199185	0.0298
$\Delta$ USDZAR_N(-11)	-0.383995	0.214337	-1.791553	0.0758
R-squared	0.712253			
F-statistic	11.48529			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(OLG)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.039809	0.059360	0.670642	0.5037
OLG(-1)	-0.988412	0.078862	-12.53351	0.0000
MKT_P(-1)	0.295170	0.246884	1.195583	0.2341
MKT_N(-1)	0.218514	0.248772	0.878371	0.3814
USDZAR_P(-1)	-0.649059	0.293659	-2.210245	0.0289
USDZAR_N(-1)	-0.569506	0.300053	-1.898021	0.0600

ΔOLG(-9)	-0.085997	0.045558	-1.887650	0.0614
ΔOLG(-10)	-0.151290	0.060322	-2.508048	0.0134
ΔUSDZAR_P(-4)	0.633183	0.268858	2.355080	0.0201
0	-0.084510	0.041267	-2.047881	0.0426
ΔMKT_P(-4)	-0.586093	0.266964	-2.195398	0.0300
ΔMKT_N(-8)	-0.951601	0.363703	-2.616422	0.0100
ΔMKT_N(-9)	-0.852035	0.320764	-2.656273	0.0089
ΔOLG(-11)	-0.141910	0.059617	-2.380348	0.0188
ΔMKT_P(-7)	-0.592680	0.291706	-2.031772	0.0443
ΔUSDZAR_N(-1)	0.680698	0.332539	2.046970	0.0427

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R-squared	0.616386
F-statistic	13.49701
Prob(F-statistic)	0.000000

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**Dependent Variable: D(OMN)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.026464	0.040600	-0.651812	0.5160
OMN(-1)	-1.410871	0.152795	-9.233759	0.0000
MKT_P(-1)	1.529799	0.292177	5.235857	0.0000
MKT_N(-1)	1.244715	0.283030	4.397823	0.0000
USDZAR_P(-1)	-1.063232	0.230670	-4.609323	0.0000
USDZAR_N(-1)	-0.776196	0.219070	-3.543139	0.0006
ΔMKT_P	0.528171	0.186919	2.825671	0.0057
ΔMKT_N	0.833252	0.219226	3.800885	0.0002
ΔMKT_P(-1)	-0.541368	0.262945	-2.058865	0.0420
ΔOMN(-2)	0.231026	0.082331	2.806068	0.0060
ΔUSDZAR_P	-0.528190	0.180880	-2.920117	0.0043
ΔOMN(-9)	-0.194252	0.069636	-2.789522	0.0063
ΔUSDZAR_N(-10)	-0.458456	0.136549	-3.357440	0.0011
ΔUSDZAR_N(-11)	-0.838715	0.179990	-4.659781	0.0000
ΔUSDZAR_P(-1)	1.201577	0.238928	5.029043	0.0000
ΔMKT_P(-7)	-0.716531	0.171763	-4.171618	0.0001
ΔUSDZAR_P(-6)	-0.793404	0.194354	-4.082256	0.0001
ΔMKT_P(-3)	-0.643994	0.226111	-2.848131	0.0053
ΔMKT_P(-8)	-0.890238	0.207032	-4.299997	0.0000
ΔUSDZAR_N(-7)	-0.482107	0.157911	-3.053037	0.0029
ΔUSDZAR_P(-2)	0.469238	0.163661	2.867133	0.0050
ΔMKT_N(-2)	-0.595758	0.293340	-2.030950	0.0448
ΔMKT_P(-6)	-0.304373	0.169951	-1.790946	0.0762
ΔUSDZAR_P(-12)	-0.429641	0.164134	-2.617627	0.0102
ΔMKT_N(-4)	-0.297510	0.184175	-1.615369	0.1093
ΔOMN(-11)	-0.153626	0.085831	-1.789871	0.0764
ΔOMN(-1)	0.278753	0.123116	2.264151	0.0256
ΔMKT_N(-8)	-0.465283	0.216231	-2.151782	0.0337
ΔUSDZAR_P(-3)	0.377478	0.144970	2.603835	0.0106
ΔMKT_P(-10)	-0.750359	0.203503	-3.687221	0.0004
ΔMKT_N(-9)	-1.170463	0.270083	-4.333711	0.0000
ΔUSDZAR_N(-5)	-0.515761	0.180282	-2.860852	0.0051
ΔMKT_N(-7)	-0.557350	0.237611	-2.345639	0.0209
ΔMKT_N(-1)	-0.793111	0.324888	-2.441181	0.0163
ΔMKT_N(-11)	-0.368740	0.215461	-1.711404	0.0900

$\Delta$ OMN(-12)	-0.166525	0.071632	-2.324746	0.0220
$\Delta$ OMN(-10)	-0.193546	0.085292	-2.269217	0.0253
$\Delta$ MKT_P(-2)	-0.435717	0.228948	-1.903127	0.0598

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R-squared	0.804567
F-statistic	11.57170
Prob(F-statistic)	0.000000

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**Dependent Variable: D(PET)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.009691	0.052613	-0.184201	0.8542
PET(-1)	-1.132865	0.079880	-14.18213	0.0000
MKT_P(-1)	1.290023	0.260283	4.956223	0.0000
MKT_N(-1)	1.269935	0.257611	4.929660	0.0000
USDZAR_P(-1)	-0.603916	0.243582	-2.479314	0.0146
USDZAR_N(-1)	-0.564614	0.244146	-2.312612	0.0225
$\Delta$ MKT_P	1.442907	0.268157	5.380830	0.0000
$\Delta$ USDZAR_N(-6)	0.641587	0.297661	2.155430	0.0331
$\Delta$ MKT_N(-5)	-0.698705	0.282861	-2.470137	0.0149
$\Delta$ MKT_P(-7)	-0.518193	0.212898	-2.434001	0.0164
$\Delta$ USDZAR_P	-0.566159	0.271374	-2.086267	0.0391
$\Delta$ USDZAR_N(-3)	0.420442	0.223931	1.877554	0.0629
$\Delta$ USDZAR_P(-7)	0.852502	0.328333	2.596454	0.0106
$\Delta$ USDZAR_P(-12)	-0.350454	0.191308	-1.831887	0.0695
$\Delta$ USDZAR_P(-8)	0.738040	0.251789	2.931189	0.0040
$\Delta$ USDZAR_P(-9)	1.025668	0.257014	3.990714	0.0001
$\Delta$ USDZAR_N(-8)	0.734493	0.301522	2.435952	0.0163
$\Delta$ MKT_P(-11)	0.854765	0.298748	2.861158	0.0050
$\Delta$ MKT_N(-10)	0.588608	0.321481	1.830926	0.0696
$\Delta$ USDZAR_N(-5)	0.394723	0.234529	1.683046	0.0950
$\Delta$ MKT_N(-12)	0.647377	0.280302	2.309568	0.0226
$\Delta$ PET(-4)	0.097098	0.053661	1.809480	0.0729
$\Delta$ MKT_P(-4)	-0.466608	0.253410	-1.841320	0.0681

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R-squared	0.737043
F-statistic	15.16116
Prob(F-statistic)	0.000000

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**Dependent Variable: D(PIK)**

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Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.006172	0.034176	0.180595	0.8570
PIK(-1)	-1.041179	0.114245	-9.113543	0.0000
MKT_P(-1)	-0.281634	0.236030	-1.193212	0.2353
MKT_N(-1)	-0.268298	0.238196	-1.126376	0.2624
USDZAR_P(-1)	-0.355938	0.189688	-1.876444	0.0632
USDZAR_N(-1)	-0.371723	0.184955	-2.009808	0.0468
$\Delta$ MKT_N	0.933235	0.187825	4.968651	0.0000
$\Delta$ MKT_P(-2)	0.802732	0.227469	3.528972	0.0006
$\Delta$ MKT_P(-1)	0.932539	0.245103	3.804677	0.0002

$\Delta$ MKT_P(-5)	0.444782	0.131737	3.376280	0.0010
$\Delta$ USDZAR_P(-2)	0.288645	0.134522	2.145714	0.0340
$\Delta$ USDZAR_P(-9)	0.316795	0.106318	2.979701	0.0035
$\Delta$ MKT_P(-4)	0.462004	0.187191	2.468082	0.0151
$\Delta$ PIK(-12)	-0.208565	0.064503	-3.233429	0.0016
$\Delta$ USDZAR_P(-11)	0.298801	0.118077	2.530564	0.0128
$\Delta$ USDZAR_P(-12)	-0.322265	0.136809	-2.355584	0.0202
$\Delta$ USDZAR_P	-0.340893	0.155301	-2.195041	0.0302
$\Delta$ MKT_N(-12)	0.274081	0.149108	1.838142	0.0687
$\Delta$ MKT_P	0.421416	0.157635	2.673358	0.0086
$\Delta$ PIK(-1)	0.156041	0.082082	1.901029	0.0598
$\Delta$ MKT_N(-2)	0.862909	0.258390	3.339559	0.0011
$\Delta$ MKT_P(-3)	0.469617	0.186353	2.520043	0.0131
$\Delta$ USDZAR_P(-1)	0.448624	0.196130	2.287377	0.0240
$\Delta$ PIK(-11)	-0.112639	0.063736	-1.767277	0.0799
$\Delta$ MKT_N(-1)	0.725527	0.274492	2.643162	0.0094
$\Delta$ USDZAR_N(-11)	-0.385718	0.142803	-2.701056	0.0080
$\Delta$ USDZAR_P(-5)	-0.414683	0.135996	-3.049229	0.0029
$\Delta$ USDZAR_N(-6)	-0.242313	0.130912	-1.850965	0.0668
$\Delta$ MKT_N(-3)	0.606285	0.237569	2.552040	0.0120
R-squared	0.735457			
F-statistic	11.21970			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(PNC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.013796	0.056862	0.242623	0.8087
PNC(-1)	-0.836277	0.079233	-10.55462	0.0000
MKT_P(-1)	1.612266	0.324576	4.967292	0.0000
MKT_N(-1)	1.477655	0.328401	4.499540	0.0000
USDZAR_P(-1)	-0.800411	0.353120	-2.266681	0.0252
USDZAR_N(-1)	-0.650255	0.363820	-1.787300	0.0765
$\Delta$ MKT_P	0.965948	0.286516	3.371358	0.0010
$\Delta$ USDZAR_P(-10)	-0.965899	0.225182	-4.289423	0.0000
$\Delta$ MKT_N	1.080498	0.329885	3.275375	0.0014
$\Delta$ USDZAR_P(-7)	0.637585	0.303362	2.101731	0.0377
$\Delta$ USDZAR_P(-1)	1.233539	0.384989	3.204092	0.0017
$\Delta$ MKT_N(-1)	-0.984866	0.311014	-3.166629	0.0020
$\Delta$ USDZAR_N(-1)	0.503734	0.292502	1.722155	0.0877
$\Delta$ MKT_P(-8)	-0.718520	0.235846	-3.046559	0.0029
$\Delta$ MKT_P(-7)	-0.618040	0.232058	-2.663305	0.0088
$\Delta$ USDZAR_P(-12)	-0.698528	0.255959	-2.729056	0.0073
$\Delta$ USDZAR_N(-2)	0.549643	0.282122	1.948245	0.0538
$\Delta$ PNC(-8)	0.077431	0.040205	1.925908	0.0565
$\Delta$ USDZAR_N(-11)	-0.565187	0.283110	-1.996353	0.0482
$\Delta$ MKT_P(-11)	0.523160	0.216543	2.415965	0.0172
$\Delta$ USDZAR_N(-12)	0.388728	0.226518	1.716105	0.0888
$\Delta$ USDZAR_N(-4)	-0.393857	0.220314	-1.787709	0.0764
$\Delta$ USDZAR_N(-6)	0.580933	0.267379	2.172698	0.0318
$\Delta$ USDZAR_P(-8)	0.449524	0.249546	1.801366	0.0742
$\Delta$ MKT_P(-10)	0.627013	0.226630	2.766684	0.0066

R-squared	0.675713
F-statistic	10.15797
Prob(F-statistic)	0.000000

**Dependent Variable: D(PPC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.024480	0.039333	-0.622377	0.5348
PPC(-1)	-0.995956	0.080392	-12.38870	0.0000
MKT_P(-1)	0.519802	0.200572	2.591598	0.0107
MKT_N(-1)	0.453053	0.198452	2.282934	0.0241
USDZAR_P(-1)	-0.316505	0.195856	-1.616008	0.1086
USDZAR_N(-1)	-0.241917	0.193976	-1.247148	0.2147
$\Delta$ MKT_P	0.725589	0.213860	3.392819	0.0009
$\Delta$ PPC(-6)	-0.145967	0.062191	-2.347061	0.0205
$\Delta$ USDZAR_N(-10)	-0.457485	0.174099	-2.627729	0.0097
$\Delta$ USDZAR_N(-7)	-0.187843	0.173408	-1.083247	0.2808
$\Delta$ USDZAR_P	-0.509486	0.216448	-2.353845	0.0201
$\Delta$ USDZAR_N(-3)	-0.370865	0.170670	-2.172993	0.0317
$\Delta$ USDZAR_N(-8)	-0.458609	0.226407	-2.025596	0.0449
$\Delta$ PPC(-9)	-0.188162	0.065525	-2.871614	0.0048
$\Delta$ PPC(-2)	0.133250	0.056369	2.363907	0.0196
$\Delta$ MKT_P(-7)	-0.658043	0.193510	-3.400567	0.0009
$\Delta$ MKT_N(-8)	-0.822588	0.232341	-3.540438	0.0006
$\Delta$ USDZAR_N(-6)	-0.231989	0.172318	-1.346284	0.1806
$\Delta$ USDZAR_P(-9)	-0.581413	0.229457	-2.533862	0.0125
R-squared	0.660548			
F-statistic	13.51336			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(PPR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.038419	0.042295	0.908364	0.3655
PPR(-1)	-1.176530	0.076256	-15.42873	0.0000
MKT_P(-1)	-0.799653	0.254618	-3.140597	0.0021
MKT_N(-1)	-0.893017	0.260830	-3.423746	0.0008
USDZAR_P(-1)	-0.212927	0.164920	-1.291092	0.1991
USDZAR_N(-1)	-0.120251	0.165915	-0.724775	0.4700
$\Delta$ USDZAR_P(-9)	0.476096	0.164243	2.898736	0.0044
$\Delta$ PPR(-10)	-0.127973	0.066019	-1.938440	0.0549
$\Delta$ USDZAR_P(-8)	0.349155	0.188685	1.850464	0.0667
$\Delta$ MKT_P(-6)	1.066381	0.241470	4.416205	0.0000
$\Delta$ MKT_N(-5)	0.656414	0.259954	2.525116	0.0128
$\Delta$ MKT_P(-1)	0.768389	0.238713	3.218877	0.0016
$\Delta$ MKT_P(-2)	0.988991	0.242802	4.073240	0.0001
$\Delta$ MKT_N(-1)	1.139825	0.325296	3.503959	0.0006

$\Delta$ MKT_N(-7)	0.600315	0.237784	2.524622	0.0129
$\Delta$ MKT_P(-11)	0.330719	0.160147	2.065102	0.0410
$\Delta$ PPR(-11)	-0.141374	0.065188	-2.168712	0.0320
$\Delta$ MKT_P(-5)	0.421994	0.190555	2.214554	0.0286
$\Delta$ USDZAR_N(-11)	-0.401452	0.199883	-2.008434	0.0468
$\Delta$ USDZAR_P(-12)	-0.396060	0.198268	-1.997595	0.0480
R-squared	0.710499	Mean dependent var		-0.000312
F-statistic	15.75864	Durbin-Watson stat		2.012166
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(RCL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.016140	0.033112	-0.487455	0.6268
RCL(-1)	-1.431637	0.202674	-7.063730	0.0000
MKT_P(-1)	0.731941	0.196714	3.720833	0.0003
MKT_N(-1)	0.804294	0.202267	3.976404	0.0001
USDZAR_P(-1)	-0.855769	0.203754	-4.200011	0.0001
USDZAR_N(-1)	-0.922015	0.205653	-4.483347	0.0000
$\Delta$ MKT_N	1.009258	0.208568	4.838986	0.0000
$\Delta$ RCL(-4)	0.216733	0.105127	2.061644	0.0414
$\Delta$ MKT_P(-12)	0.485497	0.139714	3.474935	0.0007
$\Delta$ USDZAR_P(-2)	0.448090	0.164083	2.730864	0.0073
$\Delta$ USDZAR_P(-1)	0.934505	0.264505	3.533039	0.0006
$\Delta$ USDZAR_N(-12)	0.410516	0.138630	2.961234	0.0037
$\Delta$ USDZAR_P(-12)	-0.483701	0.140806	-3.435224	0.0008
$\Delta$ MKT_N(-1)	-0.520012	0.206574	-2.517319	0.0132
$\Delta$ RCL(-12)	0.095232	0.048541	1.961877	0.0521
$\Delta$ USDZAR_P(-3)	0.368225	0.202391	1.819372	0.0714
$\Delta$ RCL(-2)	0.301540	0.155058	1.944691	0.0542
$\Delta$ RCL(-5)	0.166373	0.073577	2.261203	0.0256
$\Delta$ MKT_N(-7)	-0.337754	0.166886	-2.023859	0.0452
$\Delta$ USDZAR_N(-2)	0.489253	0.217920	2.245100	0.0266
$\Delta$ RCL(-3)	0.208959	0.127521	1.638622	0.1039
$\Delta$ RCL(-1)	0.333385	0.179197	1.860435	0.0653
$\Delta$ USDZAR_N(-4)	0.340852	0.174820	1.949732	0.0536
R-squared	0.752411			
F-statistic	16.43798			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(RDF)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.045432	0.037216	1.220755	0.2247
RDF(-1)	-0.782024	0.082745	-9.450977	0.0000
MKT_P(-1)	-0.222789	0.217430	-1.024650	0.3077
MKT_N(-1)	-0.182906	0.222878	-0.820657	0.4136

USDZAR_P(-1)	-0.616592	0.231344	-2.665261	0.0088
USDZAR_N(-1)	-0.654015	0.234933	-2.783833	0.0063
$\Delta$ USDZAR_N	-0.672890	0.201360	-3.341723	0.0011
$\Delta$ RAF(-9)	-0.159767	0.055098	-2.899668	0.0045
$\Delta$ USDZAR_P(-5)	-0.387309	0.174531	-2.219145	0.0285
$\Delta$ USDZAR_N(-12)	0.326877	0.144634	2.260038	0.0257
$\Delta$ MKT_P	0.544037	0.184384	2.950571	0.0039
$\Delta$ MKT_N(-1)	0.884738	0.209483	4.223433	0.0000
$\Delta$ MKT_N(-4)	-0.723112	0.177323	-4.077930	0.0001
$\Delta$ USDZAR_P	-0.501947	0.176673	-2.841106	0.0053
$\Delta$ MKT_N	0.594599	0.204301	2.910409	0.0043
$\Delta$ MKT_N(-2)	0.548183	0.198930	2.755658	0.0068
$\Delta$ USDZAR_N(-8)	0.396134	0.162338	2.440183	0.0162
$\Delta$ USDZAR_N(-3)	-0.684948	0.208865	-3.279380	0.0014
$\Delta$ USDZAR_P(-9)	0.460320	0.180986	2.543408	0.0123
$\Delta$ USDZAR_N(-1)	-0.384635	0.234631	-1.639316	0.1039
$\Delta$ MKT_P(-4)	0.277865	0.155919	1.782116	0.0774
$\Delta$ MKT_N(-9)	0.445400	0.195590	2.277205	0.0247
$\Delta$ MKT_P(-10)	0.294468	0.157539	1.869175	0.0642
$\Delta$ USDZAR_N(-4)	-0.343609	0.184231	-1.865100	0.0648
$\Delta$ USDZAR_P(-2)	-0.585952	0.210994	-2.777105	0.0064
$\Delta$ MKT_P(-1)	0.470751	0.225976	2.083187	0.0395
$\Delta$ USDZAR_P(-11)	0.790528	0.182249	4.337637	0.0000
$\Delta$ USDZAR_P(-4)	-0.429578	0.193695	-2.217807	0.0286
$\Delta$ USDZAR_N(-10)	0.675530	0.188164	3.590112	0.0005
R-squared	0.695254			
F-statistic	9.207163			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(REM)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.104223	0.046457	-2.243407	0.0270
REM(-1)	-2.140672	0.214239	-9.991994	0.0000
MKT_P(-1)	3.651847	0.485007	7.529466	0.0000
MKT_N(-1)	3.492217	0.472405	7.392428	0.0000
USDZAR_P(-1)	-2.895752	0.477213	-6.068047	0.0000
USDZAR_N(-1)	-2.748575	0.482515	-5.696357	0.0000
$\Delta$ MKT_P	1.830284	0.215280	8.501881	0.0000
$\Delta$ MKT_N	0.635520	0.238071	2.669454	0.0088
$\Delta$ MKT_P(-8)	-0.985706	0.200379	-4.919205	0.0000
$\Delta$ MKT_N(-9)	-0.386571	0.210068	-1.840220	0.0686
$\Delta$ USDZAR_N(-2)	1.111311	0.353450	3.144180	0.0022
$\Delta$ USDZAR_P	-0.461803	0.198961	-2.321069	0.0222
$\Delta$ USDZAR_P(-1)	2.255865	0.455013	4.957807	0.0000
$\Delta$ MKT_P(-3)	-0.763007	0.272921	-2.795702	0.0062
$\Delta$ MKT_N(-1)	-1.069672	0.424010	-2.522754	0.0131
$\Delta$ USDZAR_N	-0.613282	0.227529	-2.695404	0.0082
$\Delta$ USDZAR_P(-6)	0.456693	0.247299	1.846722	0.0676
$\Delta$ MKT_P(-1)	-1.825750	0.386142	-4.728178	0.0000
$\Delta$ USDZAR_N(-6)	0.334478	0.173246	1.930659	0.0562

ΔMKT_N(-2)	-0.912956	0.344123	-2.652990	0.0092
ΔUSDZAR_N(-1)	1.641812	0.420111	3.908043	0.0002
ΔUSDZAR_P(-3)	0.865287	0.327389	2.642992	0.0095
ΔUSDZAR_N(-5)	0.979843	0.267934	3.657035	0.0004
ΔREM(-8)	0.112155	0.054814	2.046093	0.0432
ΔMKT_P(-12)	0.550835	0.177174	3.108999	0.0024
ΔREM(-1)	0.845820	0.175852	4.809851	0.0000
ΔUSDZAR_P(-8)	0.606028	0.203140	2.983306	0.0035
ΔMKT_N(-11)	0.562697	0.218412	2.576310	0.0114
ΔUSDZAR_P(-4)	1.189963	0.281735	4.223702	0.0001
ΔMKT_P(-4)	-0.328794	0.176391	-1.864004	0.0651
ΔREM(-3)	0.289052	0.083288	3.470520	0.0008
ΔMKT_P(-2)	-0.839503	0.280573	-2.992107	0.0035
ΔREM(-2)	0.540287	0.126218	4.280588	0.0000
ΔUSDZAR_N(-3)	1.158409	0.294428	3.934444	0.0002
ΔUSDZAR_P(-2)	1.725543	0.403815	4.273106	0.0000
ΔUSDZAR_N(-7)	0.725977	0.224489	3.233902	0.0016
ΔUSDZAR_N(-4)	0.489709	0.210615	2.325142	0.0220

R-squared	0.843774
F-statistic	15.75288
Prob(F-statistic)	0.000000

#### Dependent Variable: D(RLO)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.027238	0.030332	-0.897981	0.3710
RLO(-1)	-1.027983	0.081598	-12.59814	0.0000
MKT_P(-1)	0.937319	0.177725	5.273992	0.0000
MKT_N(-1)	0.874525	0.177193	4.935434	0.0000
USDZAR_P(-1)	-0.780030	0.187113	-4.168773	0.0001
USDZAR_N(-1)	-0.714300	0.190300	-3.753545	0.0003
ΔMKT_P	0.801879	0.162306	4.940533	0.0000
ΔUSDZAR_N	-0.605504	0.187772	-3.224678	0.0016
ΔUSDZAR_P	-0.447552	0.162303	-2.757502	0.0067
ΔUSDZAR_P(-11)	0.557276	0.159304	3.498205	0.0007
ΔUSDZAR_P(-5)	-0.285594	0.171602	-1.664281	0.0986
ΔRLO(-8)	-0.099827	0.055247	-1.806939	0.0732
ΔUSDZAR_N(-10)	0.310376	0.148937	2.083940	0.0392
ΔUSDZAR_N(-12)	0.254799	0.133372	1.910437	0.0584
ΔMKT_N	0.304125	0.186056	1.634589	0.1047
ΔMKT_P(-6)	0.249008	0.127070	1.959613	0.0523
ΔUSDZAR_N(-3)	-0.251172	0.141968	-1.769219	0.0793
ΔUSDZAR_N(-4)	-0.383660	0.172705	-2.221478	0.0281
ΔUSDZAR_P(-6)	-0.284096	0.144662	-1.963853	0.0518

R-squared	0.666202
F-statistic	13.63812
Prob(F-statistic)	0.000000

**Dependent Variable: D(RTO)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.091300	0.042449	2.150819	0.0334
RTO(-1)	-1.027388	0.079399	-12.93953	0.0000
MKT_P(-1)	-0.530731	0.256284	-2.070875	0.0404
MKT_N(-1)	-0.647912	0.260352	-2.488594	0.0141
USDZAR_P(-1)	-0.400013	0.172092	-2.324412	0.0217
USDZAR_N(-1)	-0.272487	0.174728	-1.559497	0.1214
DMKT_N	-0.738009	0.268075	-2.752997	0.0068
DMKT_N(-1)	0.662561	0.267564	2.476274	0.0146
DMKT_P(-12)	0.554308	0.169995	3.260733	0.0014
DUSDZAR_P(-9)	1.062119	0.238970	4.444566	0.0000
DRTO(-4)	0.155279	0.062038	2.502949	0.0136
DRTO(-3)	0.144549	0.060756	2.379179	0.0189
DMKT_P	0.500869	0.240449	2.083055	0.0393
DUSDZAR_N(-8)	0.734691	0.225813	3.253540	0.0015
DUSDZAR_N(-10)	0.407126	0.185399	2.195946	0.0299
DRTO(-12)	0.109268	0.051089	2.138784	0.0344
DRTO(-7)	0.091847	0.053562	1.714783	0.0889
R-squared	0.660144			
F-statistic	15.17517			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SAP)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.203879	0.040846	-4.991418	0.0000
SAP(-1)	-1.031799	0.076767	-13.44065	0.0000
MKT_P(-1)	2.020626	0.249766	8.090064	0.0000
MKT_N(-1)	1.991329	0.251128	7.929549	0.0000
USDZAR_P(-1)	-0.125143	0.162587	-0.769699	0.4429
USDZAR_N(-1)	-0.113458	0.161797	-0.701237	0.4844
$\Delta$ MKT_P	1.524289	0.218692	6.970027	0.0000
$\Delta$ MKT_N	1.149008	0.252790	4.545307	0.0000
$\Delta$ MKT_N(-6)	-0.364027	0.215705	-1.687614	0.0939
$\Delta$ MKT_P(-3)	-0.468747	0.196419	-2.386473	0.0185
$\Delta$ SAP(-10)	0.173211	0.049671	3.487169	0.0007
$\Delta$ SAP(-6)	-0.219552	0.056890	-3.859221	0.0002
$\Delta$ MKT_P(-6)	0.763315	0.199328	3.829437	0.0002
$\Delta$ SAP(-4)	0.134113	0.050701	2.645152	0.0092
$\Delta$ SAP(-7)	-0.106800	0.053743	-1.987220	0.0490
$\Delta$ MKT_N(-4)	-0.408416	0.226466	-1.803430	0.0737
$\Delta$ MKT_N(-8)	0.325407	0.190966	1.704006	0.0908
R-squared	0.756200			
F-statistic	24.61996			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SBV)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.028911	0.053940	-0.535990	0.5930
SBV(-1)	-1.348691	0.137734	-9.792016	0.0000
MKT_P(-1)	0.517552	0.217298	2.381764	0.0188
MKT_N(-1)	0.345867	0.223538	1.547240	0.1245
USDZAR_P(-1)	0.074910	0.278166	0.269301	0.7882
USDZAR_N(-1)	0.242802	0.284448	0.853590	0.3951
$\Delta$ USDZAR_P(-3)	-1.888828	0.382773	-4.934588	0.0000
$\Delta$ MKT_N(-7)	-0.962644	0.318830	-3.019298	0.0031
$\Delta$ USDZAR_N(-6)	-1.144076	0.291115	-3.929979	0.0001
$\Delta$ USDZAR_N(-11)	-0.714934	0.229124	-3.120291	0.0023
$\Delta$ SBV(-1)	0.439825	0.109012	4.034644	0.0001
$\Delta$ SBV(-2)	0.220908	0.079913	2.764340	0.0066
$\Delta$ USDZAR_N(-1)	-1.331931	0.411838	-3.234115	0.0016
$\Delta$ MKT_N(-9)	0.956141	0.367102	2.604565	0.0104
$\Delta$ USDZAR_N(-4)	-0.895526	0.380688	-2.352390	0.0203
$\Delta$ USDZAR_P(-5)	-0.764326	0.372603	-2.051313	0.0425
$\Delta$ USDZAR_N(-2)	-0.668398	0.339708	-1.967566	0.0515
$\Delta$ MKT_P(-10)	0.756932	0.292474	2.588034	0.0109
$\Delta$ MKT_P(-5)	-0.652815	0.320523	-2.036716	0.0439
$\Delta$ MKT_P(-6)	-1.230538	0.378426	-3.251727	0.0015
$\Delta$ MKT_N(-5)	-1.121638	0.392026	-2.861135	0.0050
$\Delta$ MKT_N(-2)	-0.715685	0.360303	-1.986342	0.0493
$\Delta$ USDZAR_P(-2)	-0.609666	0.342805	-1.778461	0.0779
$\Delta$ MKT_P(-3)	-1.201664	0.371221	-3.237053	0.0016
$\Delta$ MKT_N(-4)	-1.030806	0.441804	-2.333176	0.0213
R-squared	0.686758			
F-statistic	10.77940			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SHP)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.126617	0.033047	3.831466	0.0002
SHP(-1)	-0.988858	0.081512	-12.13146	0.0000
MKT_P(-1)	-0.363954	0.180693	-2.014219	0.0463
MKT_N(-1)	-0.429700	0.186702	-2.301535	0.0232
USDZAR_P(-1)	-0.881465	0.224136	-3.932719	0.0001
USDZAR_N(-1)	-0.803024	0.221618	-3.623456	0.0004

$\Delta$ USDZAR_P(-8)	-0.306904	0.152558	-2.011725	0.0466
$\Delta$ USDZAR_N(-5)	-0.464854	0.164477	-2.826260	0.0056
$\Delta$ USDZAR_N(-9)	-0.835667	0.190340	-4.390381	0.0000
$\Delta$ SHP(-9)	-0.215655	0.058066	-3.713950	0.0003
$\Delta$ SHP(-11)	-0.105297	0.058259	-1.807401	0.0733
$\Delta$ MKT_N	0.526719	0.211447	2.491024	0.0142
$\Delta$ USDZAR_P(-10)	-0.436817	0.187136	-2.334227	0.0213
$\Delta$ MKT_P(-1)	0.669932	0.221917	3.018841	0.0031
$\Delta$ MKT_N(-2)	0.490646	0.210437	2.331555	0.0215
$\Delta$ USDZAR_P	-0.619500	0.173703	-3.566433	0.0005
$\Delta$ MKT_P(-2)	0.398899	0.150878	2.643850	0.0093
$\Delta$ USDZAR_N(-11)	-0.401244	0.184575	-2.173881	0.0318
$\Delta$ USDZAR_P(-1)	0.903845	0.245591	3.680292	0.0004
$\Delta$ USDZAR_N(-2)	0.697594	0.208255	3.349716	0.0011
$\Delta$ USDZAR_N(-10)	-0.433574	0.153748	-2.820024	0.0057
$\Delta$ USDZAR_P(-6)	-0.504501	0.156786	-3.217773	0.0017
$\Delta$ USDZAR_P(-3)	0.383004	0.175421	2.183337	0.0310
$\Delta$ SHP(-10)	-0.147697	0.071369	-2.069477	0.0407
$\Delta$ USDZAR_N(-12)	0.301668	0.138452	2.178864	0.0314
$\Delta$ USDZAR_P(-12)	-0.500404	0.162346	-3.082330	0.0026
$\Delta$ SHP(-3)	0.126294	0.051837	2.436356	0.0164
R-squared	0.754999			
F-statistic	13.63021			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SNH)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.166098	0.040352	-4.116229	0.0001
SNH(-1)	-1.126023	0.076704	-14.68001	0.0000
MKT_P(-1)	1.741974	0.216665	8.039958	0.0000
MKT_N(-1)	1.783425	0.220692	8.081063	0.0000
USDZAR_P(-1)	-1.804045	0.340490	-5.298373	0.0000
USDZAR_N(-1)	-1.869563	0.346885	-5.389576	0.0000
$\Delta$ MKT_P	0.897664	0.184002	4.878567	0.0000
$\Delta$ MKT_N	1.071143	0.206488	5.187437	0.0000
$\Delta$ MKT_N(-1)	-0.621409	0.202157	-3.073895	0.0027
$\Delta$ USDZAR_P(-1)	1.804835	0.341488	5.285214	0.0000
$\Delta$ USDZAR_P(-7)	0.474607	0.186489	2.544966	0.0123
$\Delta$ MKT_P(-12)	-0.527974	0.187334	-2.818362	0.0057
$\Delta$ USDZAR_P(-4)	1.339343	0.251956	5.315780	0.0000
$\Delta$ SNH(-9)	-0.213875	0.052360	-4.084701	0.0001
$\Delta$ USDZAR_N(-5)	0.575449	0.184228	3.123575	0.0023
$\Delta$ MKT_N(-7)	-0.457802	0.225239	-2.032518	0.0446
$\Delta$ USDZAR_N(-6)	0.530770	0.197200	2.691535	0.0082
$\Delta$ MKT_N(-5)	-0.329286	0.180640	-1.822887	0.0711
$\Delta$ MKT_P(-8)	-0.646358	0.187682	-3.443905	0.0008
$\Delta$ USDZAR_N(-2)	1.311760	0.299539	4.379266	0.0000
$\Delta$ MKT_N(-11)	-0.874569	0.252273	-3.466751	0.0008
$\Delta$ SNH(-4)	-0.194882	0.057510	-3.388687	0.0010
$\Delta$ SNH(-3)	-0.206162	0.056191	-3.668977	0.0004

$\Delta$ USDZAR_N(-3)	1.042040	0.261717	3.981546	0.0001
$\Delta$ MKT_P(-10)	-0.294413	0.167898	-1.753527	0.0823
$\Delta$ MKT_N(-12)	0.558062	0.177804	3.138632	0.0022
$\Delta$ MKT_N(-10)	-0.794149	0.225818	-3.516766	0.0006
$\Delta$ MKT_N(-8)	-0.879165	0.286140	-3.072506	0.0027
$\Delta$ MKT_N(-6)	-0.392720	0.229409	-1.711876	0.0898
$\Delta$ MKT_P(-9)	-0.912523	0.233627	-3.905901	0.0002
$\Delta$ USDZAR_N(-1)	1.438327	0.333818	4.308721	0.0000
$\Delta$ USDZAR_P(-3)	1.173068	0.257652	4.552920	0.0000
$\Delta$ MKT_P(-7)	-0.512183	0.214201	-2.391129	0.0185
$\Delta$ USDZAR_P(-2)	1.572186	0.320133	4.911039	0.0000

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R-squared	0.829448
F-statistic	15.91630
Prob(F-statistic)	0.000000

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**Dependent Variable: D(SNU)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.117039	0.078516	1.490632	0.1388
SNU(-1)	-1.214954	0.085999	-14.12761	0.0000
MKT_P(-1)	1.210359	0.427212	2.833160	0.0054
MKT_N(-1)	1.221425	0.434502	2.811090	0.0058
USDZAR_P(-1)	-0.932055	0.351477	-2.651822	0.0091
USDZAR_N(-1)	-0.894804	0.351867	-2.543016	0.0123
$\Delta$ MKT_N(-8)	0.968464	0.539663	1.794572	0.0753
$\Delta$ MKT_P	0.835250	0.395043	2.114326	0.0366
$\Delta$ USDZAR_N(-1)	0.788174	0.401912	1.961063	0.0523
$\Delta$ USDZAR_N(-9)	1.314623	0.498683	2.636191	0.0095
$\Delta$ USDZAR_P(-11)	1.163374	0.404615	2.875262	0.0048
$\Delta$ USDZAR_P(-10)	0.993326	0.433495	2.291439	0.0238
$\Delta$ USDZAR_N(-3)	-0.928615	0.423148	-2.194540	0.0302
$\Delta$ USDZAR_P(-4)	-0.630609	0.409778	-1.538904	0.1266
$\Delta$ MKT_N(-5)	0.761272	0.474352	1.604866	0.1113
$\Delta$ MKT_N(-6)	1.102921	0.498542	2.212295	0.0289
$\Delta$ USDZAR_N(-7)	1.734829	0.453193	3.828011	0.0002
$\Delta$ MKT_P(-9)	0.764492	0.385719	1.981993	0.0499
$\Delta$ USDZAR_N(-6)	0.820051	0.346866	2.364170	0.0197
$\Delta$ USDZAR_N(-8)	1.244484	0.456724	2.724802	0.0074
$\Delta$ USDZAR_N(-4)	0.602350	0.370441	1.626037	0.1067
$\Delta$ USDZAR_P(-8)	1.208686	0.476199	2.538196	0.0125
$\Delta$ USDZAR_P(-3)	0.579461	0.379483	1.526978	0.1295
$\Delta$ MKT_N	1.203633	0.451285	2.667123	0.0088
$\Delta$ USDZAR_P(-9)	1.150399	0.476410	2.414725	0.0173
$\Delta$ USDZAR_N(-10)	0.903058	0.448000	2.015756	0.0462
$\Delta$ MKT_P(-7)	1.401414	0.487837	2.872709	0.0048
$\Delta$ MKT_P(-6)	0.787696	0.419423	1.878046	0.0629

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R-squared	0.711296
F-statistic	10.49377
Prob(F-statistic)	0.000000

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**Dependent Variable: D(SOL)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.015688	0.029803	0.526397	0.5996
SOL(-1)	-0.874481	0.086594	-10.09861	0.0000
MKT_P(-1)	0.591852	0.203893	2.902750	0.0044
MKT_N(-1)	0.544570	0.204488	2.663087	0.0089
USDZAR_P(-1)	-0.511443	0.186365	-2.744307	0.0071
USDZAR_N(-1)	-0.458131	0.190316	-2.407208	0.0177
$\Delta$ MKT_P	0.893358	0.159823	5.589670	0.0000
$\Delta$ MKT_N	1.329948	0.190612	6.977256	0.0000
$\Delta$ USDZAR_P(-1)	1.010988	0.210486	4.803105	0.0000
$\Delta$ USDZAR_P(-4)	0.261705	0.157820	1.658245	0.1000
$\Delta$ MKT_N(-12)	0.299251	0.133655	2.238981	0.0271
$\Delta$ USDZAR_N(-10)	-0.257902	0.144133	-1.789338	0.0762
$\Delta$ USDZAR_P(-11)	-0.247056	0.140761	-1.755153	0.0819
$\Delta$ MKT_N(-7)	-0.418218	0.180637	-2.315243	0.0224
$\Delta$ SOL(-5)	-0.167660	0.057278	-2.927124	0.0041
$\Delta$ MKT_N(-5)	0.398121	0.199652	1.994079	0.0486
$\Delta$ MKT_P(-8)	-0.463674	0.143568	-3.229641	0.0016
$\Delta$ MKT_P(-7)	-0.261722	0.128478	-2.037102	0.0440
$\Delta$ USDZAR_N(-3)	0.264704	0.163906	1.614969	0.1091
$\Delta$ USDZAR_N(-11)	-0.294461	0.118218	-2.490842	0.0142
$\Delta$ SOL(-11)	0.123014	0.047454	2.592283	0.0108
$\Delta$ MKT_N(-3)	0.626926	0.208705	3.003891	0.0033
$\Delta$ USDZAR_N	0.322365	0.176519	1.826234	0.0705
$\Delta$ USDZAR_P(-3)	0.359970	0.164656	2.186199	0.0309
$\Delta$ MKT_P(-2)	0.372319	0.159895	2.328522	0.0217
$\Delta$ MKT_P(-1)	0.562814	0.183615	3.065178	0.0027
$\Delta$ SOL(-2)	0.105903	0.054605	1.939444	0.0549
$\Delta$ MKT_P(-4)	0.361428	0.175431	2.060232	0.0417
$\Delta$ USDZAR_N(-2)	0.572998	0.191369	2.994213	0.0034
R-squared	0.841839			
F-statistic	21.48083			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SPA)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.011771	0.044236	0.266089	0.7906
SPA(-1)	-1.005229	0.079122	-12.70480	0.0000

MKT_P(-1)	-0.106546	0.196972	-0.540921	0.5895
MKT_N(-1)	-0.179105	0.202350	-0.885123	0.3777
USDZAR_P(-1)	-0.578780	0.279140	-2.073442	0.0401
USDZAR_N(-1)	-0.504454	0.279400	-1.805493	0.0733
$\Delta$ USDZAR_P(-1)	0.918707	0.301965	3.042428	0.0028
$\Delta$ USDZAR_P(-4)	0.449513	0.210549	2.134953	0.0346
$\Delta$ USDZAR_P(-11)	0.435794	0.189657	2.297807	0.0232
$\Delta$ SPA(-10)	-0.102677	0.055504	-1.849904	0.0666
$\Delta$ USDZAR_P(-9)	0.505603	0.200584	2.520659	0.0129
$\Delta$ MKT_N(-8)	0.501921	0.252008	1.991687	0.0485

R-squared	0.608552
F-statistic	18.51409
Prob(F-statistic)	0.000000

**Dependent Variable: D(SPG)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.191591	0.063147	-3.034020	0.0030
SPG(-1)	-1.519191	0.157057	-9.672836	0.0000
MKT_P(-1)	4.193896	0.562774	7.452181	0.0000
MKT_N(-1)	3.743117	0.538534	6.950562	0.0000
USDZAR_P(-1)	-1.252130	0.445529	-2.810433	0.0059
USDZAR_N(-1)	-0.826030	0.455253	-1.814442	0.0724
$\Delta$ MKT_P	1.321710	0.266320	4.962857	0.0000
$\Delta$ SPG(-1)	0.303588	0.131771	2.303907	0.0231
$\Delta$ MKT_P(-9)	0.575216	0.195965	2.935299	0.0041
$\Delta$ USDZAR_P(-8)	0.686754	0.206035	3.333197	0.0012
$\Delta$ USDZAR_P(-2)	1.372610	0.337701	4.064570	0.0001
$\Delta$ USDZAR_P(-1)	1.085184	0.346682	3.130204	0.0022
$\Delta$ MKT_P(-3)	-2.495174	0.400556	-6.229279	0.0000
$\Delta$ MKT_N	0.475102	0.325010	1.461805	0.1467
$\Delta$ MKT_N(-4)	-0.736345	0.405542	-1.815706	0.0722
$\Delta$ MKT_P(-4)	-1.300419	0.338868	-3.837539	0.0002
$\Delta$ USDZAR_N(-1)	0.833831	0.364819	2.285603	0.0242
$\Delta$ MKT_P(-7)	-0.544420	0.203639	-2.673458	0.0087
$\Delta$ USDZAR_P(-6)	-0.437336	0.205880	-2.124230	0.0359
$\Delta$ MKT_P(-2)	-1.612553	0.479848	-3.360547	0.0011
$\Delta$ USDZAR_P(-3)	0.958055	0.232454	4.121475	0.0001
$\Delta$ MKT_N(-1)	-1.924983	0.553136	-3.480124	0.0007
$\Delta$ MKT_N(-3)	-0.965032	0.461508	-2.091043	0.0389
$\Delta$ SPG(-2)	0.352558	0.110618	3.187167	0.0019
$\Delta$ MKT_P(-5)	-0.518909	0.298966	-1.735680	0.0855
$\Delta$ MKT_P(-1)	-2.784101	0.519976	-5.354288	0.0000
$\Delta$ MKT_N(-2)	-2.090995	0.487743	-4.287088	0.0000
$\Delta$ USDZAR_P(-11)	0.981196	0.248954	3.941280	0.0001
$\Delta$ SPG(-11)	0.102720	0.046840	2.192997	0.0305
$\Delta$ USDZAR_P(-10)	0.831845	0.262488	3.169073	0.0020
$\Delta$ USDZAR_N(-9)	0.872224	0.295460	2.952085	0.0039
$\Delta$ USDZAR_N(-10)	0.871200	0.257198	3.387268	0.0010
$\Delta$ USDZAR_P	-0.700826	0.264732	-2.647302	0.0093
$\Delta$ USDZAR_N	0.475667	0.308605	1.541345	0.1262
$\Delta$ SPG(-3)	0.170110	0.074502	2.283290	0.0244

R-squared	0.828504
F-statistic	15.34565
Prob(F-statistic)	0.000000

**Dependent Variable: D(SUI)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.084587	0.030750	-2.750819	0.0069
SUI(-1)	-0.946151	0.077976	-12.13395	0.0000
MKT_P(-1)	0.742749	0.182204	4.076466	0.0001
MKT_N(-1)	0.726170	0.184991	3.925438	0.0001
USDZAR_P(-1)	-0.043907	0.128362	-0.342058	0.7329
USDZAR_N(-1)	-0.026999	0.126250	-0.213855	0.8310
$\Delta$ MKT_P	0.752850	0.166469	4.522468	0.0000
$\Delta$ USDZAR_P(-11)	0.404801	0.127477	3.175488	0.0019
$\Delta$ MKT_N	0.614868	0.193974	3.169840	0.0019
$\Delta$ MKT_N(-9)	-0.698062	0.194960	-3.580536	0.0005
$\Delta$ MKT_N(-7)	-0.620092	0.201243	-3.081314	0.0025
$\Delta$ MKT_P(-3)	-0.289341	0.132635	-2.181480	0.0311
$\Delta$ USDZAR_N(-4)	-0.581852	0.182096	-3.195303	0.0018
$\Delta$ MKT_P(-8)	-0.560769	0.194582	-2.881913	0.0047
$\Delta$ USDZAR_N(-3)	-0.825350	0.189329	-4.359347	0.0000
$\Delta$ USDZAR_P(-4)	-0.524864	0.189170	-2.774558	0.0064
$\Delta$ USDZAR_P(-5)	-0.531567	0.176128	-3.018078	0.0031
$\Delta$ MKT_N(-10)	-0.400639	0.180021	-2.225518	0.0279
$\Delta$ SUI(-11)	-0.133776	0.053553	-2.498015	0.0138
$\Delta$ SUI(-7)	0.109900	0.067553	1.626885	0.1063
$\Delta$ SUI(-6)	0.119234	0.065079	1.832135	0.0694
R-squared	0.708367			
F-statistic	14.81667			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(SUR)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.057645	0.035015	-1.646289	0.1022
SUR(-1)	-0.985721	0.083283	-11.83587	0.0000
MKT_P(-1)	0.473488	0.204206	2.318674	0.0220
MKT_N(-1)	0.420631	0.204491	2.056962	0.0418
USDZAR_P(-1)	-0.171851	0.147212	-1.167369	0.2453
USDZAR_N(-1)	-0.124210	0.146235	-0.849386	0.3973
$\Delta$ MKT_N(-6)	-0.617898	0.199554	-3.096393	0.0024
$\Delta$ MKT_P	0.407829	0.191115	2.133950	0.0348
$\Delta$ USDZAR_N(-3)	-0.567729	0.169998	-3.339625	0.0011
$\Delta$ MKT_N(-9)	-0.328905	0.183766	-1.789808	0.0759

$\Delta$ MKT_N	0.361771	0.223786	1.616589	0.1085
$\Delta$ USDZAR_N(-6)	-0.309372	0.174951	-1.768334	0.0794
$\Delta$ USDZAR_N(-4)	-0.564577	0.222052	-2.542551	0.0122
$\Delta$ MKT_N(-10)	-0.389645	0.188882	-2.062907	0.0412
$\Delta$ USDZAR_P(-5)	-0.487617	0.218193	-2.234797	0.0272
$\Delta$ USDZAR_N(-12)	0.232889	0.144674	1.609754	0.1100
$\Delta$ MKT_P(-5)	-0.292873	0.177264	-1.652182	0.1010
R-squared	0.626559			
F-statistic	13.10783			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(SVB)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.116278	0.102340	-1.136189	0.2581
SVB(-1)	-1.878737	0.151313	-12.41620	0.0000
MKT_P(-1)	-0.452571	0.445612	-1.015617	0.3118
MKT_N(-1)	-0.180555	0.454442	-0.397311	0.6918
USDZAR_P(-1)	0.999614	0.640967	1.559540	0.1214
USDZAR_N(-1)	0.714098	0.643732	1.109310	0.2694
$\Delta$ USDZAR_P(-12)	2.294707	0.456699	5.024548	0.0000
$\Delta$ SVB(-1)	0.606795	0.112020	5.416843	0.0000
$\Delta$ SVB(-2)	0.302496	0.072354	4.180767	0.0001
$\Delta$ SVB(-4)	-0.150462	0.046560	-3.231586	0.0016
$\Delta$ MKT_P(-10)	-1.302251	0.481517	-2.704476	0.0078
$\Delta$ USDZAR_N(-12)	-0.836742	0.494571	-1.691854	0.0932
$\Delta$ USDZAR_P(-7)	-0.880776	0.516173	-1.706359	0.0904
$\Delta$ USDZAR_N(-9)	-1.109605	0.499154	-2.222974	0.0280
$\Delta$ MKT_P(-4)	-1.078575	0.599215	-1.799982	0.0743
$\Delta$ USDZAR_P(-1)	-1.619822	0.707183	-2.290526	0.0237
$\Delta$ MKT_N(-3)	-1.773946	0.686832	-2.582794	0.0110
$\Delta$ USDZAR_P(-8)	-1.114126	0.563832	-1.975989	0.0504
R-squared	0.755465			
F-statistic	22.53444			
Prob(F-statistic)	0.000000			

#### Dependent Variable: D(TBS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.002620	0.028878	-0.090742	0.9279
TBS(-1)	-0.699281	0.129888	-5.383709	0.0000
MKT_P(-1)	0.121487	0.197789	0.614223	0.5403
MKT_N(-1)	0.107354	0.198291	0.541394	0.5893
USDZAR_P(-1)	-0.474871	0.157898	-3.007457	0.0032
USDZAR_N(-1)	-0.463053	0.162817	-2.844006	0.0053
$\Delta$ MKT_P	0.627827	0.160058	3.922508	0.0001

$\Delta$ USDZAR_N(-9)	-0.382918	0.122940	-3.114670	0.0023
$\Delta$ MKT_N	0.673556	0.184089	3.658858	0.0004
$\Delta$ MKT_P(-12)	-0.193676	0.119777	-1.616979	0.1086
$\Delta$ USDZAR_N	-0.486167	0.180877	-2.687835	0.0082
$\Delta$ TBS(-9)	-0.129159	0.052248	-2.472010	0.0149
$\Delta$ USDZAR_N(-11)	-0.218298	0.127669	-1.709871	0.0900
$\Delta$ TBS(-11)	-0.097215	0.051609	-1.883669	0.0621
$\Delta$ TBS(-1)	-0.222107	0.106124	-2.092890	0.0385
$\Delta$ MKT_P(-9)	0.452747	0.133356	3.395030	0.0009
$\Delta$ USDZAR_N(-8)	0.279367	0.130361	2.143020	0.0342
$\Delta$ USDZAR_N(-7)	0.332465	0.129264	2.571979	0.0114
$\Delta$ MKT_P(-8)	0.236273	0.130876	1.805318	0.0736
$\Delta$ TBS(-4)	0.081217	0.049171	1.651745	0.1013
$\Delta$ USDZAR_N(-12)	0.213493	0.120592	1.770374	0.0793
$\Delta$ MKT_N(-2)	0.411951	0.181720	2.266957	0.0252
$\Delta$ USDZAR_N(-2)	-0.308760	0.147593	-2.091970	0.0386
$\Delta$ USDZAR_P(-3)	-0.381195	0.148021	-2.575277	0.0113
$\Delta$ TBS(-2)	-0.161853	0.075458	-2.144930	0.0340
$\Delta$ MKT_P(-1)	0.457749	0.208500	2.195440	0.0301
R-squared	0.747994			
F-statistic	13.77225			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(TDH)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.146595	0.060067	-2.440540	0.0161
TDH(-1)	-0.861172	0.081026	-10.62829	0.0000
MKT_P(-1)	1.089040	0.377718	2.883210	0.0047
MKT_N(-1)	1.096383	0.379632	2.888017	0.0046
USDZAR_P(-1)	-0.243936	0.342689	-0.711830	0.4780
USDZAR_N(-1)	-0.275835	0.345706	-0.797889	0.4265
$\Delta$ USDZAR_P(-7)	0.917472	0.353895	2.592497	0.0107
$\Delta$ USDZAR_P(-2)	0.734335	0.317613	2.312044	0.0225
$\Delta$ USDZAR_N(-6)	0.816038	0.351581	2.321050	0.0220
$\Delta$ USDZAR_P(-5)	0.595899	0.298449	1.996653	0.0481
$\Delta$ MKT_P(-2)	-0.957400	0.302033	-3.169849	0.0019
$\Delta$ MKT_P(-1)	-1.214492	0.365279	-3.324834	0.0012
$\Delta$ MKT_N(-6)	-2.022537	0.416291	-4.858469	0.0000
$\Delta$ USDZAR_N(-8)	0.610614	0.275139	2.219297	0.0284
$\Delta$ MKT_P(-9)	-0.679459	0.312309	-2.175602	0.0316
$\Delta$ MKT_P	0.997550	0.316246	3.154349	0.0020
$\Delta$ USDZAR_P(-6)	0.521339	0.289931	1.798146	0.0747
$\Delta$ MKT_N(-8)	-0.899814	0.431182	-2.086852	0.0390
$\Delta$ MKT_P(-5)	-0.666291	0.294767	-2.260403	0.0256
$\Delta$ MKT_P(-7)	-1.143102	0.368217	-3.104423	0.0024
$\Delta$ MKT_P(-11)	-0.688617	0.238868	-2.882834	0.0047
$\Delta$ USDZAR_P(-1)	0.605946	0.404029	1.499759	0.1363
$\Delta$ USDZAR_N(-3)	0.611125	0.283107	2.158635	0.0329
$\Delta$ MKT_N(-3)	-0.636897	0.326712	-1.949413	0.0536

R-squared	0.671576
F-statistic	10.57985
Prob(F-statistic)	0.000000

**Dependent Variable: D(TFG)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.069248	0.043824	1.580141	0.1168
TFG(-1)	-0.854729	0.080562	-10.60962	0.0000
MKT_P(-1)	0.245010	0.270899	0.904433	0.3677
MKT_N(-1)	0.228843	0.275596	0.830358	0.4081
USDZAR_P(-1)	-1.956369	0.389157	-5.027201	0.0000
USDZAR_N(-1)	-1.939607	0.394303	-4.919079	0.0000
$\Delta$ MKT_P	0.842192	0.223733	3.764269	0.0003
$\Delta$ USDZAR_P	-0.701747	0.213762	-3.282848	0.0014
$\Delta$ USDZAR_P(-2)	1.058446	0.279299	3.789647	0.0002
$\Delta$ USDZAR_N	-0.647369	0.259270	-2.496896	0.0139
$\Delta$ MKT_N	0.801945	0.261740	3.063898	0.0027
$\Delta$ MKT_P(-1)	0.400914	0.246644	1.625476	0.1068
$\Delta$ TFG(-2)	0.183759	0.058611	3.135230	0.0022
$\Delta$ MKT_N(-1)	0.454000	0.252483	1.798139	0.0748
$\Delta$ USDZAR_P(-3)	0.626831	0.243227	2.577142	0.0112
$\Delta$ USDZAR_N(-8)	0.319146	0.174611	1.827759	0.0702
$\Delta$ USDZAR_N(-11)	0.321372	0.171702	1.871688	0.0638
$\Delta$ USDZAR_N(-12)	0.437340	0.166383	2.628513	0.0097
$\Delta$ TFG(-5)	0.126326	0.061240	2.062802	0.0414
$\Delta$ USDZAR_P(-11)	0.392769	0.169795	2.313194	0.0225
$\Delta$ MKT_P(-7)	-0.338835	0.181204	-1.869905	0.0640
$\Delta$ TFG(-8)	0.147136	0.064545	2.279602	0.0245
$\Delta$ MKT_N(-8)	-0.492068	0.230321	-2.136445	0.0348
$\Delta$ USDZAR_N(-2)	1.011199	0.279632	3.616181	0.0004
$\Delta$ USDZAR_N(-5)	0.306974	0.172386	1.780736	0.0776
$\Delta$ USDZAR_P(-1)	1.343296	0.352806	3.807466	0.0002
$\Delta$ USDZAR_N(-1)	0.887516	0.323273	2.745406	0.0070
R-squared	0.697664			
F-statistic	10.20660			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(TPC)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.057168	0.037455	-1.526307	0.1295
TPC(-1)	-0.825812	0.078731	-10.48903	0.0000
MKT_P(-1)	0.097018	0.186683	0.519693	0.6042
MKT_N(-1)	0.095879	0.185597	0.516598	0.6064

USDZAR_P(-1)	-0.216284	0.147528	-1.466053	0.1452
USDZAR_N(-1)	-0.222564	0.149671	-1.487024	0.1396
$\Delta$ MKT_N(-11)	-0.619194	0.199142	-3.109302	0.0023
$\Delta$ TPC(-9)	-0.197987	0.052753	-3.753074	0.0003
$\Delta$ MKT_P(-9)	0.424706	0.164186	2.586734	0.0109
$\Delta$ USDZAR_P(-11)	0.473732	0.154520	3.065819	0.0027
$\Delta$ USDZAR_N(-4)	-0.507243	0.164815	-3.077646	0.0026
$\Delta$ MKT_P(-4)	0.476065	0.181905	2.617108	0.0100
$\Delta$ MKT_P(-10)	0.330397	0.177658	1.859733	0.0654
$\Delta$ MKT_P	0.351856	0.201775	1.743801	0.0837
$\Delta$ TPC(-4)	-0.127999	0.060638	-2.110885	0.0368
$\Delta$ USDZAR_N(-12)	0.343456	0.166009	2.068893	0.0407
$\Delta$ USDZAR_P(-8)	-0.456979	0.167120	-2.734436	0.0072
$\Delta$ MKT_N(-5)	0.795326	0.207833	3.826746	0.0002
$\Delta$ TPC(-7)	-0.099133	0.053717	-1.845472	0.0674
$\Delta$ MKT_P(-8)	0.299563	0.166589	1.798219	0.0746
$\Delta$ TPC(-5)	-0.128525	0.059941	-2.144203	0.0340
R-squared	0.660429			
F-statistic	11.76658			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(TRE)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.003587	0.031669	-0.113277	0.9100
TRE(-1)	-0.911360	0.084409	-10.79700	0.0000
MKT_P(-1)	0.569020	0.168220	3.382599	0.0010
MKT_N(-1)	0.463383	0.173692	2.667848	0.0086
USDZAR_P(-1)	-0.063148	0.161981	-0.389849	0.6973
USDZAR_N(-1)	0.048168	0.159431	0.302123	0.7630
DTRE(-11)	-0.126795	0.060431	-2.098182	0.0378
DUSDZAR_N(-10)	-0.402165	0.138760	-2.898277	0.0044
DUSDZAR_N(-3)	-0.254034	0.147986	-1.716612	0.0885
DUSDZAR_P	0.440538	0.180271	2.443748	0.0159
DMKT_N(-6)	0.327652	0.164375	1.993323	0.0483
DUSDZAR_P(-7)	0.344941	0.146239	2.358743	0.0198
DMKT_N	0.436557	0.207462	2.104277	0.0373
DTRE(-3)	-0.119377	0.060246	-1.981496	0.0497
R-squared	0.607686			
F-statistic	15.37065			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(TSX)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.128788	0.052589	-2.448962	0.0158

TSX(-1)	-1.043845	0.078246	-13.34060	0.0000
MKT_P(-1)	1.316605	0.255802	5.146971	0.0000
MKT_N(-1)	1.245420	0.251585	4.950288	0.0000
USDZAR_P(-1)	-1.217689	0.376493	-3.234291	0.0016
USDZAR_N(-1)	-1.166974	0.374101	-3.119412	0.0023
$\Delta$ MKT_P	1.137102	0.264958	4.291637	0.0000
$\Delta$ USDZAR_P(-2)	1.040388	0.325267	3.198563	0.0018
$\Delta$ MKT_N(-5)	1.335383	0.404665	3.299975	0.0013
$\Delta$ MKT_P(-10)	0.579967	0.204809	2.831753	0.0054
$\Delta$ TSX(-10)	-0.132031	0.067290	-1.962120	0.0521
$\Delta$ MKT_N(-7)	1.447009	0.373564	3.873524	0.0002
$\Delta$ MKT_P(-5)	0.706327	0.343892	2.053922	0.0422
$\Delta$ TSX(-6)	0.156699	0.063241	2.477809	0.0146
$\Delta$ TSX(-9)	-0.116598	0.064216	-1.815703	0.0719
$\Delta$ USDZAR_P(-1)	0.739171	0.358212	2.063501	0.0412
$\Delta$ MKT_N(-4)	0.750371	0.348062	2.155851	0.0331
$\Delta$ USDZAR_N(-1)	0.837422	0.367023	2.281658	0.0243
$\Delta$ MKT_P(-8)	1.066616	0.280231	3.806196	0.0002
$\Delta$ MKT_P(-4)	0.949225	0.332812	2.852136	0.0051
$\Delta$ MKT_P(-7)	0.716252	0.302209	2.370052	0.0194
$\Delta$ MKT_N(-3)	1.171836	0.322969	3.628325	0.0004
$\Delta$ MKT_N(-6)	0.943463	0.409607	2.303339	0.0230
$\Delta$ MKT_P(-6)	0.788532	0.334252	2.359093	0.0199
R-squared	0.671504			
F-statistic	10.66528			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(VLE)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.040270	0.037275	1.080369	0.2821
VLE(-1)	-1.091107	0.085419	-12.77354	0.0000
MKT_P(-1)	-0.019480	0.167949	-0.115988	0.9079
MKT_N(-1)	-0.132292	0.169168	-0.782014	0.4357
USDZAR_P(-1)	-1.020498	0.308469	-3.308271	0.0012
USDZAR_N(-1)	-0.900836	0.309065	-2.914719	0.0042
$\Delta$ USDZAR_P(-4)	0.967896	0.236055	4.100308	0.0001
$\Delta$ USDZAR_N(-1)	0.509113	0.308073	1.652571	0.1009
$\Delta$ USDZAR_P(-9)	0.256223	0.157179	1.630133	0.1056
$\Delta$ VLE(-8)	0.094157	0.055269	1.703596	0.0910
$\Delta$ USDZAR_N(-3)	0.711495	0.264290	2.692097	0.0081
$\Delta$ USDZAR_P(-2)	0.833562	0.305655	2.727133	0.0073
$\Delta$ MKT_P(-2)	0.313975	0.185495	1.692628	0.0930
$\Delta$ USDZAR_N(-12)	0.294640	0.153883	1.914704	0.0578
$\Delta$ MKT_P(-3)	0.308403	0.185213	1.665130	0.0984
$\Delta$ USDZAR_N(-6)	0.312184	0.188316	1.657772	0.0999
$\Delta$ USDZAR_P(-5)	0.416030	0.215571	1.929900	0.0559
$\Delta$ USDZAR_P(-1)	0.848256	0.291207	2.912895	0.0042
R-squared	0.649998			
F-statistic	13.54610			

Prob(F-statistic) 0.000000

**Dependent Variable: D(WBO)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.083280	0.034440	2.418100	0.0172
WBO(-1)	-1.542789	0.157011	-9.826007	0.0000
MKT_P(-1)	0.920648	0.193511	4.757610	0.0000
MKT_N(-1)	0.829123	0.191069	4.339385	0.0000
USDZAR_P(-1)	-0.726825	0.214619	-3.386578	0.0010
USDZAR_N(-1)	-0.609365	0.214152	-2.845476	0.0053
$\Delta$ MKT_P	0.807078	0.177952	4.535367	0.0000
$\Delta$ WBO(-12)	0.154812	0.057042	2.713975	0.0077
$\Delta$ USDZAR_P	-0.627057	0.174331	-3.596928	0.0005
$\Delta$ WBO(-1)	0.622100	0.121332	5.127269	0.0000
$\Delta$ WBO(-2)	0.469297	0.102525	4.577407	0.0000
$\Delta$ MKT_N	0.543777	0.203234	2.675624	0.0085
$\Delta$ WBO(-10)	0.094357	0.056550	1.668566	0.0979
$\Delta$ USDZAR_N(-3)	-0.337986	0.157160	-2.150589	0.0336
$\Delta$ USDZAR_N(-4)	-0.683218	0.195161	-3.500794	0.0007
$\Delta$ MKT_P(-7)	-0.227692	0.139575	-1.631331	0.1056
$\Delta$ USDZAR_N(-12)	0.399131	0.144511	2.761936	0.0067
$\Delta$ USDZAR_P(-11)	0.489800	0.173599	2.821441	0.0056
$\Delta$ USDZAR_N(-2)	0.497374	0.173893	2.860225	0.0050
$\Delta$ USDZAR_P(-1)	0.550703	0.241395	2.281335	0.0244
$\Delta$ USDZAR_P(-5)	-0.368199	0.183288	-2.008856	0.0469
$\Delta$ USDZAR_N(-10)	0.288132	0.168252	1.712502	0.0895
$\Delta$ MKT_P(-8)	-0.288649	0.140397	-2.055954	0.0421
$\Delta$ WBO(-3)	0.166341	0.075021	2.217265	0.0286
$\Delta$ USDZAR_P(-6)	-0.509827	0.197635	-2.579646	0.0112
$\Delta$ USDZAR_N(-5)	-0.348654	0.187288	-1.861589	0.0652
$\Delta$ USDZAR_N(-7)	-0.340988	0.156738	-2.175529	0.0316
R-squared	0.718440			
F-statistic	11.28609			
Prob(F-statistic)	0.000000			

**Dependent Variable: D(WHL)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.027838	0.034923	0.797121	0.4269
WHL(-1)	-0.872811	0.078048	-11.18295	0.0000
MKT_P(-1)	0.224444	0.225600	0.994876	0.3217
MKT_N(-1)	0.114492	0.225799	0.507052	0.6130
USDZAR_P(-1)	-0.791400	0.223544	-3.540241	0.0006
USDZAR_N(-1)	-0.684521	0.219700	-3.115711	0.0023

$\Delta$ MKT_P	0.846249	0.183556	4.610314	0.0000
$\Delta$ MKT_N	0.929786	0.225709	4.119394	0.0001
$\Delta$ USDZAR_P	-0.750627	0.185910	-4.037584	0.0001
$\Delta$ USDZAR_N(-3)	-0.566249	0.161979	-3.495821	0.0007
$\Delta$ MKT_P(-11)	0.274429	0.137895	1.990126	0.0488
$\Delta$ MKT_P(-1)	0.813968	0.234027	3.478091	0.0007
$\Delta$ MKT_N(-2)	0.569427	0.200724	2.836873	0.0053
$\Delta$ USDZAR_P(-3)	0.309967	0.165686	1.870810	0.0637
$\Delta$ WHL(-9)	-0.135829	0.055505	-2.447149	0.0158
$\Delta$ MKT_P(-9)	0.297152	0.149025	1.993972	0.0483
$\Delta$ USDZAR_N(-12)	0.310625	0.137232	2.263507	0.0253
$\Delta$ USDZAR_P(-1)	0.427837	0.214612	1.993532	0.0484

R-squared	0.697478
F-statistic	16.81694
Prob(F-statistic)	0.000000

**Dependent Variable: D(WNH)**

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.010236	0.048570	-0.210748	0.8334
WNH(-1)	-1.105551	0.085956	-12.86180	0.0000
MKT_P(-1)	0.664853	0.242421	2.742553	0.0070
MKT_N(-1)	0.605542	0.240175	2.521253	0.0129
USDZAR_P(-1)	-1.063069	0.306616	-3.467099	0.0007
USDZAR_N(-1)	-1.003388	0.311818	-3.217861	0.0016
DWNH(-9)	-0.110236	0.062949	-1.751200	0.0823
DUSDZAR_N(-12)	0.785287	0.205716	3.817330	0.0002
DWNH(-8)	-0.120722	0.063224	-1.909426	0.0585
DUSDZAR_N	-0.698077	0.304567	-2.292031	0.0235
DUSDZAR_P(-11)	0.534601	0.198712	2.690330	0.0081
DMKT_P	0.587229	0.259930	2.259185	0.0256
DWNH(-6)	-0.121959	0.054586	-2.234256	0.0272
DUSDZAR_P	-0.485955	0.270904	-1.793826	0.0752
DMKT_P(-9)	0.356073	0.197241	1.805273	0.0734

R-squared	0.655864
F-statistic	17.28860
Prob(F-statistic)	0.000000

**PANEL C: Results based on the direct test of asymmetric exposure**  
**Asymmetric exposure is tested based on the STAR Model as follows:**

$$R_{i,t} = \alpha_i + \beta_{i,m} * R_{m,t} + \{\beta_{i,XR} + \beta_{i,XR} * G_i(\gamma.c. z_{t-d})\} * XR + \varepsilon_{i,t}$$

(\*\*\*) represents significance at the 1% level. while (\*\*) and (\*) represent significance at the 5% and 10% respectively.

### 1. Smooth Threshold Linearity Tests (ACL)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.461576	(8. 139)	0.0159
H03: $b_1=b_2=b_3=0$	3.125457	(6. 141)	0.0066
H02: $b_1=b_2=0$	4.172625	(4. 143)	0.0032
H01: $b_1=0$	3.622614	(2. 145)	0.0292

The H0i test uses t

The i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.027869	(2. 141)	0.3604
H2: $b_2=0   b_3=0$	4.545478	(2. 143)	0.0122
H1: $b_1=0   b_2=b_3=0$	3.622614	(2. 145)	0.0292

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

**. Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1)**

### 2. Smooth Threshold Linearity Tests (ADH)

Sample: 2003M01 2015M11

Included observations: 146

Test for nonlinearity using USDZAR(-9) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.928821	(8. 135)	0.4950
H03: $b_1=b_2=b_3=0$	0.282488	(6. 137)	0.9444
H02: $b_1=b_2=0$	0.134560	(4. 139)	0.9694
H01: $b_1=0$	0.099686	(2. 141)	0.9052

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.579969	(2. 137)	0.5613

H2: $b_2=0 \mid b_3=0$	0.170608	(2. 139)	0.8433
H1: $b_1=0 \mid b_2=b_3=0$	0.099686	(2. 141)	0.9052

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 3. Smooth Threshold Linearity Tests (ADI)

Sample: 2003M01 2015M11

Included observations: 145

Test for nonlinearity using USDZAR(-10) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.197632	(8. 134)	0.0313
H03: $b_1=b_2=b_3=0$	2.889986	(6. 136)	0.0111
H02: $b_1=b_2=0$	3.614752	(4. 138)	0.0078
H01: $b_1=0$	3.993663	(2. 140)	0.0206

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.398682	(2. 136)	0.2505
H2: $b_2=0 \mid b_3=0$	3.115166	(2. 138)	0.0475
H1: $b_1=0 \mid b_2=b_3=0$	3.993663	(2. 140)	0.0206

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H1) \leq \Pr(H2)$

### 4. Smooth Threshold Linearity Tests (AEG)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.314363	(8. 143)	0.2409
H03: $b_1=b_2=b_3=0$	1.546675	(6. 145)	0.1670
H02: $b_1=b_2=0$	2.019451	(4. 147)	0.0947
H01: $b_1=0$	3.535814	(2. 149)	0.0316

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
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H3: $b_3=0$	0.621899	(2. 145)	0.5383
H2: $b_2=0 \mid b_3=0$	0.525604	(2. 147)	0.5923
H1: $b_1=0 \mid b_2=b_3=0$	3.535814	(2. 149)	0.0316

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 5. Smooth Threshold Linearity Tests (AFE)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.556308	(8. 141)	0.0124
H03: $b_1=b_2=b_3=0$	2.457254	(6. 143)	0.0272
H02: $b_1=b_2=0$	2.624112	(4. 145)	0.0371
H01: $b_1=0$	0.687492	(2. 147)	0.5044

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.047696	(2. 143)	0.1328
H2: $b_2=0 \mid b_3=0$	4.527735	(2. 145)	0.0124
H1: $b_1=0 \mid b_2=b_3=0$	0.687492	(2. 147)	0.5044

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  $\Pr(H_2) < \Pr(H_3)$  and  $\Pr(H_2) < \Pr(H_1)$

### 6. Smooth Threshold Linearity Tests (AGL)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.462152	(8. 143)	0.1761
H03: $b_1=b_2=b_3=0$	1.701879	(6. 145)	0.1245
H02: $b_1=b_2=0$	1.019778	(4. 147)	0.3992
H01: $b_1=0$	0.691781	(2. 149)	0.5023

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
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H3: $b_3=0$	3.010297	(2. 145)	0.0524
H2: $b_2=0 \mid b_3=0$	1.344575	(2. 147)	0.2638
H1: $b_1=0 \mid b_2=b_3=0$	0.691781	(2. 149)	0.5023

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 7. Smooth Threshold Linearity Tests (AHL)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.851710	(8. 136)	0.5590
H03: $b_1=b_2=b_3=0$	1.023061	(6. 138)	0.4130
H02: $b_1=b_2=0$	1.358108	(4. 140)	0.2516
H01: $b_1=0$	2.624594	(2. 142)	0.0760

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.377137	(2. 138)	0.6865
H2: $b_2=0 \mid b_3=0$	0.124004	(2. 140)	0.8835
H1: $b_1=0 \mid b_2=b_3=0$	2.624594	(2. 142)	0.0760

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 8. Smooth Threshold Linearity Tests (AMS)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.474265	(8. 142)	0.1716
H03: $b_1=b_2=b_3=0$	1.775347	(6. 144)	0.1081
H02: $b_1=b_2=0$	2.593357	(4. 146)	0.0389
H01: $b_1=0$	4.458428	(2. 148)	0.0132

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.196422	(2. 144)	0.8219

H2: $b_2=0 \mid b_3=0$	0.743726	(2. 146)	0.4771
H1: $b_1=0 \mid b_2=b_3=0$	4.458428	(2. 148)	0.0132

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 9. Smooth Threshold Linearity Tests (A00)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.852601	(8. 143)	0.5582
H03: $b_1=b_2=b_3=0$	0.951867	(6. 145)	0.4602
H02: $b_1=b_2=0$	0.680863	(4. 147)	0.6063
H01: $b_1=0$	1.197985	(2. 149)	0.3047

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.484892	(2. 145)	0.2300
H2: $b_2=0 \mid b_3=0$	0.176976	(2. 147)	0.8380
H1: $b_1=0 \mid b_2=b_3=0$	1.197985	(2. 149)	0.3047

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 10. Smooth Threshold Linearity Tests (APK)

Sample: 2003M01 2015M11

Included observations: 144

Test for nonlinearity using USDZAR(-11) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.387699	(8. 133)	0.0195
H03: $b_1=b_2=b_3=0$	2.709960	(6. 135)	0.0162
H02: $b_1=b_2=0$	1.439117	(4. 137)	0.2244
H01: $b_1=0$	0.263922	(2. 139)	0.7684

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	5.080205	(2. 135)	0.0075
H2: $b_2=0 \mid b_3=0$	2.608204	(2. 137)	0.0773

H1:  $b_1=0 \mid b_2=b_3=0$  0.263922 (2. 139) 0.7684

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. **Pr(H3) <= Pr(H2)**

### 11. Smooth Threshold Linearity Tests (ARI)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.125729	(8. 142)	0.0370
H03: $b_1=b_2=b_3=0$	0.616196	(6. 144)	0.7171
H02: $b_1=b_2=0$	0.346032	(4. 146)	0.8465
H01: $b_1=0$	0.629819	(2. 148)	0.5341

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.155053	(2. 144)	0.3179
H2: $b_2=0 \mid b_3=0$	0.070160	(2. 146)	0.9323
H1: $b_1=0 \mid b_2=b_3=0$	0.629819	(2. 148)	0.5341

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 12. Smooth Threshold Linearity Tests (ARL)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.532042	(8. 139)	0.1514
H03: $b_1=b_2=b_3=0$	2.045551	(6. 141)	0.0635
H02: $b_1=b_2=0$	2.560703	(4. 143)	0.0411
H01: $b_1=0$	1.278056	(2. 145)	0.2817

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.014227	(2. 141)	0.3653
H2: $b_2=0 \mid b_3=0$	3.794095	(2. 143)	0.0248

H1: $b_1=0 \mid b_2=b_3=0$	1.278056	(2. 145)	0.2817
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All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 13. Smooth Threshold Linearity Tests (ART)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.764867	(8. 136)	0.6342
H03: $b_1=b_2=b_3=0$	0.526754	(6. 138)	0.7872
H02: $b_1=b_2=0$	0.672048	(4. 140)	0.6124
H01: $b_1=0$	1.161966	(2. 142)	0.3158

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.250558	(2. 138)	0.7787
H2: $b_2=0 \mid b_3=0$	0.195299	(2. 140)	0.8228
H1: $b_1=0 \mid b_2=b_3=0$	1.161966	(2. 142)	0.3158

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 14. Smooth Threshold Linearity Tests (ASR)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.239522	(8. 141)	0.2805
H03: $b_1=b_2=b_3=0$	1.243900	(6. 143)	0.2875
H02: $b_1=b_2=0$	1.065740	(4. 145)	0.3757
H01: $b_1=0$	1.309138	(2. 147)	0.2732

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
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H3: $b_3=0$	1.583077	(2. 143)	0.2089
H2: $b_2=0 \mid b_3=0$	0.825451	(2. 145)	0.4401
H1: $b_1=0 \mid b_2=b_3=0$	1.309138	(2. 147)	0.2732

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 15. Smooth Threshold Linearity Tests (AVI)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.080364	(8. 142)	0.3803
H03: $b_1=b_2=b_3=0$	0.640556	(6. 144)	0.6976
H02: $b_1=b_2=0$	0.910275	(4. 146)	0.4597
H01: $b_1=0$	0.853930	(2. 148)	0.4278

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.122989	(2. 144)	0.8844
H2: $b_2=0 \mid b_3=0$	0.967001	(2. 146)	0.3826
H1: $b_1=0 \mid b_2=b_3=0$	0.853930	(2. 148)	0.4278

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 16. Smooth Threshold Linearity Tests (BAU)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.094128	(8. 142)	0.0401
H03: $b_1=b_2=b_3=0$	2.696564	(6. 144)	0.0164
H02: $b_1=b_2=0$	3.795668	(4. 146)	0.0058
H01: $b_1=0$	2.761833	(2. 148)	0.0664

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.545607	(2. 144)	0.5807
H2: $b_2=0 \mid b_3=0$	4.691721	(2. 146)	0.0106

H1: $b_1=0 \mid b_2=b_3=0$	2.761833	(2. 148)	0.0664
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All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

Linear model is rejected at the 5% level using H03.

Recommended model: exponential.

.  $\Pr(H_2) < \Pr(H_3)$  and  $\Pr(H_2) < \Pr(H_1)$

### 17. Smooth Threshold Linearity Tests (BAW)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.462051	(8. 142)	0.1763
H03: $b_1=b_2=b_3=0$	1.716495	(6. 144)	0.1212
H02: $b_1=b_2=0$	2.279451	(4. 146)	0.0635
H01: $b_1=0$	1.160059	(2. 148)	0.3163

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.614648	(2. 144)	0.5422
H2: $b_2=0 \mid b_3=0$	3.361818	(2. 146)	0.0374
H1: $b_1=0 \mid b_2=b_3=0$	1.160059	(2. 148)	0.3163

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 18. Smooth Threshold Linearity Tests (BDM)

Sample: 2003M01 2015M11

Included observations: 144

Test for nonlinearity using USDZAR(-11) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.438927	(8. 133)	0.0171
H03: $b_1=b_2=b_3=0$	1.124540	(6. 135)	0.3514
H02: $b_1=b_2=0$	0.802647	(4. 137)	0.5255
H01: $b_1=0$	0.060117	(2. 139)	0.9417

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value

H3: $b_3=0$	1.750734	(2. 135)	0.1776
H2: $b_2=0 \mid b_3=0$	1.544705	(2. 137)	0.2171
H1: $b_1=0 \mid b_2=b_3=0$	0.060117	(2. 139)	0.9417

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 19. Smooth Threshold Linearity Tests (BEL)

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.460318	(8. 138)	0.8821
H03: $b_1=b_2=b_3=0$	0.615379	(6. 140)	0.7177
H02: $b_1=b_2=0$	0.750415	(4. 142)	0.5593
H01: $b_1=0$	0.382150	(2. 144)	0.6831

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.358860	(2. 140)	0.6991
H2: $b_2=0 \mid b_3=0$	1.118053	(2. 142)	0.3298
H1: $b_1=0 \mid b_2=b_3=0$	0.382150	(2. 144)	0.6831

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 20. Smooth Threshold Linearity Tests (BIL)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.292706	(8. 143)	0.2518
H03: $b_1=b_2=b_3=0$	1.669472	(6. 145)	0.1325
H02: $b_1=b_2=0$	1.586691	(4. 147)	0.1809
H01: $b_1=0$	1.338925	(2. 149)	0.2653

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.800473	(2. 145)	0.1689
H2: $b_2=0 \mid b_3=0$	1.819726	(2. 147)	0.1657
H1: $b_1=0 \mid b_2=b_3=0$	1.338925	(2. 149)	0.2653

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 21. Smooth Threshold Linearity Tests (BSR)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.945573	(8. 141)	0.4813
H03: $b_1=b_2=b_3=0$	1.175929	(6. 143)	0.3225
H02: $b_1=b_2=0$	0.504949	(4. 145)	0.7321
H01: $b_1=0$	0.994987	(2. 147)	0.3722

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.497037	(2. 143)	0.0859
H2: $b_2=0 \mid b_3=0$	0.028068	(2. 145)	0.9723
H1: $b_1=0 \mid b_2=b_3=0$	0.994987	(2. 147)	0.3722

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 22. Smooth Threshold Linearity Tests (BVT)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.771637	(8. 139)	0.0876
H03: $b_1=b_2=b_3=0$	2.146846	(6. 141)	0.0517
H02: $b_1=b_2=0$	3.111880	(4. 143)	0.0172
H01: $b_1=0$	1.299331	(2. 145)	0.2759

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value

H3: $b_3=0$	0.279495	(2. 141)	0.7566
H2: $b_2=0 \mid b_3=0$	4.855335	(2. 143)	0.0091
H1: $b_1=0 \mid b_2=b_3=0$	1.299331	(2. 145)	0.2759

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 23. Smooth Threshold Linearity Tests (CFR)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.703646	(8. 143)	0.1023
H03: $b_1=b_2=b_3=0$	0.796310	(6. 145)	0.5743
H02: $b_1=b_2=0$	1.185110	(4. 147)	0.3198
H01: $b_1=0$	1.952571	(2. 149)	0.1455

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.049366	(2. 145)	0.9518
H2: $b_2=0 \mid b_3=0$	0.432522	(2. 147)	0.6497
H1: $b_1=0 \mid b_2=b_3=0$	1.952571	(2. 149)	0.1455

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 24. Smooth Threshold Linearity Tests (CKS)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.962714	(8. 140)	0.0554
H03: $b_1=b_2=b_3=0$	1.783939	(6. 142)	0.1065
H02: $b_1=b_2=0$	1.039126	(4. 144)	0.3892
H01: $b_1=0$	1.200773	(2. 146)	0.3039

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.209778	(2. 142)	0.0433
H2: $b_2=0 \mid b_3=0$	0.879462	(2. 144)	0.4172
H1: $b_1=0 \mid b_2=b_3=0$	1.200773	(2. 146)	0.3039

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

## 25. Smooth Threshold Linearity Tests (CLH)

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.001987	(8. 137)	0.4375
H03: $b_1=b_2=b_3=0$	1.252839	(6. 139)	0.2833
H02: $b_1=b_2=0$	1.631811	(4. 141)	0.1695
H01: $b_1=0$	1.883670	(2. 143)	0.1558

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.517245	(2. 139)	0.5973
H2: $b_2=0 \mid b_3=0$	1.370198	(2. 141)	0.2574
H1: $b_1=0 \mid b_2=b_3=0$	1.883670	(2. 143)	0.1558

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

## 26. Smooth Threshold Linearity Tests (CLS)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.834728	(8. 143)	0.0752
H03: $b_1=b_2=b_3=0$	1.459619	(6. 145)	0.1961
H02: $b_1=b_2=0$	1.801759	(4. 147)	0.1315
H01: $b_1=0$	3.392116	(2. 149)	0.0363

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.785838	(2. 145)	0.4577
H2: $b_2=0 \mid b_3=0$	0.245746	(2. 147)	0.7824
H1: $b_1=0 \mid b_2=b_3=0$	3.392116	(2. 149)	0.0363

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 27. Smooth Threshold Linearity Tests (CMH)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	3.025059	(8. 139)	0.0037
H03: $b_1=b_2=b_3=0$	4.018770	(6. 141)	0.0010
H02: $b_1=b_2=0$	5.357713	(4. 143)	0.0005
H01: $b_1=0$	2.183309	(2. 145)	0.1164

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.296456	(2. 141)	0.2767
H2: $b_2=0 \mid b_3=0$	8.311921	(2. 143)	0.0004
H1: $b_1=0 \mid b_2=b_3=0$	2.183309	(2. 145)	0.1164

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

. Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1))

### 28. Smooth Threshold Linearity Tests (COM)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.511778	(8. 140)	0.1582
H03: $b_1=b_2=b_3=0$	1.654491	(6. 142)	0.1365

H02: $b_1=b_2=0$	1.608099	(4. 144)	0.1754
H01: $b_1=0$	0.164424	(2. 146)	0.8485

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.715322	(2. 142)	0.1836
H2: $b_2=0 \mid b_3=0$	3.047163	(2. 144)	0.0506
H1: $b_1=0 \mid b_2=b_3=0$	0.164424	(2. 146)	0.8485

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 29. Smooth Threshold Linearity Tests (CRG)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.849842	(8. 140)	0.0727
H03: $b_1=b_2=b_3=0$	1.787166	(6. 142)	0.1058
H02: $b_1=b_2=0$	2.025859	(4. 144)	0.0939
H01: $b_1=0$	2.403131	(2. 146)	0.0940

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.293277	(2. 142)	0.2776
H2: $b_2=0 \mid b_3=0$	1.627916	(2. 144)	0.1999
H1: $b_1=0 \mid b_2=b_3=0$	2.403131	(2. 146)	0.0940

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 30. Smooth Threshold Linearity Tests (CSB)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.485729	(8. 141)	0.1675
H03: $b_1=b_2=b_3=0$	1.711771	(6. 143)	0.1223

H02: $b_1=b_2=0$	1.608833	(4. 145)	0.1752
H01: $b_1=0$	0.576878	(2. 147)	0.5629

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.878651	(2. 143)	0.1565
H2: $b_2=0 \mid b_3=0$	2.628011	(2. 145)	0.0757
H1: $b_1=0 \mid b_2=b_3=0$	0.576878	(2. 147)	0.5629

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 31. Smooth Threshold Linearity Tests (CUL)

Sample: 2003M01 2015M11

Included observations: 146

Test for nonlinearity using USDZAR(-9) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.996973	(8. 135)	0.4414
H03: $b_1=b_2=b_3=0$	1.184558	(6. 137)	0.3181
H02: $b_1=b_2=0$	1.350389	(4. 139)	0.2544
H01: $b_1=0$	0.262364	(2. 141)	0.7696

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.858399	(2. 137)	0.4261
H2: $b_2=0 \mid b_3=0$	2.433080	(2. 139)	0.0915
H1: $b_1=0 \mid b_2=b_3=0$	0.262364	(2. 141)	0.7696

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 32. Smooth Threshold Linearity Tests (DAW)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.701003	(8. 143)	0.1030

H03: $b_1=b_2=b_3=0$	2.110917	(6. 145)	0.0554
H02: $b_1=b_2=0$	1.649278	(4. 147)	0.1650
H01: $b_1=0$	2.066460	(2. 149)	0.1302

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.946825	(2. 145)	0.0557
H2: $b_2=0 \mid b_3=0$	1.225832	(2. 147)	0.2965
H1: $b_1=0 \mid b_2=b_3=0$	2.066460	(2. 149)	0.1302

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 33. Smooth Threshold Linearity Tests (DCT)

Sample: 2003M01 2015M11

Included observations: 146

Test for nonlinearity using USDZAR(-9) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.650097	(8. 135)	0.1164
H03: $b_1=b_2=b_3=0$	2.217199	(6. 137)	0.0450
H02: $b_1=b_2=0$	1.135679	(4. 139)	0.3423
H01: $b_1=0$	0.327923	(2. 141)	0.7210

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	4.273265	(2. 137)	0.0158
H2: $b_2=0 \mid b_3=0$	1.939067	(2. 139)	0.1477
H1: $b_1=0 \mid b_2=b_3=0$	0.327923	(2. 141)	0.7210

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

Linear model is rejected at the 5% level using H03.

**Recommended model: first-order logistic.**

**. Pr(H3) <= Pr(H2)**

### 34. Smooth Threshold Linearity Tests (DST)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.281390	(8. 136)	0.2582
H03: $b_1=b_2=b_3=0$	1.595875	(6. 138)	0.1528

H02: $b_1=b_2=0$	0.978037	(4. 140)	0.4217
H01: $b_1=0$	1.980933	(2. 142)	0.1417

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.781761	(2. 138)	0.0654
H2: $b_2=0 \mid b_3=0$	0.002960	(2. 140)	0.9970
H1: $b_1=0 \mid b_2=b_3=0$	1.980933	(2. 142)	0.1417

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 35. Smooth Threshold Linearity Tests (DTA)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.449614	(8. 143)	0.8892
H03: $b_1=b_2=b_3=0$	0.206963	(6. 145)	0.9742
H02: $b_1=b_2=0$	0.133056	(4. 147)	0.9700
H01: $b_1=0$	0.150422	(2. 149)	0.8605

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.357104	(2. 145)	0.7003
H2: $b_2=0 \mid b_3=0$	0.117471	(2. 147)	0.8892
H1: $b_1=0 \mid b_2=b_3=0$	0.150422	(2. 149)	0.8605

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 36. Smooth Threshold Linearity Tests (DTC)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.996805	(8. 142)	0.0509

H03: $b_1=b_2=b_3=0$	2.057346	(6. 144)	0.0618
H02: $b_1=b_2=0$	3.046163	(4. 146)	0.0190
H01: $b_1=0$	3.143569	(2. 148)	0.0460

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.150601	(2. 144)	0.8603
H2: $b_2=0 \mid b_3=0$	2.869345	(2. 146)	0.0599
H1: $b_1=0 \mid b_2=b_3=0$	3.143569	(2. 148)	0.0460

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 37. Smooth Threshold Linearity Tests (ELR)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.706765	(8. 141)	0.6852
H03: $b_1=b_2=b_3=0$	0.534660	(6. 143)	0.7812
H02: $b_1=b_2=0$	0.810998	(4. 145)	0.5201
H01: $b_1=0$	1.574811	(2. 147)	0.2105

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.004261	(2. 143)	0.9957
H2: $b_2=0 \mid b_3=0$	0.067172	(2. 145)	0.9351
H1: $b_1=0 \mid b_2=b_3=0$	1.574811	(2. 147)	0.2105

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 38. Smooth Threshold Linearity Tests (EOH)

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
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H04: $b_1=b_2=b_3=b_4=0$	2.233434	(8. 137)	0.0285
H03: $b_1=b_2=b_3=0$	1.699739	(6. 139)	0.1254
H02: $b_1=b_2=0$	0.920381	(4. 141)	0.4540
H01: $b_1=0$	1.616485	(2. 143)	0.2022

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.200986	(2. 139)	0.0437
H2: $b_2=0 \mid b_3=0$	0.241427	(2. 141)	0.7858
H1: $b_1=0 \mid b_2=b_3=0$	1.616485	(2. 143)	0.2022

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 39. Smooth Threshold Linearity Tests (EXX)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.580869	(8. 142)	0.7924
H03: $b_1=b_2=b_3=0$	0.577797	(6. 144)	0.7476
H02: $b_1=b_2=0$	0.677417	(4. 146)	0.6087
H01: $b_1=0$	0.924741	(2. 148)	0.3989

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.389880	(2. 144)	0.6779
H2: $b_2=0 \mid b_3=0$	0.437127	(2. 146)	0.6467
H1: $b_1=0 \mid b_2=b_3=0$	0.924741	(2. 148)	0.3989

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 40. Smooth Threshold Linearity Tests (FBR)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.206482	(8. 143)	0.0302

H03: $b_1=b_2=b_3=0$	2.899577	(6. 145)	0.0106
H02: $b_1=b_2=0$	3.951567	(4. 147)	0.0045
H01: $b_1=0$	4.425558	(2. 149)	0.0136

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.815442	(2. 145)	0.4445
H2: $b_2=0 \mid b_3=0$	3.338651	(2. 147)	0.0382
H1: $b_1=0 \mid b_2=b_3=0$	4.425558	(2. 149)	0.0136

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: **first-order logistic.**

.  $\Pr(H1) \leq \Pr(H2)$

#### 41. Smooth Threshold Linearity Tests (GND)

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.326289	(8. 138)	0.0225
H03: $b_1=b_2=b_3=0$	2.685004	(6. 140)	0.0169
H02: $b_1=b_2=0$	3.471702	(4. 142)	0.0097
H01: $b_1=0$	1.799281	(2. 144)	0.1691

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.101666	(2. 140)	0.3352
H2: $b_2=0 \mid b_3=0$	5.043087	(2. 142)	0.0077
H1: $b_1=0 \mid b_2=b_3=0$	1.799281	(2. 144)	0.1691

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  $\Pr(H2) < \Pr(H3)$  and  $\Pr(H2) < \Pr(H1)$

#### 42. Smooth Threshold Linearity Tests (GRF)

Sample: 2003M01 2015M11

Included observations: 146

Test for nonlinearity using USDZAR(-9) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.642713	(8. 135)	0.7406
H03: $b_1=b_2=b_3=0$	0.699789	(6. 137)	0.6502
H02: $b_1=b_2=0$	0.691970	(4. 139)	0.5987
H01: $b_1=0$	0.001922	(2. 141)	0.9981

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.720983	(2. 137)	0.4881
H2: $b_2=0 \mid b_3=0$	1.382008	(2. 139)	0.2545
H1: $b_1=0 \mid b_2=b_3=0$	0.001922	(2. 141)	0.9981

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 43. Smooth Threshold Linearity Tests (GRT)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	3.617992	(8. 142)	0.0007
H03: $b_1=b_2=b_3=0$	2.167953	(6. 144)	0.0494
H02: $b_1=b_2=0$	2.426768	(4. 146)	0.0505
H01: $b_1=0$	1.329305	(2. 148)	0.2678

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.609782	(2. 144)	0.2035
H2: $b_2=0 \mid b_3=0$	3.479687	(2. 146)	0.0334
H1: $b_1=0 \mid b_2=b_3=0$	1.329305	(2. 148)	0.2678

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  $\Pr(H2) < \Pr(H3)$  and  $\Pr(H2) < \Pr(H1)$

#### 44. Smooth Threshold Linearity Tests (HCI)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.431236	(8. 140)	0.1885
H03: $b_1=b_2=b_3=0$	1.385232	(6. 142)	0.2245
H02: $b_1=b_2=0$	2.006398	(4. 144)	0.0967
H01: $b_1=0$	0.880202	(2. 146)	0.4169

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.188147	(2. 142)	0.8287
H2: $b_2=0 \mid b_3=0$	3.107186	(2. 144)	0.0477
H1: $b_1=0 \mid b_2=b_3=0$	0.880202	(2. 146)	0.4169

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

**45. Smooth Threshold Linearity Tests (HDC)**

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.097707	(8. 137)	0.0400
H03: $b_1=b_2=b_3=0$	2.686998	(6. 139)	0.0169
H02: $b_1=b_2=0$	1.744480	(4. 141)	0.1435
H01: $b_1=0$	1.978586	(2. 143)	0.1420

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	4.403595	(2. 139)	0.0140
H2: $b_2=0 \mid b_3=0$	1.496631	(2. 141)	0.2274
H1: $b_1=0 \mid b_2=b_3=0$	1.978586	(2. 143)	0.1420

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H3) \leq \Pr(H2)$  or  $\Pr(H1) \leq \Pr(H2)$

**46. Smooth Threshold Linearity Tests (HWA)**

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.342557	(8. 140)	0.9479
H03: $b_1=b_2=b_3=0$	0.250243	(6. 142)	0.9585
H02: $b_1=b_2=0$	0.178025	(4. 144)	0.9494
H01: $b_1=0$	0.048637	(2. 146)	0.9525

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.397658	(2. 142)	0.6726
H2: $b_2=0   b_3=0$	0.307875	(2. 144)	0.7355
H1: $b_1=0   b_2=b_3=0$	0.048637	(2. 146)	0.9525

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 47. Smooth Threshold Linearity Tests (HWN)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.273373	(8. 136)	0.2624
H03: $b_1=b_2=b_3=0$	1.292939	(6. 138)	0.2644
H02: $b_1=b_2=0$	1.776987	(4. 140)	0.1368
H01: $b_1=0$	1.289079	(2. 142)	0.2787

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.357466	(2. 138)	0.7001
H2: $b_2=0   b_3=0$	2.242339	(2. 140)	0.1100
H1: $b_1=0   b_2=b_3=0$	1.289079	(2. 142)	0.2787

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 48. Smooth Threshold Linearity Tests (HYP)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.285078	(8. 139)	0.2560
H03: $b_1=b_2=b_3=0$	1.402648	(6. 141)	0.2177
H02: $b_1=b_2=0$	1.714602	(4. 143)	0.1500
H01: $b_1=0$	0.195591	(2. 145)	0.8226

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.788867	(2. 141)	0.4564
H2: $b_2=0 \mid b_3=0$	3.227604	(2. 143)	0.0426
H1: $b_1=0 \mid b_2=b_3=0$	0.195591	(2. 145)	0.8226

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 49. Smooth Threshold Linearity Tests (IDQ)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.237844	(8. 143)	0.9831
H03: $b_1=b_2=b_3=0$	0.222978	(6. 145)	0.9688
H02: $b_1=b_2=0$	0.237455	(4. 147)	0.9168
H01: $b_1=0$	0.245477	(2. 149)	0.7826

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.199199	(2. 145)	0.8196
H2: $b_2=0 \mid b_3=0$	0.231963	(2. 147)	0.7933
H1: $b_1=0 \mid b_2=b_3=0$	0.245477	(2. 149)	0.7826

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 50. Smooth Threshold Linearity Tests (IMP)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.616969	(8. 140)	0.0106
H03: $b_1=b_2=b_3=0$	3.192725	(6. 142)	0.0057
H02: $b_1=b_2=0$	4.615487	(4. 144)	0.0016
H01: $b_1=0$	5.912308	(2. 146)	0.0034

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.421384	(2. 142)	0.6570
H2: $b_2=0 \mid b_3=0$	3.144945	(2. 144)	0.0460
H1: $b_1=0 \mid b_2=b_3=0$	5.912308	(2. 146)	0.0034

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H1) \leq \Pr(H2)$

### 51. Smooth Threshold Linearity Tests (ING)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.720959	(8. 140)	0.6728
H03: $b_1=b_2=b_3=0$	0.467018	(6. 142)	0.8318
H02: $b_1=b_2=0$	0.632120	(4. 144)	0.6404
H01: $b_1=0$	0.611210	(2. 146)	0.5441

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.151710	(2. 142)	0.8594
H2: $b_2=0 \mid b_3=0$	0.655910	(2. 144)	0.5205
H1: $b_1=0 \mid b_2=b_3=0$	0.611210	(2. 146)	0.5441

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 52. Smooth Threshold Linearity Tests (IPL)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.315523	(8. 140)	0.9591
H03: $b_1=b_2=b_3=0$	0.403182	(6. 142)	0.8760
H02: $b_1=b_2=0$	0.487930	(4. 144)	0.7446
H01: $b_1=0$	0.076132	(2. 146)	0.9267

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.243935	(2. 142)	0.7839
H2: $b_2=0 \mid b_3=0$	0.899832	(2. 144)	0.4089
H1: $b_1=0 \mid b_2=b_3=0$	0.076132	(2. 146)	0.9267

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 53. Smooth Threshold Linearity Tests (ISA)

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.156133	(8. 137)	0.9959
H03: $b_1=b_2=b_3=0$	0.206436	(6. 139)	0.9743
H02: $b_1=b_2=0$	0.297181	(4. 141)	0.8794
H01: $b_1=0$	0.113761	(2. 143)	0.8926

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.033099	(2. 139)	0.9675
H2: $b_2=0 \mid b_3=0$	0.481425	(2. 141)	0.6189
H1: $b_1=0 \mid b_2=b_3=0$	0.113761	(2. 143)	0.8926

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 54. Smooth Threshold Linearity Tests (ITE)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.707124	(8. 143)	0.1015
H03: $b_1=b_2=b_3=0$	1.555907	(6. 145)	0.1642
H02: $b_1=b_2=0$	2.219762	(4. 147)	0.0696
H01: $b_1=0$	0.943927	(2. 149)	0.3914

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.272160	(2. 145)	0.7621
H2: $b_2=0   b_3=0$	3.464374	(2. 147)	0.0339
H1: $b_1=0   b_2=b_3=0$	0.943927	(2. 149)	0.3914

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 55. Smooth Threshold Linearity Tests (ITU)

+++++++.....632.3Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.470320	(8. 141)	0.1732
H03: $b_1=b_2=b_3=0$	1.779416	(6. 143)	0.1073
H02: $b_1=b_2=0$	1.863795	(4. 145)	0.1199
H01: $b_1=0$	2.292780	(2. 147)	0.1046

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.580797	(2. 143)	0.2094
H2: $b_2=0   b_3=0$	1.421656	(2. 145)	0.2447
H1: $b_1=0   b_2=b_3=0$	2.292780	(2. 147)	0.1046

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 56. Smooth Threshold Linearity Tests (IVT)

Sample: 2003M01 2015M11  
 Included observations: 149  
 Test for nonlinearity using USDZAR(-6) as the threshold variable  
 Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.893511	(8. 138)	0.5238
H03: $b_1=b_2=b_3=0$	1.085588	(6. 140)	0.3740
H02: $b_1=b_2=0$	1.495681	(4. 142)	0.2067
H01: $b_1=0$	0.630605	(2. 144)	0.5337

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.295100	(2. 140)	0.7449
H2: $b_2=0   b_3=0$	2.348943	(2. 142)	0.0992
H1: $b_1=0   b_2=b_3=0$	0.630605	(2. 144)	0.5337

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 57. Smooth Threshold Linearity Tests (JSC)

Sample: 2003M01 2015M11  
 Included observations: 152  
 Test for nonlinearity using USDZAR(-3) as the threshold variable  
 Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.481435	(8. 141)	0.1690
H03: $b_1=b_2=b_3=0$	1.743120	(6. 143)	0.1152
H02: $b_1=b_2=0$	2.619102	(4. 145)	0.0374
H01: $b_1=0$	4.572710	(2. 147)	0.0118

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.059135	(2. 143)	0.9426
H2: $b_2=0   b_3=0$	0.685086	(2. 145)	0.5057
H1: $b_1=0   b_2=b_3=0$	4.572710	(2. 147)	0.0118

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 58. Smooth Threshold Linearity Tests (LAB)

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.502333	(8. 138)	0.8529
H03: $b_1=b_2=b_3=0$	0.581480	(6. 140)	0.7446
H02: $b_1=b_2=0$	0.692441	(4. 142)	0.5984
H01: $b_1=0$	0.784039	(2. 144)	0.4585

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.371810	(2. 140)	0.6902
H2: $b_2=0   b_3=0$	0.605143	(2. 142)	0.5474
H1: $b_1=0   b_2=b_3=0$	0.784039	(2. 144)	0.4585

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 59. Smooth Threshold Linearity Tests (LON)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.927035	(8. 143)	0.4962
H03: $b_1=b_2=b_3=0$	1.143627	(6. 145)	0.3401
H02: $b_1=b_2=0$	1.558625	(4. 147)	0.1884
H01: $b_1=0$	3.054949	(2. 149)	0.0501

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.341556	(2. 145)	0.7112
H2: $b_2=0   b_3=0$	0.099238	(2. 147)	0.9056
H1: $b_1=0   b_2=b_3=0$	3.054949	(2. 149)	0.0501

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 60. Smooth Threshold Linearity Tests (MFL)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.430140	(8. 136)	0.1893
H03: $b_1=b_2=b_3=0$	0.821189	(6. 138)	0.5553
H02: $b_1=b_2=0$	0.964250	(4. 140)	0.4292
H01: $b_1=0$	0.401918	(2. 142)	0.6698

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.547532	(2. 138)	0.5796
H2: $b_2=0   b_3=0$	1.523618	(2. 140)	0.2215
H1: $b_1=0   b_2=b_3=0$	0.401918	(2. 142)	0.6698

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 61. Smooth Threshold Linearity Tests (MRF)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.746466	(8. 142)	0.0927
H03: $b_1=b_2=b_3=0$	0.544957	(6. 144)	0.7733
H02: $b_1=b_2=0$	0.661053	(4. 146)	0.6200
H01: $b_1=0$	0.782989	(2. 148)	0.4589

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.324988	(2. 144)	0.7231
H2: $b_2=0   b_3=0$	0.543943	(2. 146)	0.5816
H1: $b_1=0   b_2=b_3=0$	0.782989	(2. 148)	0.4589

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 62. Smooth Threshold Linearity Tests (MRP)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.470963	(8. 140)	0.8750
H03: $b_1=b_2=b_3=0$	0.575820	(6. 142)	0.7491
H02: $b_1=b_2=0$	0.785713	(4. 144)	0.5362
H01: $b_1=0$	0.354001	(2. 146)	0.7025

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.174060	(2. 142)	0.8404
H2: $b_2=0   b_3=0$	1.216375	(2. 144)	0.2993
H1: $b_1=0   b_2=b_3=0$	0.354001	(2. 146)	0.7025

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 63. Smooth Threshold Linearity Tests (MSM)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.902641	(8. 141)	0.0640
H03: $b_1=b_2=b_3=0$	1.716152	(6. 143)	0.1213
H02: $b_1=b_2=0$	2.377430	(4. 145)	0.0546
H01: $b_1=0$	0.700996	(2. 147)	0.4977

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.430919	(2. 143)	0.6508
H02: $b_2=0   b_3=0$	4.025014	(2. 145)	0.0199
H1: $b_1=0   b_2=b_3=0$	0.700996	(2. 147)	0.4977

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 64. Smooth Threshold Linearity Tests (MST)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

##### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.751771	(8. 141)	0.0916
H03: $b_1=b_2=b_3=0$	2.321316	(6. 143)	0.0361
H02: $b_1=b_2=0$	1.609213	(4. 145)	0.1751
H01: $b_1=0$	2.429946	(2. 147)	0.0916

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

##### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.628823	(2. 143)	0.0290
H2: $b_2=0   b_3=0$	0.795249	(2. 145)	0.4534
H1: $b_1=0   b_2=b_3=0$	2.429946	(2. 147)	0.0916

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H3) \leq \Pr(H2)$  or  $\Pr(H1) \leq \Pr(H2)$

#### 65. Smooth Threshold Linearity Tests (MTA)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

##### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.292410	(8. 136)	0.9675
H03: $b_1=b_2=b_3=0$	0.347904	(6. 138)	0.9101
H02: $b_1=b_2=0$	0.086497	(4. 140)	0.9865
H01: $b_1=0$	0.081651	(2. 142)	0.9216

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

##### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.871037	(2. 138)	0.4208
H2: $b_2=0   b_3=0$	0.092386	(2. 140)	0.9118



H2: $b_2=0 \mid b_3=0$	1.777117	(2. 146)	0.1728
H1: $b_1=0 \mid b_2=b_3=0$	1.946831	(2. 148)	0.1464

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 68. Smooth Threshold Linearity Tests (NCS)

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.099260	(8. 137)	0.3675
H03: $b_1=b_2=b_3=0$	1.064276	(6. 139)	0.3870
H02: $b_1=b_2=0$	1.019117	(4. 141)	0.3997
H01: $b_1=0$	1.602012	(2. 143)	0.2051

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.150251	(2. 139)	0.3196
H2: $b_2=0 \mid b_3=0$	0.448577	(2. 141)	0.6394
H1: $b_1=0 \mid b_2=b_3=0$	1.602012	(2. 143)	0.2051

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 69. Smooth Threshold Linearity Tests (NHM)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.796416	(8. 141)	0.6067
H03: $b_1=b_2=b_3=0$	0.808185	(6. 143)	0.5652
H02: $b_1=b_2=0$	0.326239	(4. 145)	0.8600
H01: $b_1=0$	0.000291	(2. 147)	0.9997

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.765191	(2. 143)	0.1749
H2: $b_2=0 \mid b_3=0$	0.652189	(2. 145)	0.5224



H2: $b_2=0 \mid b_3=0$	0.881951	(2. 145)	0.4162
H1: $b_1=0 \mid b_2=b_3=0$	1.664256	(2. 147)	0.1929

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

## 72. Smooth Threshold Linearity Tests (NTC)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	3.196853	(8. 143)	0.0023
H03: $b_1=b_2=b_3=0$	1.993907	(6. 145)	0.0702
H02: $b_1=b_2=0$	2.923030	(4. 147)	0.0231
H01: $b_1=0$	4.600170	(2. 149)	0.0115

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.199344	(2. 145)	0.8195
H2: $b_2=0 \mid b_3=0$	1.231590	(2. 147)	0.2948
H1: $b_1=0 \mid b_2=b_3=0$	4.600170	(2. 149)	0.0115

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

## 73. Smooth Threshold Linearity Tests (NWL)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.488497	(8. 143)	0.0147
H03: $b_1=b_2=b_3=0$	3.256757	(6. 145)	0.0049
H02: $b_1=b_2=0$	3.144024	(4. 147)	0.0163
H01: $b_1=0$	5.637631	(2. 149)	0.0044

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value

H3: $b_3=0$	3.286602	(2. 145)	0.0402
H2: $b_2=0 \mid b_3=0$	0.675010	(2. 147)	0.5107
H1: $b_1=0 \mid b_2=b_3=0$	5.637631	(2. 149)	0.0044

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. **Pr(H3) <= Pr(H2) or Pr(H1) <= Pr(H2)**

#### 74. Smooth Threshold Linearity Tests (OCE)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.250705	(8. 139)	0.0272
H03: $b_1=b_2=b_3=0$	2.519582	(6. 141)	0.0240
H02: $b_1=b_2=0$	3.695829	(4. 143)	0.0068
H01: $b_1=0$	6.661712	(2. 145)	0.0017

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.245125	(2. 141)	0.7829
H2: $b_2=0 \mid b_3=0$	0.752672	(2. 143)	0.4730
H1: $b_1=0 \mid b_2=b_3=0$	6.661712	(2. 145)	0.0017

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. **Pr(H1) <= Pr(H2)**

#### 75. Smooth Threshold Linearity Tests (OLG)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	18.51031	(8. 142)	0.0000
H03: $b_1=b_2=b_3=0$	18.68784	(6. 144)	0.0000
H02: $b_1=b_2=0$	28.27785	(4. 146)	0.0000
H01: $b_1=0$	29.53863	(2. 148)	0.0000

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.159213	(2. 144)	0.8530
H2: $b_2=0 \mid b_3=0$	19.59464	(2. 146)	0.0000
H1: $b_1=0 \mid b_2=b_3=0$	29.53863	(2. 148)	0.0000

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H1) \leq \Pr(H2)$

**76. Smooth Threshold Linearity Tests (OMN)**

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.927372	(8. 143)	0.0602
H03: $b_1=b_2=b_3=0$	2.222711	(6. 145)	0.0441
H02: $b_1=b_2=0$	1.580797	(4. 147)	0.1824
H01: $b_1=0$	2.697887	(2. 149)	0.0706

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.403166	(2. 145)	0.0359
H2: $b_2=0 \mid b_3=0$	0.482450	(2. 147)	0.6182
H1: $b_1=0 \mid b_2=b_3=0$	2.697887	(2. 149)	0.0706

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H3) \leq \Pr(H2)$  or  $\Pr(H1) \leq \Pr(H2)$

**77. Smooth Threshold Linearity Tests (PET)**

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.362875	(8. 138)	0.2181
H03: $b_1=b_2=b_3=0$	1.692158	(6. 140)	0.1272
H02: $b_1=b_2=0$	2.010463	(4. 142)	0.0962
H01: $b_1=0$	0.236198	(2. 144)	0.7899

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

**Terasvirta Sequential Tests**

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.052571	(2. 140)	0.3518
H2: $b_2=0 \mid b_3=0$	3.775623	(2. 142)	0.0253
H1: $b_1=0 \mid b_2=b_3=0$	0.236198	(2. 144)	0.7899

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

**78. Smooth Threshold Linearity Tests (PIK)**

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

**Linearity Tests**

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.236473	(8. 141)	0.0281
H03: $b_1=b_2=b_3=0$	2.875246	(6. 143)	0.0113
H02: $b_1=b_2=0$	4.353632	(4. 145)	0.0024
H01: $b_1=0$	2.553540	(2. 147)	0.0813

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

**Terasvirta Sequential Tests**

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.034437	(2. 143)	0.9662
H2: $b_2=0 \mid b_3=0$	5.980686	(2. 145)	0.0032
H1: $b_1=0 \mid b_2=b_3=0$	2.553540	(2. 147)	0.0813

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

**. Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1)**

**79. Smooth Threshold Linearity Tests (PNC)**

Sample: 2003M01 2015M11

Included observations: 146

Test for nonlinearity using USDZAR(-9) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

**Linearity Tests**

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.460717	(8. 135)	0.8818
H03: $b_1=b_2=b_3=0$	0.612873	(6. 137)	0.7197
H02: $b_1=b_2=0$	0.497446	(4. 139)	0.7376

H01: $b_1=0$	0.251481	(2. 141)	0.7780
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The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.845930	(2. 137)	0.4314
H2: $b_2=0 \mid b_3=0$	0.744324	(2. 139)	0.4769
H1: $b_1=0 \mid b_2=b_3=0$	0.251481	(2. 141)	0.7780

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 80. Smooth Threshold Linearity Tests (PPC)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.098115	(8. 136)	0.3684
H03: $b_1=b_2=b_3=0$	1.069672	(6. 138)	0.3837
H02: $b_1=b_2=0$	0.764699	(4. 140)	0.5499
H01: $b_1=0$	0.186869	(2. 142)	0.8298

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.665088	(2. 138)	0.1930
H2: $b_2=0 \mid b_3=0$	1.341629	(2. 140)	0.2648
H1: $b_1=0 \mid b_2=b_3=0$	0.186869	(2. 142)	0.8298

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 81. Smooth Threshold Linearity Tests (PPR)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	4.832901	(8. 143)	0.0000
H03: $b_1=b_2=b_3=0$	3.785197	(6. 145)	0.0016
H02: $b_1=b_2=0$	2.621792	(4. 147)	0.0372

H01: $b_1=0$	1.121503	(2. 149)	0.3285
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The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	5.771595	(2. 145)	0.0039
H2: $b_2=0 \mid b_3=0$	4.075779	(2. 147)	0.0189
H1: $b_1=0 \mid b_2=b_3=0$	1.121503	(2. 149)	0.3285

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. **Pr(H3) <= Pr(H2)**

### 82. Smooth Threshold Linearity Tests (RCL)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.069452	(8. 142)	0.0426
H03: $b_1=b_2=b_3=0$	1.148040	(6. 144)	0.3377
H02: $b_1=b_2=0$	1.424203	(4. 146)	0.2288
H01: $b_1=0$	0.691962	(2. 148)	0.5022

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.610896	(2. 144)	0.5443
H2: $b_2=0 \mid b_3=0$	2.145732	(2. 146)	0.1207
H1: $b_1=0 \mid b_2=b_3=0$	0.691962	(2. 148)	0.5022

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 83. Smooth Threshold Linearity Tests (RDF)

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	3.973085	(8. 138)	0.0003
H03: $b_1=b_2=b_3=0$	2.766032	(6. 140)	0.0143

H02: $b_1=b_2=0$	2.181152	(4. 142)	0.0741
H01: $b_1=0$	2.752180	(2. 144)	0.0671

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.765855	(2. 140)	0.0255
H2: $b_2=0 \mid b_3=0$	1.587660	(2. 142)	0.2080
H1: $b_1=0 \mid b_2=b_3=0$	2.752180	(2. 144)	0.0671

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  **$\Pr(H3) \leq \Pr(H2)$  or  $\Pr(H1) \leq \Pr(H2)$**

#### 84. Smooth Threshold Linearity Tests (REM)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.513013	(8. 139)	0.0140
H03: $b_1=b_2=b_3=0$	2.971462	(6. 141)	0.0092
H02: $b_1=b_2=0$	3.016395	(4. 143)	0.0200
H01: $b_1=0$	1.581331	(2. 145)	0.2092

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.735188	(2. 141)	0.0683
H2: $b_2=0 \mid b_3=0$	4.377786	(2. 143)	0.0143
H1: $b_1=0 \mid b_2=b_3=0$	1.581331	(2. 145)	0.2092

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  **$\Pr(H2) < \Pr(H3)$  and  $\Pr(H2) < \Pr(H1)$**

#### 85. Smooth Threshold Linearity Tests (RLO)

Sample: 2003M01 2015M11

Included observations: 143

Test for nonlinearity using USDZAR(-12) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value

H04: $b_1=b_2=b_3=b_4=0$	1.993065	(8. 132)	0.0520
H03: $b_1=b_2=b_3=0$	2.459568	(6. 134)	0.0274
H02: $b_1=b_2=0$	3.681459	(4. 136)	0.0070
H01: $b_1=0$	6.174645	(2. 138)	0.0027

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.111945	(2. 134)	0.8942
H2: $b_2=0 \mid b_3=0$	1.172808	(2. 136)	0.3126
H1: $b_1=0 \mid b_2=b_3=0$	6.174645	(2. 138)	0.0027

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

.  $\Pr(H1) \leq \Pr(H2)$

### 86. Smooth Threshold Linearity Tests (RTO)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.187853	(8. 142)	0.3104
H03: $b_1=b_2=b_3=0$	1.111691	(6. 144)	0.3584
H02: $b_1=b_2=0$	0.845294	(4. 146)	0.4986
H01: $b_1=0$	0.735337	(2. 148)	0.4811

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.629899	(2. 144)	0.1995
H2: $b_2=0 \mid b_3=0$	0.955691	(2. 146)	0.3869
H1: $b_1=0 \mid b_2=b_3=0$	0.735337	(2. 148)	0.4811

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 87. Smooth Threshold Linearity Tests (SAP)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
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H04: $b_1=b_2=b_3=b_4=0$	2.433023	(8. 143)	0.0170
H03: $b_1=b_2=b_3=0$	2.539335	(6. 145)	0.0229
H02: $b_1=b_2=0$	0.327170	(4. 147)	0.8594
H01: $b_1=0$	0.065461	(2. 149)	0.9367

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	6.911040	(2. 145)	0.0014
H2: $b_2=0 \mid b_3=0$	0.589241	(2. 147)	0.5561
H1: $b_1=0 \mid b_2=b_3=0$	0.065461	(2. 149)	0.9367

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. Pr(H3) <= Pr(H2)

### 88. Smooth Threshold Linearity Tests (SBV)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.170537	(8. 139)	0.3212
H03: $b_1=b_2=b_3=0$	1.471269	(6. 141)	0.1922
H02: $b_1=b_2=0$	2.155343	(4. 143)	0.0771
H01: $b_1=0$	1.539116	(2. 145)	0.2181

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.154118	(2. 141)	0.8573
H2: $b_2=0 \mid b_3=0$	2.734743	(2. 143)	0.0683
H1: $b_1=0 \mid b_2=b_3=0$	1.539116	(2. 145)	0.2181

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 89. Smooth Threshold Linearity Tests (SHP)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.111227	(8. 141)	0.3593
H03: $b_1=b_2=b_3=0$	1.204863	(6. 143)	0.3072
H02: $b_1=b_2=0$	1.805065	(4. 145)	0.1310
H01: $b_1=0$	1.531943	(2. 147)	0.2195

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.051681	(2. 143)	0.9496
H2: $b_2=0 \mid b_3=0$	2.056172	(2. 145)	0.1317
H1: $b_1=0 \mid b_2=b_3=0$	1.531943	(2. 147)	0.2195

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 90. Smooth Threshold Linearity Tests (SNH)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.260749	(8. 142)	0.0264
H03: $b_1=b_2=b_3=0$	1.509943	(6. 144)	0.1789
H02: $b_1=b_2=0$	2.019035	(4. 146)	0.0948
H01: $b_1=0$	2.347185	(2. 148)	0.0992

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.518398	(2. 144)	0.5966
H2: $b_2=0 \mid b_3=0$	1.669644	(2. 146)	0.1919
H1: $b_1=0 \mid b_2=b_3=0$	2.347185	(2. 148)	0.0992

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 91. Smooth Threshold Linearity Tests (SNU)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.541807	(8. 140)	0.8233
H03: $b_1=b_2=b_3=0$	0.676209	(6. 142)	0.6691
H02: $b_1=b_2=0$	0.997706	(4. 144)	0.4109
H01: $b_1=0$	0.535838	(2. 146)	0.5863

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.059286	(2. 142)	0.9425
H2: $b_2=0 \mid b_3=0$	1.456225	(2. 144)	0.2365
H1: $b_1=0 \mid b_2=b_3=0$	0.535838	(2. 146)	0.5863

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 92. Smooth Threshold Linearity Tests (SOL)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	3.164612	(8. 143)	0.0025
H03: $b_1=b_2=b_3=0$	1.810163	(6. 145)	0.1010
H02: $b_1=b_2=0$	1.487884	(4. 147)	0.2088
H01: $b_1=0$	1.825738	(2. 149)	0.1647

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	2.398116	(2. 145)	0.0945
H2: $b_2=0 \mid b_3=0$	1.146441	(2. 147)	0.3206
H1: $b_1=0 \mid b_2=b_3=0$	1.825738	(2. 149)	0.1647

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 93. Smooth Threshold Linearity Tests (SPA)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.877135	(8. 140)	0.5375
H03: $b_1=b_2=b_3=0$	0.709737	(6. 142)	0.6423
H02: $b_1=b_2=0$	0.949634	(4. 144)	0.4373
H01: $b_1=0$	0.617744	(2. 146)	0.5406

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.249736	(2. 142)	0.7793
H2: $b_2=0   b_3=0$	1.279160	(2. 144)	0.2814
H1: $b_1=0   b_2=b_3=0$	0.617744	(2. 146)	0.5406

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 94. Smooth Threshold Linearity Tests (SPG)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.217662	(8. 142)	0.0294
H03: $b_1=b_2=b_3=0$	2.858151	(6. 144)	0.0116
H02: $b_1=b_2=0$	0.797818	(4. 146)	0.5284
H01: $b_1=0$	0.695482	(2. 148)	0.5005

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	6.850927	(2. 144)	0.0014
H2: $b_2=0   b_3=0$	0.901084	(2. 146)	0.4084
H1: $b_1=0   b_2=b_3=0$	0.695482	(2. 148)	0.5005

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: first-order logistic.

. Pr(H3) <= Pr(H2)

#### 95. Smooth Threshold Linearity Tests (SUI)

Sample: 2003M01 2015M11

Included observations: 150

Test for nonlinearity using USDZAR(-5) as the threshold variable  
Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.638638	(8. 139)	0.0101
H03: $b_1=b_2=b_3=0$	3.327119	(6. 141)	0.0043
H02: $b_1=b_2=0$	3.301862	(4. 143)	0.0127
H01: $b_1=0$	2.594115	(2. 145)	0.0782

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.176603	(2. 141)	0.0447
H2: $b_2=0   b_3=0$	3.905642	(2. 143)	0.0223
H1: $b_1=0   b_2=b_3=0$	2.594115	(2. 145)	0.0782

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  **$Pr(H2) < Pr(H3)$  and  $Pr(H2) < Pr(H1)$**

#### 96. Smooth Threshold Linearity Tests (SUR)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.760205	(8. 141)	0.0898
H03: $b_1=b_2=b_3=0$	2.127759	(6. 143)	0.0537
H02: $b_1=b_2=0$	2.928243	(4. 145)	0.0230
H01: $b_1=0$	0.794452	(2. 147)	0.4538

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.562158	(2. 143)	0.5712
H2: $b_2=0   b_3=0$	5.018598	(2. 145)	0.0078
H1: $b_1=0   b_2=b_3=0$	0.794452	(2. 147)	0.4538

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 97. Smooth Threshold Linearity Tests (SVB)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

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Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.159197	(8. 141)	0.3281
H03: $b_1=b_2=b_3=0$	1.532045	(6. 143)	0.1718
H02: $b_1=b_2=0$	1.667308	(4. 145)	0.1607
H01: $b_1=0$	3.069446	(2. 147)	0.0494

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The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

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Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.250019	(2. 143)	0.2896
H2: $b_2=0   b_3=0$	0.294627	(2. 145)	0.7453
H1: $b_1=0   b_2=b_3=0$	3.069446	(2. 147)	0.0494

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All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

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#### 98. Smooth Threshold Linearity Tests (TBS)

Sample: 2003M01 2015M11

Included observations: 149

Test for nonlinearity using USDZAR(-6) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

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Linearity Tests Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.491292	(8. 138)	0.0148
H03: $b_1=b_2=b_3=0$	0.888579	(6. 140)	0.5051
H02: $b_1=b_2=0$	1.191251	(4. 142)	0.3173
H01: $b_1=0$	1.372903	(2. 144)	0.2567

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The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

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Terasvirta Sequential Tests Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.306506	(2. 140)	0.7365
H2: $b_2=0   b_3=0$	1.009419	(2. 142)	0.3670
H1: $b_1=0   b_2=b_3=0$	1.372903	(2. 144)	0.2567

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All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

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### 99. Smooth Threshold Linearity Tests (TDH)

Sample: 2003M01 2015M11

Included observations: 151

Test for nonlinearity using USDZAR(-4) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.933619	(8. 140)	0.4909
H03: $b_1=b_2=b_3=0$	0.756034	(6. 142)	0.6056
H02: $b_1=b_2=0$	0.640385	(4. 144)	0.6345
H01: $b_1=0$	0.819876	(2. 146)	0.4425

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.987554	(2. 142)	0.3750
H2: $b_2=0   b_3=0$	0.466881	(2. 144)	0.6279
H1: $b_1=0   b_2=b_3=0$	0.819876	(2. 146)	0.4425

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 100. Smooth Threshold Linearity Tests (TFG)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.360604	(8. 141)	0.0205
H03: $b_1=b_2=b_3=0$	3.156797	(6. 143)	0.0062
H02: $b_1=b_2=0$	4.144124	(4. 145)	0.0033
H01: $b_1=0$	3.367150	(2. 147)	0.0372

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
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H3: $b_3=0$	1.163456	(2. 143)	0.3153
H2: $b_2=0 \mid b_3=0$	4.749335	(2. 145)	0.0100
H1: $b_1=0 \mid b_2=b_3=0$	3.367150	(2. 147)	0.0372

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

. **Pr(H2) < Pr(H3) and Pr(H2) < Pr(H1)**

### 101. Smooth Threshold Linearity Tests (TPC)

Sample: 2003M01 2015M11

Included observations: 148

Test for nonlinearity using USDZAR(-7) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.711485	(8. 137)	0.6810
H03: $b_1=b_2=b_3=0$	0.891560	(6. 139)	0.5030
H02: $b_1=b_2=0$	1.283640	(4. 141)	0.2793
H01: $b_1=0$	0.546520	(2. 143)	0.5802

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.138763	(2. 139)	0.8706
H2: $b_2=0 \mid b_3=0$	2.013017	(2. 141)	0.1374
H1: $b_1=0 \mid b_2=b_3=0$	0.546520	(2. 143)	0.5802

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 102. Smooth Threshold Linearity Tests (TRE)

Sample: 2003M01 2015M11

Included observations: 147

Test for nonlinearity using USDZAR(-8) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

#### Linearity Tests

Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.277741	(8. 136)	0.2601
H03: $b_1=b_2=b_3=0$	0.837203	(6. 138)	0.5432
H02: $b_1=b_2=0$	0.509288	(4. 140)	0.7290
H01: $b_1=0$	0.869796	(2. 142)	0.4213

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

#### Terasvirta Sequential Tests

Null Hypothesis	F-statistic	d.f.	p-value
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H3: $b_3=0$	1.485961	(2. 138)	0.2299
H2: $b_2=0 \mid b_3=0$	0.159083	(2. 140)	0.8531
H1: $b_1=0 \mid b_2=b_3=0$	0.869796	(2. 142)	0.4213

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

### 103. Smooth Threshold Linearity Tests (TSX)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.624999	(8. 142)	0.0104
H03: $b_1=b_2=b_3=0$	3.253640	(6. 144)	0.0050
H02: $b_1=b_2=0$	4.016900	(4. 146)	0.0040
H01: $b_1=0$	2.352452	(2. 148)	0.0987

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	1.655032	(2. 144)	0.1947
H2: $b_2=0 \mid b_3=0$	5.537114	(2. 146)	0.0048
H1: $b_1=0 \mid b_2=b_3=0$	2.352452	(2. 148)	0.0987

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is rejected at the 5% level using H03.**

Recommended model: exponential.

.  **$\Pr(H_2) < \Pr(H_3)$  and  $\Pr(H_2) < \Pr(H_1)$**

### 104. Smooth Threshold Linearity Tests (WBO)

Sample: 2003M01 2015M11

Included observations: 154

Test for nonlinearity using USDZAR(-1) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	2.834630	(8. 143)	0.0060
H03: $b_1=b_2=b_3=0$	1.850520	(6. 145)	0.0933
H02: $b_1=b_2=0$	0.940222	(4. 147)	0.4425
H01: $b_1=0$	0.552009	(2. 149)	0.5770

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	3.604481	(2. 145)	0.0297
H2: $b_2=0 \mid b_3=0$	1.326020	(2. 147)	0.2687
H1: $b_1=0 \mid b_2=b_3=0$	0.552009	(2. 149)	0.5770

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 105. Smooth Threshold Linearity Tests (WHL)

Sample: 2003M01 2015M11

Included observations: 152

Test for nonlinearity using USDZAR(-3) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	1.095077	(8. 141)	0.3702
H03: $b_1=b_2=b_3=0$	1.428516	(6. 143)	0.2076
H02: $b_1=b_2=0$	2.126799	(4. 145)	0.0804
H01: $b_1=0$	0.962454	(2. 147)	0.3843

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.085597	(2. 143)	0.9180
H2: $b_2=0 \mid b_3=0$	3.261531	(2. 145)	0.0412
H1: $b_1=0 \mid b_2=b_3=0$	0.962454	(2. 147)	0.3843

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**

#### 106. Smooth Threshold Linearity Tests (WNH)

Sample: 2003M01 2015M11

Included observations: 153

Test for nonlinearity using USDZAR(-2) as the threshold variable

Taylor series alternatives:  $b_0 + b_1*s [ + b_2*s^2 + b_3*s^3 + b_4*s^4 ]$

Linearity Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H04: $b_1=b_2=b_3=b_4=0$	0.971631	(8. 142)	0.4607
H03: $b_1=b_2=b_3=0$	0.547155	(6. 144)	0.7716
H02: $b_1=b_2=0$	0.828699	(4. 146)	0.5089
H01: $b_1=0$	0.721652	(2. 148)	0.4877

The H0i test uses the i-th order Taylor expansion ( $b_j=0$  for all  $j>i$ ).

Terasvirta Sequential Tests			
Null Hypothesis	F-statistic	d.f.	p-value
H3: $b_3=0$	0.006620	(2, 144)	0.9934
H2: $b_2=0 \mid b_3=0$	0.936367	(2, 146)	0.3944
H1: $b_1=0 \mid b_2=b_3=0$	0.721652	(2, 148)	0.4877

All tests are based on the third-order Taylor expansion ( $b_4=0$ ).

**Linear model is not rejected at the 5% level using H03.**









### Bounds Tests of the Asymmetric ARDL Model:

				95% Lower Bounds	95% upper bound	Outcome	
	Wald Test: Equation: NARDLUSDZAR						
ACL	Test Statistic	Value	df	Probability			
	F-statistic	<b>31.67896</b>	(5, 126)	0.0000	5.15	6.36	Cointegration
	Chi-square	158.3948	5	0.0000			
	Wald Test: Equation: NARDLUSDZAR						
ADH	Test Statistic	Value	df	Probability			
	F-statistic	<b>28.51210</b>	(5, 123)	0.0000	5.15	6.36	Cointegration
	Chi-square	142.5605	5	0.0000			
	Wald Test: Equation: NARDLUSDZAR						
ADI	Test Statistic	Value	df	Probability			
	F-statistic	<b>53.50796</b>	(5, 130)	0.0000	5.15	6.36	Cointegration
	Chi-square	267.5398	5	0.0000			
	Wald Test: Equation: NARDLUSDZAR						
AEG	Test Statistic	Value	df	Probability	5.15	6.36	No

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F-statistic	<b>5.612398</b>	(5. 111)	0.0001
Chi-square	28.06199	5	0.0000

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Wald Test:  
Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability			
F-statistic	<b>25.22224</b>	(5. 123)	0.0000	5.15	6.36	Cointegration
Chi-square	126.1112	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability			
F-statistic	<b>26.40646</b>	(5. 122)	0.0000	5.15	6.36	Cointegration
Chi-square	132.0323	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability			
F-statistic	<b>44.93760</b>	(5. 131)	0.0000	5.15	6.36	Cointegration
Chi-square	224.6880	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability			
F-statistic	<b>13.85645</b>	(5. 120)	0.0000	5.15	6.36	Cointegration
Chi-square	69.28223	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability			
F-statistic	<b>16.40149</b>	(5. 124)	0.0000	5.15	6.36	Cointegration

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Chi-square	82.00746	5	0.0000
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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>32.75285</b>	(5, 121)	0.0000	5.15	6.36	Cointegration
Chi-square	163.7643	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>29.01189</b>	(5, 134)	0.0000	5.15	6.36	Cointegration
Chi-square	145.0594	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>23.37691</b>	(5, 123)	0.0000	5.15	6.36	Cointegration
Chi-square	116.8845	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>20.01693</b>	(5, 121)	0.0000	5.15	6.36	Cointegration
Chi-square	100.0846	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>8.185486</b>	(5, 119)	0.0000	5.15	6.36	Cointegration
Chi-square	40.92743	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>12.36513</b>	(5. 126)	0.0000	5.15	6.36	Cointegration
Chi-square	61.82563	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>10.07793</b>	(5. 111)	0.0000	5.15	6.36	Cointegration
Chi-square	50.38966	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>44.45402</b>	(5. 126)	0.0000	5.15	6.36	Cointegration
Chi-square	222.2701	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>31.86805</b>	(5. 125)	0.0000	5.15	6.36	Cointegration
Chi-square	159.3403	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>13.67145</b>	(5. 121)	0.0000	5.15	6.36	Cointegration
Chi-square	68.35723	5	0.0000			

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				Cointegration		
Wald Test:						
Equation: NARDLUSDZAR						
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	Test Statistic	Value	df	Probability		
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BEL	F-statistic	<b>47.34783</b>	(5. 112)	0.0000	5.15	6.36
	Chi-square	236.7392	5	0.0000		
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				Cointegration		
Wald Test:						
Equation: NARDLUSDZAR						
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
BIL	F-statistic	<b>12.04920</b>	(5. 113)	0.0000	5.15	6.36
	Chi-square	60.24598	5	0.0000		
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				Cointegration		
Wald Test:						
Equation: NARDLUSDZAR						
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
BSR	F-statistic	<b>22.10541</b>	(5. 125)	0.0000	5.15	6.36
	Chi-square	110.5271	5	0.0000		
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				Cointegration		
Wald Test:						
Equation: NARDLUSDZAR						
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	Test Statistic	Value	df	Probability		
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BVT	F-statistic	<b>37.15812</b>	(5. 116)	0.0000	5.15	6.36
	Chi-square	185.7906	5	0.0000		
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				Cointegration		
Wald Test:						
Equation: NARDLUSDZAR						
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	Test Statistic	Value	df	Probability		
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CFR	F-statistic	<b>40.30700</b>	(5. 132)	0.0000	5.15	6.36
	Chi-square	201.5350	5	0.0000		
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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>14.31565</b>	(5. 106)	0.0000	5.15	6.36	Cointegration
Chi-square	71.57824	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>27.21356</b>	(5. 117)	0.0000	5.15	6.36	
Chi-square	136.0678	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>34.27958</b>	(5. 116)	0.0000	5.15	6.36	Cointegration
Chi-square	171.3979	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>6.749496</b>	(5. 108)	0.0000	5.15	6.36	Cointegration
Chi-square	33.74748	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>35.54287</b>	(5. 122)	0.0000	5.15	6.36	Cointegration
Chi-square	177.7143	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability
F-statistic	35.77858	(5, 131)	0.0000
Chi-square	178.8929	5	0.0000

CRG      5.15      6.36      Cointegration

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability
F-statistic	<b>28.71984</b>	(5, 121)	0.0000
Chi-square	143.5992	5	0.0000

CSB      5.15      6.36      Cointegration

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability
F-statistic	<b>40.45329</b>	(5, 134)	0.0000
Chi-square	202.2664	5	0.0000

CUL      5.15      6.36      Cointegration

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability
F-statistic	<b>19.12955</b>	(5, 118)	0.0000
Chi-square	95.64775	5	0.0000

DAW      5.15      6.36      Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability
F-statistic	<b>30.22475</b>	(5, 121)	0.0000
Chi-square	151.1237	5	0.0000

DCT      5.15      6.36      Cointegration

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Cointegration

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability		
F-statistic	<b>35.83382</b>	(5, 119)	0.0000	5.15	6.36
Chi-square	179.1691	5	0.0000		

DST

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>50.54280</b>	(5, 133)	0.0000	5.15	6.36	Cointegration
Chi-square	252.7140	5	0.0000			

DTA

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>17.96718</b>	(5, 118)	0.0000	5.15	6.36	Cointegration
Chi-square	89.83592	5	0.0000			

DTC

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>21.28157</b>	(5, 110)	0.0000	5.15	6.36	Cointegration
Chi-square	106.4079	5	0.0000			

ELR

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>30.40087</b>	(5, 113)	0.0000	5.15	6.36	Cointegration
Chi-square	152.0044	5	0.0000			

EOH

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						Cointegration
	Wald Test: Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
EXX	F-statistic	<b>29.11579</b>	(5. 122)	0.0000	5.15	6.36
	Chi-square	145.5789	5	0.0000		
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	Wald Test: Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
FBR	F-statistic	<b>14.00466</b>	(5. 110)	0.0000	5.15	6.36
	Chi-square	70.02329	5	0.0000		
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	Wald Test: Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
GND	F-statistic	<b>16.85302</b>	(5. 105)	0.0000	5.15	6.36
	Chi-square	84.26511	5	0.0000		
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	Wald Test: Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
GRF	F-statistic	<b>25.46522</b>	(5. 113)	0.0000	5.15	6.36
	Chi-square	127.3261	5	0.0000		
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	Wald Test: Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
GRT	F-statistic	<b>27.03026</b>	(5. 114)	0.0000	5.15	6.36
	Chi-square	135.1513	5	0.0000		
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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability				
HCI	F-statistic	<b>18.72248</b>	(5, 124)	0.0000	5.15	6.36	Cointegration
	Chi-square	93.61238	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability				
HDC	F-statistic	<b>33.70708</b>	(5, 136)	0.0000	5.15	6.36	Cointegration
	Chi-square	168.5354	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability				
HWA	F-statistic	<b>68.61915</b>	(5, 131)	0.0000	5.15	6.36	Cointegration
	Chi-square	343.0958	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability				
HWN	F-statistic	<b>30.31116</b>	(5, 122)	0.0000	5.15	6.36	Cointegration
	Chi-square	151.5558	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability				
HYP	F-statistic	<b>24.12607</b>	(5, 125)	0.0000	5.15	6.36	Cointegration

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Chi-square	120.6304	5	0.0000
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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability	5.15	6.36	Cointegration
F-statistic	<b>11.63186</b>	(5, 101)	0.0000			
Chi-square	58.15932	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability	5.15	6.36	Cointegration
F-statistic	<b>25.80004</b>	(5, 126)	0.0000			
Chi-square	129.0002	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability	5.15	6.36	Cointegration
F-statistic	<b>32.16382</b>	(5, 138)	0.0000			
Chi-square	160.8191	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability	5.15	6.36	Cointegration
F-statistic	<b>11.25001</b>	(5, 116)	0.0000			
Chi-square	56.25007	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability	5.15	6.36	Cointegration
F-statistic	<b>49.02962</b>	(5, 114)	0.0000			
Chi-square	245.1481	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>7.151205</b>	(5. 113)	0.0000	5.15	6.36	Cointegration
Chi-square	35.75603	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>32.85072</b>	(5. 120)	0.0000	5.15	6.36	Cointegration
Chi-square	164.2536	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>31.33470</b>	(5. 116)	0.0000	5.15	6.36	Cointegration
Chi-square	156.6735	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>39.08497</b>	(5. 120)	0.0000	5.15	6.36	Cointegration
Chi-square	195.4249	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>33.40619</b>	(5. 117)	0.0000	5.15	6.36	Cointegration
Chi-square	167.0309	5	0.0000			

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NO

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>3.706541</b>	(5. 125)	0.0037	5.15	6.36	
Chi-square	18.53270	5	0.0023			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>3.590360</b>	(5. 114)	0.0047	5.15	6.36	NO
Chi-square	17.95180	5	0.0030			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>10.17210</b>	(5. 116)	0.0000	5.15	6.36	Cointegration
Chi-square	50.86049	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>18.63498</b>	(5. 118)	0.0000	5.15	6.36	Cointegration
Chi-square	93.17489	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>8.086336</b>	(5. 107)	0.0000	5.15	6.36	Cointegration
Chi-square	40.43168	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>33.80548</b>	(5, 117)	0.0000	5.15	6.36	Cointegration
Chi-square	169.0274	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>29.65634</b>	(5, 129)	0.0000	5.15	6.36	Cointegration
Chi-square	148.2817	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>11.42950</b>	(5, 116)	0.0000	5.15	6.36	Cointegration
Chi-square	57.14752	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>25.04753</b>	(5, 126)	0.0000	5.15	6.36	Cointegration
Chi-square	125.2376	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>73.79258</b>	(5, 135)	0.0000	5.15	6.36	Cointegration
Chi-square	368.9629	5	0.0000			

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>15.84971</b>	(5, 126)	0.0000	5.15	6.36	Cointegration
Chi-square	79.24854	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>23.54756</b>	(5, 128)	0.0000	5.15	6.36	Cointegration
Chi-square	117.7378	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>30.04803</b>	(5, 125)	0.0000	5.15	6.36	Cointegration
Chi-square	150.2402	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	9.916297	(5, 117)	0.0000	5.15	6.36	Cointegration
Chi-square	49.58148	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>28.36108</b>	(5, 117)	0.0000	5.15	6.36	Cointegration
Chi-square	141.8054	5	0.0000			

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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
OCE	F-statistic	<b>33.10114</b>	(5. 116)	0.0000	5.15	6.36
	Chi-square	165.5057	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
	<hr/> <hr/>					
	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
OLG	F-statistic	<b>32.07503</b>	(5. 126)	0.0000	5.15	6.36
	Chi-square	160.3752	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
	<hr/> <hr/>					
	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
OMN	F-statistic	<b>17.77818</b>	(5. 104)	0.0000	5.15	6.36
	Chi-square	88.89089	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
PET	F-statistic	<b>40.39539</b>	(5. 119)	0.0000	5.15	6.36
	Chi-square	201.9770	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
	<hr/> <hr/>					
	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
PIK	F-statistic	<b>17.04237</b>	(5. 113)	0.0000	5.15	6.36
	Chi-square	85.21184	5	0.0000		
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						Cointegration
PNC						

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	Wald Test:			5.15	6.36	
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>23.09229</b>	(5. 117)	0.0000		
	Chi-square	115.4614	5	0.0000		
PPC	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	31.22410	(5. 125)	0.0000		
	Chi-square	156.1205	5	0.0000		
PPR	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>50.16601</b>	(5. 122)	0.0000		
	Chi-square	250.8300	5	0.0000		
RCL	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>12.56561</b>	(5. 119)	0.0000		
	Chi-square	62.82804	5	0.0000		
RDF	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>19.01676</b>	(5. 113)	0.0000		
	Chi-square	95.08381	5	0.0000		
REM	Wald Test:			5.15	6.36	

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Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability
F-statistic	<b>21.54980</b>	(5, 105)	0.0000
Chi-square	107.7490	5	0.0000

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Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

RLO

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Test Statistic	Value	df	Probability
F-statistic	<b>33.32858</b>	(5, 123)	0.0000
Chi-square	166.6429	5	0.0000

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5.15

6.36

Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

RTO

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Test Statistic	Value	df	Probability
F-statistic	<b>36.38558</b>	(5, 125)	0.0000
Chi-square	181.9279	5	0.0000

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5.15

6.36

Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

SAP

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Test Statistic	Value	df	Probability
F-statistic	<b>38.20246</b>	(5, 127)	0.0000
Chi-square	191.0123	5	0.0000

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5.15

6.36

Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

SBV

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Test Statistic	Value	df	Probability
F-statistic	<b>20.51139</b>	(5, 118)	0.0000
Chi-square	102.5570	5	0.0000

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5.15

6.36

Cointegration

SHP

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Wald Test:  
Equation: NARDLUSDZAR

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5.15

6.36

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Test Statistic	Value	df	Probability	
F-statistic	<b>33.13282</b>	(5. 115)	0.0000	
Chi-square	165.6641	5	0.0000	Cointegration

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Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>45.72577</b>	(5. 108)	0.0000	5.15	6.36	Cointegration
Chi-square	228.6288	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>40.69923</b>	(5. 115)	0.0000	5.15	6.36	Cointegration
Chi-square	203.4962	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>23.73408</b>	(5. 113)	0.0000	5.15	6.36	Cointegration
Chi-square	118.6704	5	0.0000			

---

Wald Test:  
Equation: NARDLUSDZAR

Test Statistic	Value	df	Probability			
F-statistic	<b>33.23972</b>	(5. 131)	0.0000	5.15	6.36	Cointegration
Chi-square	166.1986	5	0.0000			

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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
SPG	F-statistic	<b>22.62545</b>	(5. 108)	0.0000	5.15	6.36
	Chi-square	113.1273	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
	<hr/> <hr/>					
	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
SUI	F-statistic	<b>29.93228</b>	(5. 122)	0.0000	5.15	6.36
	Chi-square	149.6614	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
	<hr/> <hr/>					
	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
SUR	F-statistic	<b>28.25343</b>	(5. 125)	0.0000	5.15	6.36
	Chi-square	141.2672	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
SVB	F-statistic	<b>31.13291</b>	(5. 124)	0.0000	5.15	6.36
	Chi-square	155.6646	5	0.0000		
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						Cointegration
	Wald Test:					
	Equation: NARDLUSDZAR					
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	Test Statistic	Value	df	Probability		
	<hr/> <hr/>					
TBS	F-statistic	<b>7.398927</b>	(5. 116)	0.0000	5.15	6.36
	Chi-square	36.99464	5	0.0000		
	<hr/> <hr/>					

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						Cointegration
TDH						

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	Wald Test:			5.15	6.36	
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>23.04381</b>	(5. 119)	0.0000		
	Chi-square	115.2191	5	0.0000		
TFG	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>24.54377</b>	(5. 115)	0.0000		
	Chi-square	122.7189	5	0.0000		
TPC	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>22.47261</b>	(5. 121)	0.0000		
	Chi-square	112.3631	5	0.0000		
TRE	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>23.83223</b>	(5. 129)	0.0000		
	Chi-square	119.1612	5	0.0000		
TSX	Wald Test:			5.15	6.36	Cointegration
	Equation: NARDLUSDZAR					
	<b>Test Statistic</b>	<b>Value</b>	<b>df</b>	<b>Probability</b>		
	F-statistic	<b>36.30741</b>	(5. 120)	0.0000		
	Chi-square	181.5370	5	0.0000		
VLE	Wald Test:			5.15	6.36	

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Equation: NARDLUSDZAR

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Test Statistic	Value	df	Probability
F-statistic	<b>34.11619</b>	(5, 124)	0.0000
Chi-square	170.5809	5	0.0000

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Cointegration

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Wald Test:

Equation: NARDLUSDZAR

WBO

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Test Statistic	Value	df	Probability
F-statistic	<b>21.72676</b>	(5, 115)	0.0000
Chi-square	108.6338	5	0.0000

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5.15

6.36

Cointegration

---

Wald Test:

Equation: NARDLUSDZAR

WHL

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Test Statistic	Value	df	Probability
F-statistic	<b>26.19914</b>	(5, 124)	0.0000
Chi-square	130.9957	5	0.0000

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5.15

6.36

Cointegration

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Wald Test:

Equation: NARDLUSDZAR

WNH

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Test Statistic	Value	df	Probability
F-statistic	<b>34.55853</b>	(5, 127)	0.0000
Chi-square	172.7926	5	0.0000

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5.15

6.36

Cointegration

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