

**LEADING INDICATORS OF CURRENCY CRISIS - AN APPLICATION  
TO THE 1996 SOUTH AFRICAN CURRENCY CRISIS**

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## Abstract

Prior to the 1990 currency crisis theoretical and empirical studies concentrated on establishing the causes of currency crises. Models developed then focused mainly on finding out a fixed exchange rate policy combined with excessively expansionary pre-crisis fundamentals push the economy into crisis with the private sector trying to profit from inconsistent policies. The 1990 currency crises on government controlled exchange rate in Europe and Mexico led to the development of new models called the second generation models on which a crisis occurs when the economy suddenly jumps from one solution to the other resulting in multiple equilibria.

In these models the main cause of this multiplicity is the interaction between the private sector and government behaviour. There is no policy inconsistency before the crisis but the crisis itself induces a policy change that make the crises self- fulfilling. Policy- makers and academics have therefore focused their attention on policy discussions that involve identifying indicators of currency crisis. The process involves setting up early warning systems by monitoring the behaviour of certain key indicators.

This paper seeks to examine the pre- crisis behaviour of some of the leading indicators which according to some of the previous studies performed well as good indicators of the crises. The case study is therefore based on the South African 1996 currency crisis. The variables considered in the study are real import and exports, net reserves, M2/Reserves and domestic credit expansion. The attack on the rand in February 1996 caused a drastic depreciation of the rand against the major currencies. The study therefore aims at analysing the behaviour of the variables to find whether they were indeed leading indicators prior to the crisis year by giving signals and lead times long enough to have allowed policy-makers to take pre- emptive measures.

The study concludes that, the causes of currency crisis may arise from either external or internal shocks. This disturbance causes a divergence of the exchange rate from its equilibrium levels. The reaction of the government and economic agents to such shocks

may cause certain key macroeconomic variables to also diverge from their equilibrium levels. In the South African case study it is concluded that the so-called leading indicators did not perform well failing to give good signals and lead times.

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## INTRODUCTION

In the 1990s the study of financial crisis has taken on new urgency. The events, like the Mexican peso crisis in late 1994, have raised several questions about the nature of speculative attacks, the degree of exchange rate flexibility that is appropriate in the evolving international financial environment, and the role of the international financial support. The scale of the recent crises and the speed with which they now arise thus pose challenges for analysts seeking to understand the dynamics of the financial crises, and mostly for policymakers hoping to avoid them. Currency crises in Europe, Mexico, South East Asia as well as the collapse of the European Exchange rate mechanism in 1992-1993 have drawn world-wide attention to speculative attacks on government-controlled exchange rates and heightened interest in the causes and symptoms of currency crises. A key question for those investigating the roots of currency crises is how to apportion causality. Are currency crises caused by erratic changes in economic fundamentals or are they apt to result from self-fulfilling shifts in speculative behaviour? Or do they spring from a combination of these two?

A search for answers to the above questions has led researchers into finding indicators that can warn the government of a likelihood of a looming crisis and thus take pre-emptive measures. An accurate forecast of currency crises is likely to remain elusive but recent empirical work may be able to help identify warning systems. An IMF study by Graciela Kaminsky et al (1997) examines the literature on currency crises and proposes an early warning system. The authors suggest that a broad variety of indicators should be considered and their behaviour monitored before and during tranquil period. They therefore suggest a signal approach as the best since multiple problems usually precede currency crises.

The purpose of this paper is to look at the dynamics of currency crises, and identify leading indicators based on the theoretical models, literature and empirical studies performed. The main aim will be to use some of the indicators (especially those identified by Kaminsky et al 1997) to assess whether their behaviour before the South African 1996 currency crisis make them leading indicators.

The early work, now called first generation research, shows how a fixed exchange rate policy combined with excessively expansionary pre-crisis fundamentals push the economy into crisis, with the private sector trying to profit from inconsistent policies. Such incidences involved currency crises in countries such as Mexico (1973 - 82) and Argentina (1978 - 81). At that time the main indicator was excessive expansive domestic credit which resulted in the loss of international reserves.

The second-generation models on the other hand emphasise multiple equilibria arising from non-linearities in government behaviour. The studies concentrate on government behaviour and reaction to changes in private behaviour or its behaviour when it faces explicit trade-offs between the fixed exchange rate policy and its objectives. Some recent models stress the point that some crises are self-fulfilling. Some economists argue that even extrinsic or non-economic events - called "sunspots" by economists - can play a key role in altering market expectations about whether a government will be able to service debts. Hence a shift in market expectations can alter the government's trade-offs and bring about self-fulfilling crises.

In this, paper chapter 1 gives the theoretical literature on currency crises of the 1980s and 1990s. This section deals more with theories surrounding the emergence of a crises trying at the same time to pick up those variables which stood up as indicators of a currency collapse; such as real exchange rate, export, imports, terms of trade, output, M1, M2/Reserves, Reserves and interest rate differentials. Chapter 2 and 3 form the heart of the paper. In Chapter 2 the empirical literature and evidence on leading indicators of currency crises is given together with the stylised facts that characterise the periods surrounding the

crises given from the study by Kaminsky and Reinhart (1996). The methodology issues, i.e. how to choose the best leading indicators using the signals approach, is also discussed. Chapter three presents the case study on the South African 1996 currency crisis along the lines of the stylised facts presented in chapter two. The study focuses on observing the pre-crisis behaviour of some of the variables considered as leading indicators. The main aim here is to find out whether the indicators chosen indeed signalled the crisis.

Chapter four of the paper presents the specific and general policy implications and conclusions. Most important are the general policy implications with regard to the so-called leading indicators which are looked at critically.

# CHAPTER 1

## THEORETICAL LITERATURE AND MODELS OF SPECULATIVE ATTACKS AND INDICATORS OF CURRENCY CRISES.

### Introduction

According to Flood and Marion (1996) in the 1990s, currency crises in Mexico and Southeast Asia drew considerable attention to speculative attacks on government-controlled exchange rates (i.e. fixed exchange rates). These crises have therefore raised a number of questions as to whether such episodes can be predicted through systematic early warning signals or whether they are essentially unpredictable. To identify indicators of currency crises, theoretical models were developed to help come up with the theory behind such collapses. In this chapter the first section looks at the theoretical literature of attacks. The second section presents the two famous models of speculative attacks. From the theoretical literature and models on currency crises the leading indicators are domestic credit expansion, real exchange rate fiscal deficit, and international reserves.

### The theory of speculative attacks and indicators

Marion argues that before the 1990s, currency crises were thought to have a significant predictable component which the first group of economic researchers, namely the first generation used in their speculative attack models. The model argued that balance of payment crises occurred when deteriorating macroeconomic fundamentals become inconsistent with the fixed exchange rate regime. Krugman (1979) and Flood and Garber (1984) for instance developed models in which there exists a gradual loss of international reserves which ultimately led to a speculative attack on the domestic currency forcing the authorities to abandon the fixed parity, and eventually float the exchange rate. The main

cause according to these models is excess domestic credit expansion. The above model can be presented using a simple basic identity for the money supply:

$$\Delta MB = \Delta NDA + \Delta R$$

where  $\Delta MB$  is the increase in the money supply,  $\Delta NDA$  is the expansion of domestic credit, and  $\Delta R$  is the increase in foreign exchange reserves held by the Central Bank.

The identity shows that for a country's monetary base to change there should be an increase in domestic credit which tends to raise the money supply or alternatively loss of reserve. The link between reserve loss and the monetary base is that each sale of foreign reserves by the central bank absorbs local currency used by the private sector to purchase the foreign currency. Assuming that the inflow of the foreign capital declines, hence to finance the current account deficit, the central bank chose not to expand domestic credit i.e.  $\Delta NDA = 0$ .

Given the basic balance of payment identity

$$CAD = \Delta K - \Delta R$$

The identity says that a current account deficit (CAD) must be financed by private capital inflow,  $\Delta K$ , or a decline in foreign reserves,  $-\Delta R$ . So as  $\Delta K$  falls there are two options. Either the domestic private sector reduces spending to narrow CAD or they should run down money holdings by selling domestic currency to the central bank to buy foreign currency to be able to finance imports. The money holdings would however not fall very much as MB is used for transactions and not as a store of wealth. The demand for money is therefore a stable function of the level of GDP and would not fall simply because of a fall in foreign capital inflow. Hence this means that:

$\Delta MB = 0$  and  $\Delta R = 0$  meaning that the current account deficit will have to be reduced.

Now assume that the central bank decides to respond to the reduction in the inflow of capital by expanding domestic credit. Assuming that  $\Delta MB = 0$  then  $-\Delta R = \Delta NDA$ . Thus reserves could only fall as a direct result of domestic credit expansion. Commenting on the issue concerning the collapse of the Mexican currency in 1994 Sachs et al (1997) concluded that the decline in reserves was the result not of a withdrawal of foreign financing per se, but of the combination of the withdrawal and a policy of sterilised intervention followed by the Banco de Mexico in order to limit the interest rate effect of a declining capital inflow.

Fiscal expansion, credit creation, monetisation of the budget deficit and a decline in international reserves set the stage for a speculative attack on the fixed exchange rate by forward looking agents who were able to sense and exploit bad policies. Accordingly, credit creation could also spill over to domestic goods markets, leading to increases in the relative price of nontraded goods and hence resulting in a real exchange rate appreciation that would contribute to a trade deficit or smaller trade surplus. On the other hand uncertainty about the domestic credit policy or the level of reserves the authority is willing to commit to defend the fixed exchange rate can lead to an increase in domestic interest rates and the likelihood of a looming crises. (Agenor Bhandari, and Flood (1992)). According to Marion and Flood (1997) empirical evidence of the 1970s and 1980s appeared to validate the predictions of these first generation models.

Speculative attack of the 1990s, particularly in Europe, have challenged the view that currency crises were due largely to the government inability to achieve fiscal and monetary discipline. Theoretical models of balance of payment crises argue that a fixed exchange rate regime can be maintained only as long as it is compatible with other policies. Although some governments make policy mistakes and are disciplined eventually, others face hard policy choices, including resolving the tension between commitment to a fixed exchange rate and desire to pursue other policy goals. These theories therefore imply that a crises can arise even if there is no deterioration of economic

fundamentals (Obstfeld 1994). When speculators sense that a fixed parity is tightly constrained by other policy goals, that parity may be prone to an attack. For example, a government may be forced to abandon a fixed exchange rate if defending the parity involves increases in interest rates that unduly increase the cost of servicing the domestic debt or seriously weaken the banking system.

Recent theoretical work focuses on a broader set of indicators, including unemployment and the state of the banking system, which has improved the ability to predict some crises. Flood argues that even then, it is hard to generalise these results across a range of countries and time periods. The key feature of the more recent analyses is that macroeconomic policies are not regarded as predetermined but are taken as responding to the expectations of agents. Because these crises arise without obvious policy inconsistencies it becomes difficult to predict them.

However because a broader set of fundamentals that affect both the government and the market participants incentives and constraints are considered, it becomes possible to determine the balance of payment crises.

## **THE SPECULATIVE ATTACK MODELS AND INDICATORS**

### **The first generation model**

The historical first-generation model presented in this section (developed by Salait and Henderston (1978), Krugman (1979) and Flood and Garber (1984)) is one of a small country that initially maintained a pegged exchange rate system, hence the price of its currency is fixed in terms of the currency of a large foreign partner. It is the responsibility of the domestic monetary authority and the analysis in this case revolves around private and government actions in domestic money market. The other assumptions are that agents have perfect foresight hence the assets available to the domestic residents includes

domestic money, domestic bonds, foreign money, and foreign bonds. Similarly for the purpose of fixing the exchange rate, the domestic government holds a stock of foreign currency. The basic model is built around five equations below:

$$m - p = -\alpha(i), \alpha > 0 \quad (1)$$

$$m = d + r \quad (2)$$

$$p = p^* + s \quad (3)$$

$$i = i^* + s \quad (4)$$

$$D(t) = \mu, \mu > 0 \quad (5)$$

Equation (1) reflects the money market equilibrium condition, where  $m$  denotes the log of domestic supply of high-powered money,  $p$  is the domestic price level and  $i$  is the domestic interest rate. Equation (2) states that the domestic money supply equal domestic credit, given by log  $d$ , plus international reserves represented by log  $r$ . Equation 3 and 4 imposes the condition that the domestic interest rate ( $i$ ) and price level ( $p$ ) are subjected to international arbitrage condition. The two equations therefore impose purchasing power parity and uncovered interest parity.  $P^*$  is the log foreign price level usually held constant by assumption and  $s$  is the log exchange rate quoted as the domestic currency price of foreign exchange and  $i^*$  is the foreign currency interest rate and  $s$  is the expected and actual rate of exchange rate changes. The last equation states that domestic credit always grows at the positive constant rate  $\mu$ .

The dynamics of the foregoing model are as follows; during a fixed exchange rate period the domestic currency interest rate ( $i$ ) is equal to the foreign interest rates ( $i^*$ ) with domestic prices ( $p$ ) moving at par with the foreign price level ( $p^*$ ). The quantity of international reserves therefore adjusts to balance the money market. When a flexible exchange rate regime is maintained the exchange rate floats freely to balance the money market because both quantity of international reserves is normally held fixed. With exchange rate fixed then reserves have to adjust to maintain money market equilibrium.

The quantity of reserves at any time is

$$r = \alpha s - d. (6)$$

Assuming there exist a world of certainty, with exchange rate fixed at  $s = \bar{s}$  it then follows that  $\hat{s}=0$  and  $i=i^*$  where  $\hat{s}$  is the expected and actual rate of exchange rate changes.

If it is assumed there exists a deficit (balance of payment) that required domestic credit to grow at a constant rate  $\mu$ , with  $i^*$  and  $p^*$  constant. Substituting equation (2), (3), and (4) into equation (1) with  $\hat{s} = 0$  yields

$$r + d - p^* = \alpha(i^*). (7)$$

Therefore the rate of change of reserves is

$$r = d = -\mu. (8)$$

With fixed exchange rate and foreign price level fixed,  $d$  grows at the rate  $\mu$  and  $r$  falls at the same rate,  $r = -\mu$ , and eventually the country's reserves will be depleted leading to a collapse of the fixed exchange rate system. Assuming the government chooses to allow the exchange rate to float as did Mexico in 1994 as opposed to devaluing the domestic currency from one fixed rate to another, as happened in most European countries in 1992 - 1993, then the question is when is the time of the attack. Following the Flood and Gaber (1984 b) strategy of shadow exchange rate which is defined as the floating exchange rate that would prevail if speculators purchase the remaining government reserves committed to defending the fixed rate and then the government eventually allows the exchange rate to float. The concept of shadow rate is important as it helps determine the amount of profit that would accrue to speculators during a crisis and this will dictate the price at which they will sell the international reserves bought from the government. The shadow rate  $s$  is therefore is generally influenced by the amount of reserves available to the government following its optimal commitment to the fixed rate. In this particular scenario the reserves

are assumed at log zero after the attack. With the assumption that  $i^* = p^* = 0$  in mind, then the exchange rate that solves the post attack money market is

$$\dot{s} = \alpha\mu + d \quad (9)$$

which is consistent with

$$d - \dot{s} = -\alpha(\dot{s}). \quad (10)$$

A plot of equation (9) and pre-attack fixed exchange rate from a text by Flood and Marion (1996) is presented in figure 1 (see appendix). At part A  $\dot{s} = \bar{s}$  and that is where  $d = d^A$ .

If  $d > d^A$  and speculators attack at this level they will be able to profit from every unit of reserves they purchase from government since  $s > \bar{s}$ . Since they foresee the capital gain they will compete against each other by trying to get a jump and attack earlier. The competition continues until the attack is driven back in time to the point where  $d = d^A$ . However if speculators attack at the level where  $d < d^A$  then they stand not to profit because post-attack, the currency will appreciate and they will experience capital loss on reserves purchased. Hence they need not attack when  $d < d^A$ . It can be concluded from these analysis that a foreseen attack must take place when  $\dot{s} = \bar{s}$ .

One important element of the first-generation models is that at the time of a foreseen speculative attack, the domestic currency interest rate must jump up to reflect prospective currency depreciation. If the size of the attack is taken to be  $\Delta r$  which is negative in an attack, equation (9) reveals that the exchange rate will be increasing at the rate  $\mu$  after the attack, hence the interest parity there requires that the domestic currency rate increases by  $\mu$ . At the time of the attack the money market is adjusted by two movements.

(1) A reduction in high-powered money supply equal to the size of the attack.

(2) A drop in the demand for domestic currency due to an increase in the domestic interest rate increases. Hence money market balance requires that a drop in demand must be matched by a drop in money supply hence

$$\Delta r = -\alpha\mu. \quad (11)$$

From earlier equations it follows that since domestic credit follows

$$d_t = d_0 + \mu t \quad (12)$$

then international reserves also follow

$$r_t = r_0 + \mu t \quad (13)$$

Hence at the time of the attack, say  $T$ , reserves fall to zero. The attack condition from equation (13) then becomes

$$-\Delta r = r_0 - \mu T = \alpha\mu \quad (14)$$

Rearranging terms gives the attack time  $T$  as

$$T = (r_0 - \alpha\mu)/\mu \quad (15)$$

Equation (15) therefore concludes that as long as the level of reserves is high coupled by lower domestic credit expansion the fixed exchange rate system may survive longer. As

$$\mu \rightarrow 0$$

the collapse is delayed indefinitely.

The above first generation model equates the attack-caused drop in the domestic money supply with a reduction in demand for money caused by higher domestic interest rates that reflect post attack currency depreciation. Researchers of the 1990 currency crises have observed that the monetary authorities in their attempt to fight against the attack resorted to sterilising the money supply effects of reserve losses to allow a smooth money growth through the attack period. Incorporating the sterilisation policies into the standard model modifies the money market equilibrium. Holding money supply constant, i.e.  $m = \bar{m}$  under a fixed exchange regime gives the money market equilibrium:

$$\bar{m} - p^* - \bar{s} = -\alpha(i^*) \quad (16)$$

As already discussed above, following an attack, there will be international reserve loss and a switch to a flexible exchange rate ( $s$ ) with money supply growing at the rate  $\mu > 0$ . Exchange rate  $s$  will rise at the rate  $\mu$  and domestic interest rate will be  $i=i^*$ . Immediately after the attack the money market equation(domestic) will be

$$m - p^* - \acute{s} = -\alpha/(i^* + \mu) \quad (17)$$

Subtracting equation 17 from 16 yields

$$\acute{s} - \bar{s} = \alpha\mu > 0 \quad (18)$$

Equation 8 predicts that no fixed exchange rate regime can survive no matter how high  $s$  is set or how high the international reserves are because  $\acute{s} > \bar{s}$ . If the monetary authority is unwilling to allow monetary policy to play a secondary role to exchange rate policy - at least some of the time-, then a fixed exchange. rate backed by any quantity of reserves is prone to an attack.

### Attack in uncertainty

The above model depicts a scenario where market participants foresee a speculative attack. It assumes perfect foresight where participants are sure when an attack will take place and how much the exchange rate will change if there is a possibility of an attack. However the model does not conclude that attacks are foreseen perfectly but aims at presenting a simplified setting underlying economic structure of how the private sector responds to inconsistent economic policies. Most importantly the model shows that an attack need not occur because of a large shock. However recent crises reveal that uncertainty is a very crucial element. Indeed the recent Asian crisis, reflects that because market participants are uncertain about the time and level of attacks they react by increasing domestic-currency interest rates in anticipation of a crisis. Where uncertainty prevails the fixed exchange rate system where an attack is imminent provides an advantage or room for speculators to gain by buying international reserves from the government at the fixed exchange rate and reselling the same reserves at a higher post-crisis exchange rate. The probability of an attack is also increased by the uncertainty as to how large the reserve commitment is nor how the currency will be distributed. All these uncertainties explain the atmosphere surrounding the crisis period.

Flood and Marion (1996) construct a model in an uncertain environment and take into account the mean and variance of the asset's price. The risk premium is derived from expected utility maximisation whilst the monetary base is constant during and after the crisis period.

The interest parity relation then is given as

$$i = i^* + E_t \dot{s}_{t+1} - \dot{s}_t + \beta t (b_t - b_t^* - \dot{s}_t) \quad (19)$$

$\beta > 0$  is a constant and can change period by period.  $b$  is the quantity of domestic government bonds in private hands and  $b^*$  is the quantity of foreign currency bonds in

private hands. Because agents aim at maximising expected utility, that is, increasing in expected wealth and decreasing in the variance of wealth,

$$\beta_t = z \text{Var}_t(\hat{s}_{t+1}) \quad (20)$$

where  $z$  is a constant determining taste and  $\text{Var}_t(s_{t+1})$  gives the conditional variance of the period ahead shadow rate. If agents expect variability in the future, then the domestic interest rates will be affected as shown in equation (19). This will affect the money demand making exchange rate even more variable should the exchange rate be allowed to float. This change in expectation alters the relevant shadow rate for determining whether an attack is profitable and also changes the attack time. This model therefore contains an element of a non-linearity in private behaviour, which can be an additional source of currency crisis. With an element of a time-varying stochastic risk premium currency crisis can be a result of inconsistent policies but can now arise from a self-fulfilling perspective when agents prophesise about the exchange market risk for some range of fundamentals. This then suggests that an economy can suddenly jump from a non-attack equilibrium to an attack equilibrium.

### **Second generation models**

The standard first generation model looks at the linear behaviour between the private sector and the government and combines these with the conditions that perfectly foreseen profit opportunities be absent in equilibrium in order to have a unique time for a foreseen future speculative attack. It then follows that a non-linear behaviour by one or more agents can therefore lead to a multiple solution in this model.

The second generation models on the other hand look at these loopholes and add one or more non-linearities ignored in the first generation model. The main focus of the second-

generation model is the non-linearities in government behaviour. The main question this generation poses is: what happens when government policy reacts to changes in private behaviour or when it is faced with trade offs which are explicit between the fixed rate policy and other objectives? If market expectations shift from their initial level there is a probability that they can affect the levels and movements of certain macroeconomic variables. In this case there have to be policies adopted to counteract such changes in expectations. It is when government is faced with such situations when such shift in expectations tends to alter its trade-offs and bring about self-fulfilling crises (see Euehngreen and Wyplosz, (1993); Obsfield (1996); Obstfield and Rogoff (1995). This view that speculation may be motivated by 'market spirits' has important policy implications. It determines to a large extent the attitude towards speculation that economists recommend to governments. If speculation is looked at as self-fulfilling, then fixed exchange rate systems is viewed as intrinsically unstable; vulnerable to erratic speculative movements. In this case measures of capital controls need to be employed to help defend the currency. For instance Euehngreen et al (1995b) proposed the introduction of a "Tobin tax" on foreign exchange transactions in order to rebuild a new, more stable European Monetary System.

Those who think that speculative movements are due to the fundamentals tend to adopt a more positive view. They advocate that implementation of fiscal and monetary policies , which make the commitment to the fixed exchange rate objective credible is the best way to avoid currency crises. Speculation is viewed as playing a useful role by making the governments realise that they should adjust their fiscal and monetary policy. Capital controls measures therefore are dismissed as useful tool to defend the currency. This optimistic view to some extent was employed by the Maastricht treaty. According to this treaty a currency can participate in the Monetary Union only if it could stay in the margins of the ERM during the preceding two years without the help of capital controls. The criterion hence relies on the idea that the speculation will select the "virtuous" currencies (Jeane, 1997).

In contrast, first-generation models generate an attack by having inconsistent policies before the attack, push the economy into a crisis. On the other hand the second-generation models admit the possibility that the economy can be at a no attack equilibrium, where speculators see but do not pursue available profit opportunities. In such a situation anything that serves to co-ordinate the expectation and actions of speculators can suddenly cause an attack. (Flood and Marion, 1997).

The non-linearities in government behaviour which causes multiple equilibria has been demonstrated in a variety of ways in the economic literature. A presentation of one of the simplified models of non-linearities is given below, adopted from Flood and Marion (1997). Flood and Marion introduced a policy non-linearity into the standard first generation model described in the earlier section. A policy non-linearity in this case is a conditional shift in the growth rate of domestic credit. From the above section if there is no attack on the fixed exchange rate, growth rate of domestic credit is  $\mu_0$  and when there is an attack, the growth rate is  $\mu_1$ ,

### *Policy non- linearity*

In figure 2, a duplicate of figure 1(see appendix) shows that there are two shadow exchange rate lines corresponding to the two rates of credit expansion  $\mu_0$  and  $\mu_1$ . Point A gives a point where  $\mu_0$  intersects the shadow rate  $\acute{s}$  and point B represents an intersection of the shadow rate line for  $\mu = \mu_1$

### *Scenario 1*

Suppose that  $\mu_0 = 0$ , thus fixed rate would survive indefinitely for a given amount of domestic credit. If  $d$  lies in the range to the left of  $d^B$  and is assumed there is no attack, then the shadow rate would be on the  $S\mu_0$  line. A speculative attack causes the shadow rate to jump to  $S\mu_1$  line below the fixed exchange rate. Any attack at this level leads to capital losses for speculators hence there is little or no incentive to attack the fixed rate if

domestic credit is below  $d^B$ . When domestic credit is growing at  $\mu_0 = 0$ , then domestic credit policy and fixed exchange rate policy are compatible and hence the rate can survive indefinitely.

### *Scenario 2*

Suppose now that domestic credit is at the level  $d^B$  where the  $S\mu_1$  shadow line intersects the  $s$  line. With  $\mu = \mu_0$  the shadow rate is at point C, a lower line. An attack on the fixed rate takes the shadow rate from C to B. The attack though successful does not give speculators a profit since there is no realisation of immediate capital gain on the reserves purchased from the central bank or monetary authorities. The economy can therefore either be at equilibrium C or B in a speculative attack that ends the fixed exchange rate regime but with no incentive for speculators there is nothing to drive the economy from C to B.

In a situation where domestic credit ranges between  $d^A$  and  $d^B$  then there is a possibility of an existence of multiple equilibria only if speculators consists of a small uncoordinated group or are faced with high costs in confronting the government. In this case the economy can stay indefinitely at a lower shadow rate line if agents believe there will be no attack. If the agents believe the situation can result in a run on the currency then the economy may jump to the higher shadow rate line. With the fear of such a run individual speculators will find it not profitable to hold domestic currency and a co-ordinated attack may occur leading to a collapse of the fixed rate and more expansionary credit policy.

So when does the economy move from a no attack to an attack equilibrium and what is the rationale for such a shift in expectations or the mechanism for co-ordinating such a shift?

The currency crisis in Europe (1992-93) is an example of a case where the attack was started by extreme beliefs on the sustainability of the fixed exchange rate from the commitment shown by the government.. According to Morris and Shin (1995) uncertainty

can eliminate multiple equilibria and make the attack outcome unique. According to their analysis the economic agents rely on the information obtained about the state of the economy e.g. domestic credit, but with a small amount of error. If the true economy is  $d$ , the agents observe the messages that lie in the interval  $d - \pi, d + \pi$  where  $\pi$  is a small positive number and messages are independent across agents. With noisy differential information it is never common knowledge that the fixed rate is sustainable hence each investor has to have full idea of possible beliefs held by other investors in case the rate is unsustainable. If a majority believe the currency is unsustainable then the individual investor may also follow suit and speculate even though the peg may be otherwise sustainable. So an individual investors behaviour is influenced or relies on the beliefs of everyone else behaving similarly hence the only attack equilibrium is the region bounded between  $d^A$  and  $d^B$  (Marion and Flood 1997)

During the European crises of 1992-93, whilst the investors knew that the Bundesbank was in full support of some exchange rate mechanism (ERM) parities in 1992, each news release by the central bank caused unrest and doubts as to the strength of the German commitment. In such a situation no matter how strongly the investor believes that the exchange rate will be sustained, he has to worry about whether others interpret official announcement the same way. (Flood and Marion (1997)). The cause of a crises in this case would be traders worry about the beliefs of others. Calvo and Mandoza (1997) in their analysis of how an attack may be influenced by collective behaviour of investors considered a situation where in a global market there exist many identical investors who form decisions simultaneously. They then show that with information friction, herd behaviour may become prevalent as the world capital markets grows. Incentives to collect country specific information to discredit rumours is reduced more by globalisation causing the fund managers who worry about their relative performance to select the same portfolio. Any small rumour about the downturn of the economy may induce herd behaviour and move the economy to an attack equilibrium.

Accordingly, the model depicted by Figure 2 shows how policy responds to an attack and depending on the size of  $d$ , four situations may be characterised. (1) The first is when  $d < d^B$ . Under this situation the post-attack policy does not offer incentives for speculators to attack

(2) when  $d = d^B$ .

This is a situation where there is neither profit nor loss in an attack. Points B and C are both viable equilibria and depending on the agents animal spirit rather than the motive to make profit, the economy may experience an attack.

(3) when  $d^B < d < d^A$  In this third situation, if there are many small traders with co-ordinated actions multiple equilibria are possible.

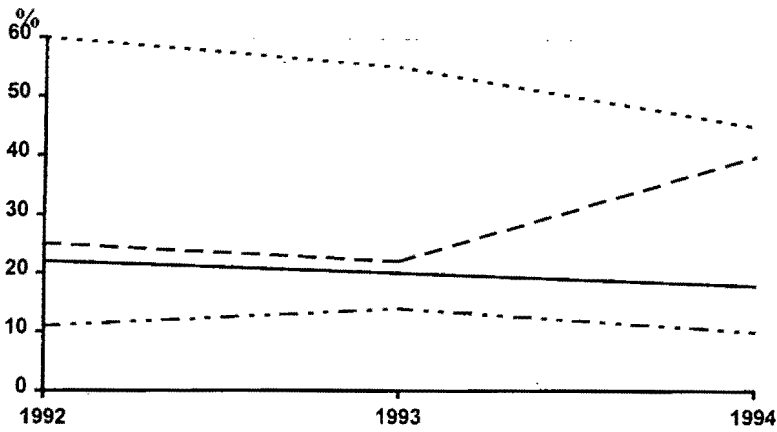
(4)  $d > d^A$

This is a situation where an attack on the fixed exchange rate can be successful.

### **Other recent models**

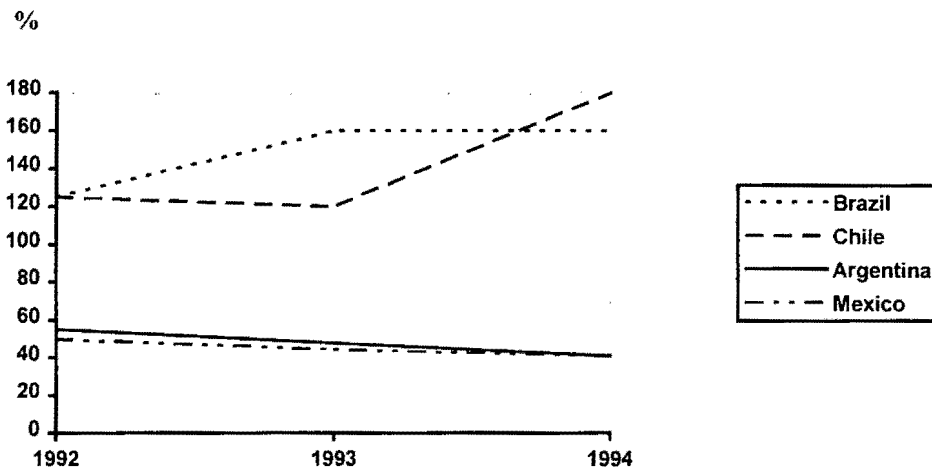
Other recent models show that to the extent that the authorities are concerned about the fiscal consequences of their exchange rate depend on the stock of public debt (Obsfield 1994) that the government has to roll over. (see Calvo (1995). Debt maturity and currency denomination are important characteristics of public debt instruments. This was evident during the Mexican crisis. Figure 3 shows public sector debt service, excluding debt amortisation, as a share of exports for the period 1992 - 1994 with Mexico standing at the top of Chile, Argentina and Brazil (Calvo 1995). When debt amortisation is added ( Figure 4) Mexico is still at the top with a ratio reaching almost 160% in 1994. Short maturity debt is dangerous because it is a trigger to a self-fulfilling balance of payment crises. When such debts are denominated in foreign currency, for example the Tesobonos, which were

denominated in dollars, it is difficult or costly for the debt to be repudiated, than when it is denominated in domestic currency.



**Figure 3.** Scheduled public sector debt service/exports ratio (foreign and domestic) for selected countries 1992 -1994. The scheduled ratio assumes rollover of all amortisations

Source: Calvo, Guillermo A (1996)



**Figure 4.** Potential public sector service/exports ratio (foreign and domestic for selected countries 1992 - 1994.

Source: Calvo, Guillermo A. (1996)

Calvo finds that the reasons why Brazil could not get into financial trouble is because its short term debts (Brazilian domestic debt) outside the Central Bank, in contrast to

Tesobonos, were largely in the hands of the Brazilian commercial banks or firms. If public debt is held by banks then the ultimate holders are largely depositors who place a high premium on liquidity services and hence less sensitive to interest changes than pure Tesobonos type foreign investors.

Some economists have focused on contagion effects as triggering balance of payment crises. These models postulate that a devaluation by one country may lead to a devaluation by its trading partners in order to avoid a loss of competitiveness. Moreover contagion effects also may arise if investors pay little heed to countries' economic fundamentals and thus do not discriminate properly among countries. If contagion effects are present a crisis in a neighbouring country may signal a future domestic crisis, for example the lumping of all emerging markets together.

## **CHAPTER 2**

# **EMPIRICAL LITERATURE OF ATTACKS AND INDICATORS**

### **Introduction**

Following the currency crises of the 1990s, researchers have concentrated on finding out more about potential indicators of currency crisis. Prior to the events of the 1990s currency crisis were thought to have a significant predictable component with the first generation models identifying fundamentals useful for prediction. Most of the time, currency crises are resolved through a devaluation of domestic currency or the floating of the exchange rate. This reaction has compelled several researchers to make an attempt at estimating the probability of a devaluation on the basis of fundamentals implied by various theoretical models of balance payment. In this chapter the empirical literature which supports the models and the theory is presented. The empirical studies show that there are a number of variables that can be used as indicators of currency crises. In particular the identified leading indicators are fiscal deficit, real exchange rates, the ratio of M2 to international reserves, foreign reserves, domestic credit expansion , real GDP growth and political environment. This chapter goes further to discuss the signals approach developed by Kemsinsky and Reinhart (1996) as a methodology for identifying the indicators. The stylised facts from the study performed by the proposers of the signals approach are also presented showing the evolution of the indicators before and after the crisis

## Empirical literature

The speculative attack model started with a scenario where there exists a fiscal deficit financed by an expansion of domestic credit which eventually engenders speculative attacks. As domestic credit increases the international reserves gradually decline. The investors then attack the fixed exchange rate depleting the government reserve holdings. Prices of domestic goods start rising leading to a real exchange rate appreciation and a widening current account deficit. Empirical work by Blanco and Garber (1986) confirms the scenario just described. Using a variant of the Krugman - Flood - Garber model, they predicted the timing of the devaluation brought by the attack on the Mexican peso for the period 1973 - 1982. The findings were that, after the attack the permanent shadow floating exchange rate happened to be the minimum exchange rate that emerged with a probability estimate of around 2 - 5% in tranquil times and above 20% before the 1976 and 1982 devaluation. Cumby and Wijnberger (1989) applied the same model to the Argentine crawling peg of 1978 - 81 and their findings were that the probability of the attack was due mainly to an expansion of domestic credit, which reached the highest level of approximately 80% just before the devaluation. When applied to the 1980s Mexican crises by Golberg (1994) the findings showed that the probability of the devaluation over a one month forecast horizon reached nearly 100% just before the crisis and that the driving force was domestic credit expansion rather than external credit constraint.

Recent empirical work involves an attempt to characterise the nature of balance of payment crises across a broad range of emerging markets. One such study was conducted by Frankel and Rose (1996) over one hundred emerging market countries using annual data from 1971 to 1992. The potential indicators of currency crashes were classified into four categories. viz.

- 1) Domestic macroeconomic indicators i.e. monetary (credit) and fiscal shocks.
- 2) Foreign variables; such as OECD output growth and world interest rates.

- 3) External variables such as real exchange rate appreciation, size of current account imbalances and level of external indebtedness.
- 4) Maturity and ownership composition of external debt.

The results of the study supported the theoretical models of currency crises and speculative attacks. Balance of payment crises seemed to occur when international reserves and output growth are low. Other indicators which were statistically significant were real exchange rate appreciation, world interest rates and a fall in foreign direct investment inflows. Surprisingly, current accounts and government deficit appeared not to have any statistically significant effect on a balance of payment crisis. High ratios of short term external debt, concessional debt and the ratio of public debt to total external debt seemed to increase the probability of the crises in the following year.

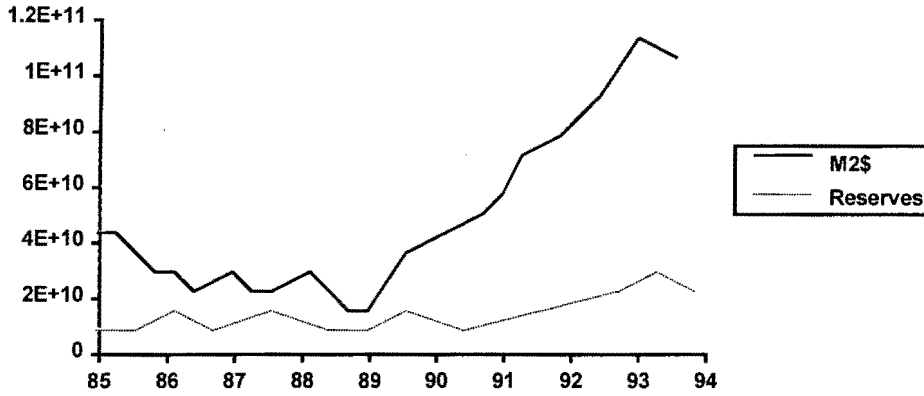
Edwards (1989) also performed a survey on 24 developing countries which had maintained fixed exchange rates for at least 10 years using pooled quarterly and annual data. The study focused on understanding the causes of devaluation. His findings showed that indicators that predicted the probability of a devaluation were the ratio of central bank foreign asset/base money; ratio of net foreign assets to M1; ratio of domestic credit to the public sector total credit; bilateral real exchange rate and parallel market premium. Collins (1995) conducted a study on 18 countries for the period 1979 - 91. The purpose of the study was to determine the distance from the critical threshold at which a country devalues and also to try find the mean rate at which the economy moves toward the critical level. Of the indicators used, international reserve/GDP ratio and growth of GDP came out to be marginally significant. Inflation served as a good determinant of the mean rate at which the economy is moving closer towards a crisis level.

After the Mexican crisis of 1994-95 and its impact on emerging markets – the so called Tequila effect, Sachs, Tornell and Velasco (1996) conducted a study and identified 3 major factors determining the country's vulnerability to financial crises.

The first factor involved the levels of international reserves relative to broad money. Figure 5 below shows M2 deflated by the peso/dollar exchange rate (M2\$) in Mexico and gross international reserves (in US Dollar) M2 increased sharply since 1989 prompted partly by banking reforms that liberalised bank interest rates and eventually lowered reserve requirements to zero. Monetary aggregates were also increased by the existence of substantial capital inflows since 1989 to finance higher expenditure to take advantage of high Mexican interest rates (Calvo and Mendoza 1995). The M2\$ represents almost 5 times the maximum level of gross international reserves ever in Mexico. This high ratio contributed to Mexico's financial vulnerability. By December 1994 Mexico's currency was virtually pegged to the US Dollar and short term interest rates - a key determinant of capital flows in Latin America (Calvo et al 1993) - had started rising since the first quarter of 1994. Hence capital started flowing in, sending a message of money bubbles and increasing M2\$ to its highest (Calvo and Mendoza 1995).

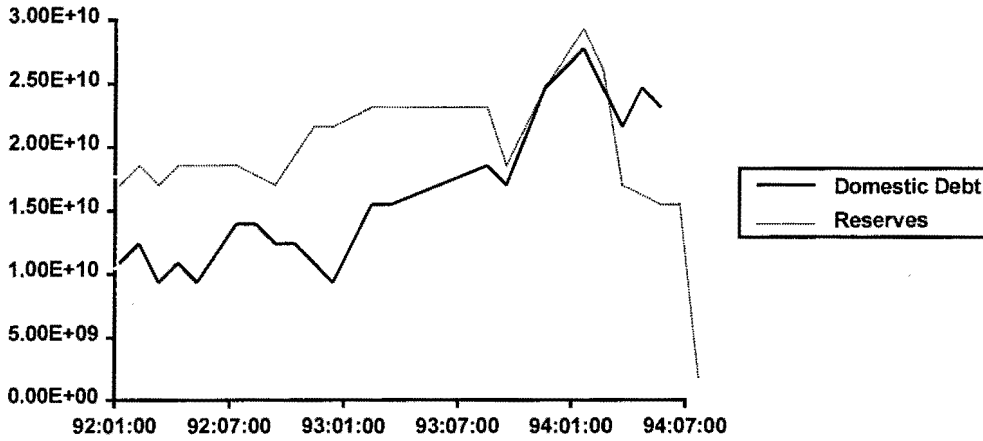
With a peg a fall in M2 would have resulted into a squeeze in liquidity or an increase in interest rates in Mexico which would have been unacceptable to the Mexican authorities more so that the interest rates on mortgages were linked to short term rates (Calvo 1996). An active credit expansion policy adopted by Mexican government was meant to offset deposit withdrawals. Whilst it was successful in preventing a fall in M2 it however created the vulnerability condition for a run against Tesobonos shown in Figure 6. Extending the same argument to Argentina, Calvo argues that excessive growth in monetary aggregates (M3) over gross international reserves made Argentina vulnerable to a currency run. This made the country's banks vulnerable particularly because Argentina is committed to a currency board which limits the central bank's ability to operate as lender of last resort

whereas Chile and Brazil whose ratios were almost the same were able to overcome the problem by adopting the appropriate monetary/exchange rate policy measures.



**Figure 5.** Mexico: M2 (in US\$) and International Reserves

Source: Calvo, Guillermo A. (1996)



**Figure 6.** Mexico: domestic debt (CETES plus Tesobonos) (in US\$)  
and international reserves

Source: Calvo, Guillermo A. (1996)

The second determinant of financial vulnerability according to the study is a weak banking system. Banking systems in emerging markets have been viewed as more vulnerable to crises than those in other markets. Emerging markets are subject to large and volatile swings in terms of trade that can adversely affect the debt-servicing capacity of a country's export and import competing industries and weaken the domestic bank's balance sheet position especially in the situation where large amounts of foreign currency - denominated debts have been issued during periods of protracted real exchange rate appreciation.

The third factor involved deregulation of the financial system, which is known to lead to large credit expansion. In situations where banks have weak credit evaluation systems and inadequate bank systems there is often a possibility of a sharp increase in non performing loans (Goldstein and Turner 1996). Applying a signal approach to 26 banking crises for the period 1970 - 95, Kaminsky and Reinhart (1996) find that recessions and large corrections in stock markets preceded over 80% of banking crises. High real interest rates were associated with all the 20 crises and over the preceding 24 months there existed large terms of trade deterioration in at least 95 % of the cases studied. Appreciation of the real exchange rate happened to be a good signal for banking crises as it is for balance of payment crises and has accurate predictive powers.

Eichengreen, Rose, and Wyploz (1995) conducted a study on a panel of 20 industrial countries over the period 1959 - 1993. They depart from the previous empirical work by constructing a definition of a currency crisis and letting the data choose the episodes for study. They used the speculative pressure idea by Gorton and Roper (1977) which is measured as a weighted average of exchange rate changes, interest rate changes and (the negative of) reserve changes. In defining speculative attacks they said it is periods when the index of speculative pressure reaches extreme values defined as being those at least two standard deviations above the mean. The findings were that crises tend to occur when unemployment is high and when political circumstances are unpropitious. Marion and

Flood (1997) concluded that the findings can be interpreted as meaning that data-defined crises are hard to predict using standard fundamentals and panel methods.

In another study Otker and Pazarbisioglu (1994) estimated the one-month ahead probabilities of a speculative attacks in five European countries during the 1979 - 1993 period. They find that coefficients of market fundamentals were statistically significant for many countries including the real effective exchange rate, foreign-domestic interest rate differential, unemployment rate, German price levels and position within the band. For many countries the fitted probabilities of crisis often rise to high levels (over 50%) in the months immediately preceding crises, with certain speculative proxies predicting crises with reasonable accuracy.

Marion and Flood (1997), in their review of the literature on currency crises, commented that empirical models seem to do better at identifying variables that are significantly correlated with crises. They also commented that domestic credit growth tends to be emphasised as a good indicator of currency crises in empirical work on developing countries. However, evidence also shows that

- 1) the level of liquidity relative to the reserves seems to be a good predictor of currency crises
- and
- 2) a variety of indicators of economic conditions (e.g. recessionary conditions, the state of banking system, monetary policy, international interest rates) are also important currency crises predictors.

## **Methodology for identifying indicators**

There are two major methodologies employed in empirical studies on identification of currency crises, namely the k - step and the signal approach (Kaminsky et al 1997). The k-step is the most commonly used method and makes an attempt to estimate a one-step (or k-step) ahead probability of a devaluation using a multivariate logit model. This approach was pioneered by Blanco and Garber (1986) in their study of the 1980 Mexican crisis, and used domestic credit growth as an indicator of the probability of a devaluation. Researchers in this line of study include Bilson (1978), Edin and Vredin (1993) and Flood and Marion (1995). The methodology also helps estimate the size of the devaluation.

The second methodology is the signals approach proposed by Kaminsky, Lizondo and Reinhart (1997). In this approach the behaviour of a group of indicators chosen is examined several months before and after the crises and compared to their behaviour during tranquil periods. The test helps narrow the list of potential indicators by eliminating those, which do not show any sign of abnormality before and after the crisis (Kaminsky et al 1997). According to Kaminsky et al (1997) whilst the first approach may be useful it has some limitations. First, it fails to rank indicators according to their ability to accurately predict crises which makes it difficult to know whether the signal is a false one or not. Second, the fact that the indicator is statistically significant does not necessarily show its relative strength in signalling the extent of the crises. Based on these limitations, Kaminsky et al (1997) suggest that the signal approach is a better methodology for identifying potential indicators. It is argued that the approach makes it possible to estimate the probability of a crisis conditional on the signals issued by the various indicators. The approach also makes it possible to tally the performance of each indicator which provided the information on the sources and breadth of the problems underlying the probability of a crisis. Similarly the approach allows one to use a group of variables. According to the authors an effective warning system should consider a broad variety of indicators because currency crises seem to be preceded by multiple economic

and political problems. Below is a summary of how the approach works in identifying the indicators.

### **The “signals” approach**

As mentioned earlier this approach uses a group of indicators whose behaviour before and after the tranquil period is observed. The usefulness of all the indicators is assessed by:

- a) determining whether they give a signal on a crisis by crisis basis;
- b) tabulating the probability of a crisis conditioned on a signal from the individual indicator; and
- c) tabulating the probability of false signals.

In their study (using the signals approach) using a sample size of 5 industrial and 15 developing countries and a monthly frequency data between 1970 –1995, Kaminsky and Reinhart (1996) observed that of the many indicators assessed only six indicators performed well. The various indicators were ranked by the probability of a crisis conditioned on a signal from the indicators, the average number of months prior to the crisis in which the first signal is issued and by the persistence of signals ahead of a crisis. The authors define a crisis as a period in which an index of exchange market pressure (comprising a weighted average of monthly percentage changes in the exchange rate and in gross international reserves) is above its sample mean by more than three standard deviations. If the indicator’s deviation from its mean crosses a set threshold level then it is signalling a crisis. The approach allows one to measure the frequency an indicator gives good signals and the signal should indeed be followed by a crisis in the next 24 months. If it is not followed by a crisis in the next 24 months, then it gives a false signal. According to the authors the noise to signal ratio can be used to eliminate those indicators that do not

signal a crisis. Tables 1 and 2 (see appendix) give the results of the performance of each indicator and the results go along with the empirical evidence where the best indicators in the study turn out to be real exchange rate appreciation, reduction in output levels, excess domestic credit growth, low levels of reserves, and high ratio of M2 to reserves. Indicators of liquidity problems in banking systems together with rapid import growth were eliminated on the above grounds.

### **The lead times**

In addition to the above signals given by an indicator, the authors believe that a good indicator should be able to give a signal 12 months to 18 months in advance. This length of time, it is argued, gives the policymaker who wants to implement pre-emptive measures enough time to react and not to be indifferent between indicators that send signals well before the crises occurs and those that signal only when the crisis is imminent. Table 2 shows the average number of months when each of the indicators gave the first signal from the study performed by Kaminsky and Reinhart (1996). The results show that on average all indicators send signals 1 year to 18 months in advance of the crisis, with real exchange rates offering the longest lead. The conclusion based on the outcome of this study is that all the indicators considered seem to be leading rather than coinciding, which is consistent with the spirit of an early warning system (Kaminsky, Lizondo & Reinhart 1997)

### **The stylised facts**

The stylised facts is a presentation of the empirical regularities during currency crises observed by Kaminsky and Reinhart (1996) using the signals approach described above. The study, which involved 5 industrialised and 15 developing countries, focused on finding the links between the banking and balance of payment crises. The stylised facts,

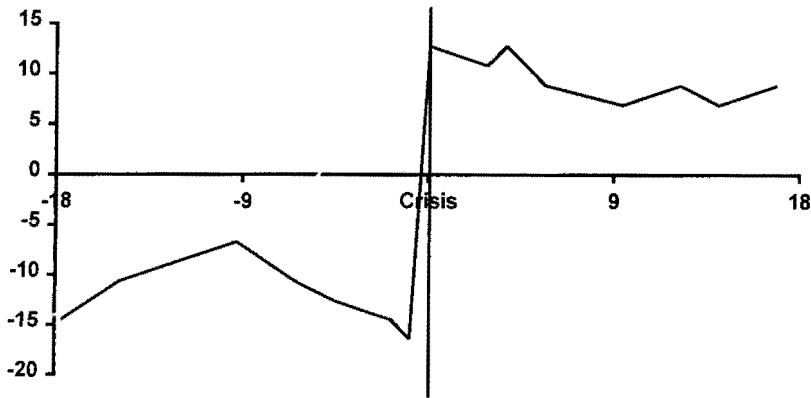
forming the second part of the study examined the pre- crisis behaviour of the various domestic crises and speculative attacks around the crises period. The industrialised countries included Denmark, Finland, Norway, Spain, and Sweden. The developing countries were Argentina, Bolivia, Brazil, Chile, Colombia, Indonesia, Israel, Malaysia, Mexico, Peru, the Philippines, Thailand, Turkey, Uruguay and Venezuela.

The graphical presentation of the behaviour of the evolution of the six leading indicators of currency crises is given below. The illustrations depict the behaviour as per the analyses in the theoretical and empirical literature already given and the variables used in the analyses are chosen in light of the purpose of this paper.

### **Empirical regularities**

#### **Real Exchange Rate**

Figure 7 below illustrates the behaviour of the real exchange rates. Dornbusch, Goldfajn and Valdes (1996) commented that the real exchange rate tends to be overvalued relative to its average level during tranquil times in periods preceding the currency crashes. This process is later reversed by devaluing the currency. Findings by Sachs et al (1996) show that during 1993 the Mexican real exchange rate had appreciated relative to the long-term average by 20 - 25%. By March 1994 the nominal exchange rate had a depreciated by 10%.

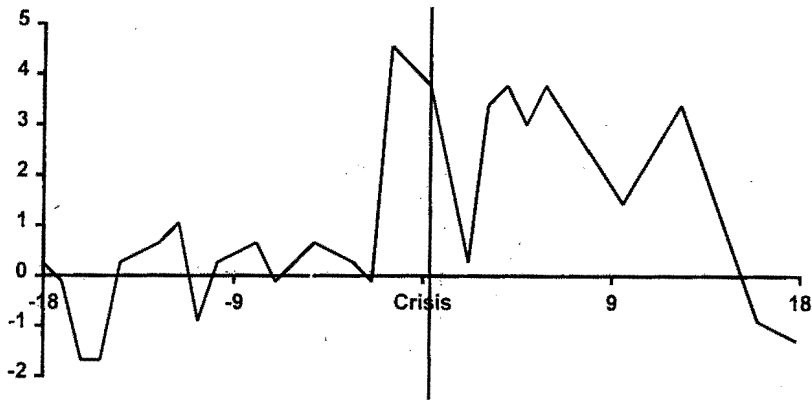


**Figure 7. Real Exchange Rate**

Source: Kaminsky and Reinhart (1996)

### Domestic Credit Expansion

The stylised facts on banking crises (from the study conducted by Kaminsky and Reinhart (1996)) find that domestic credit expansion is the leading indicator of financial crises expanding rapidly before the crisis period and declining afterwards (see Figure 8). When bad news concerning the economy erupts, it is often found that banks leverage is at its highest. Before the news, there is often high demand for loans and inflow of foreign capital due to the economy's status, i.e. political, economic and social stability. Moreover when the economy starts to liberalise its financial system Gavin and Hausman (1995) argue that more capital starts flowing into most of the countries studied. Kaminsky and Reinhart found that the boom in capital flows and lending occurred somewhat earlier than 18 months to a year. The theoretical literature shows that a reversal of the inflows (Mexican crisis 1994) can therefore result in a banking crisis. Similarly an economic downturn, decline in terms of trade a stock market or real estate market crash, can reduce the profitability of bank debtors who in some cases may find themselves in a position where they cannot service their loans. As a result good loans turn bad and the banking industry crashes contributing to a crash in the economy's currency.



**Figure 8.** Real Domestic Credit

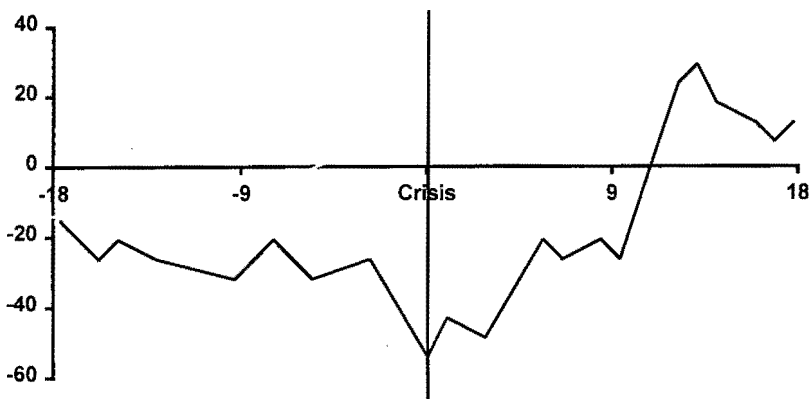
Source: Kaminsky and Reinhart (1996)

#### Terms of Trade and Output

Figures 9 and 10 show the evolution of the output and Terms of Trade. The results from Figure 9 show that on average crises are preceded by a deterioration in the terms of trade with a 10% annual decline more than those observed in tranquil times. The Kaminsky and Reinhart study noted that the deterioration is also reflected in economic activity with most of the countries experiencing a decline in output. The empirical and theoretical literature also points out that prior to the balance of payment crises, output often contracts as shown in Figure 10. To offset the contraction in output, the government often resorts to devaluing the domestic currency and such actions become so frequent creating multiple equilibria as nominal wage growth expectations erodes competitiveness. Failure to pre-commit to a fixed exchange rate can create multiple equilibria in which a sudden shift in market sentiment regarding the government's willingness to tolerate unemployment can trigger a devaluation that would not have occurred under different private expectations. Following the crises Figure 9 and 10 show that terms of trade start to recover a year and half later but production remains below that of tranquil times.

## International Reserves

Figure 11 shows that reserves declined substantially a year before the crises. This is due to the fact that the current account deficit initially created by an appreciated currency needs to be financed. During pre-crisis periods the already existing current account deficit has to be financed by either a decline in foreign exchange reserves or private capital inflows. In the absence of capital inflows the central bank reserve has to decline (Table 3 and Figure 12). Sachs et al (1996b) shows that because of the fact that current account deficit could not be financed by private capital inflow (which declined substantially) Mexican international reserves had to be used causing a decline during the last 3 quarters of 1994.



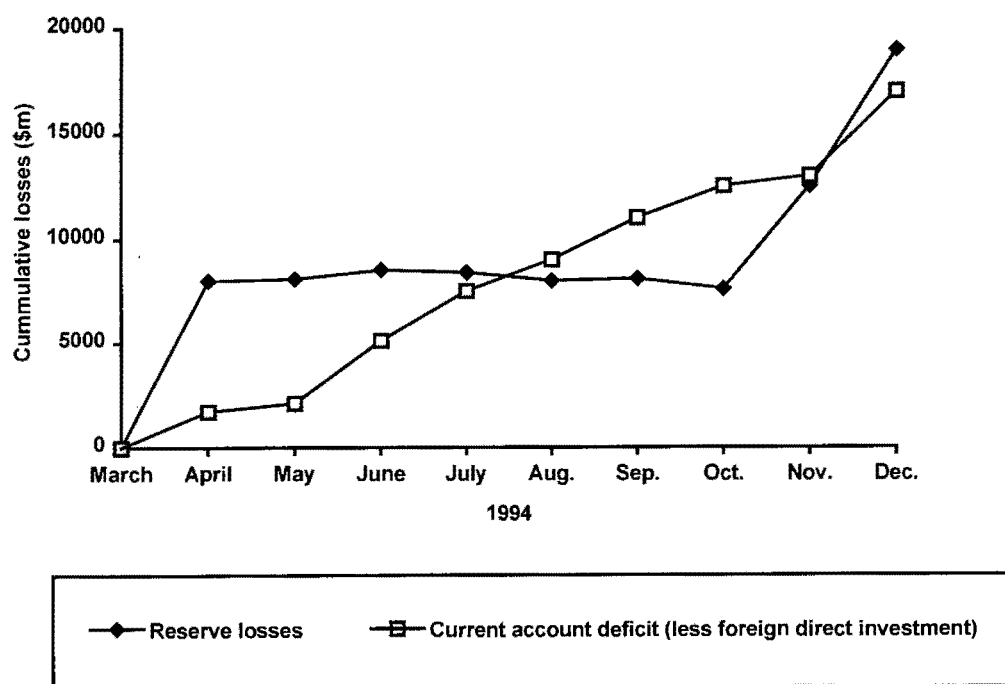
**Figure 11. Reserves**

Source: Keminsky and Reinhart (1996)

**Table 3.** Financing of Mexico current account deficit (%)

	1993				1994			
	I	II	III	IV	I	II	III	IV
Current account deficit	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Capital account	144.42	132.47	104.48	152.18	157.17	1.00	44.28	-50.62
Errors and omissions	-4.39	-3.93	-3.21	-14.23	-45.60	-29.28	54.10	17.64
Change in reserves	-40.02	-28.54	-1.27	-37.95	-11.56	128.27	1.62	132.98

Source: Sachs, Jeffrey, Aron Tornell and Velasco, A (1996b)



**Figure 12.** Current account deficit and reserve losses in Mexico

Source: Sachs, Jeffrey, Aron Tornell and Velasco, A (1996b)

## M2/Reserves

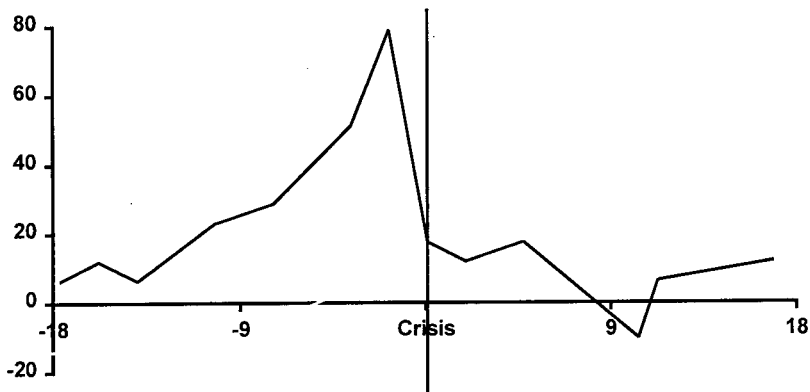
Figure 13 shows that the ratio of M2/Reserves ( $M2 = M1 + \text{short term banking securities}$  where M1 is currency + checking account) before the crises periods is high and increasing. The period preceding the crisis shows an increase in the above ratio and just before the crisis period the ratio goes down sharply.

When reserves begin to be depleted the ratio starts to drop. Evidence from the Mexican crisis 1994 (Sachs et al 1996b) reveals that the high levels of short-term liabilities to central bank liquid assets coupled with a pegged exchange rate resulted in a bank run which could be easily translated into a currency run. At the same time, Mexico liberalised the capital account which contributed to the problems of financial deepening and increased Mexican financial vulnerability. Liberalisation gives foreigners permission to buy shares from the local companies and hold government bonds. This initially generates an inflow of capital. Depending on whether a significant part of these assets are short or long term, to stop the currency from appreciating the government may decide to sterilise the inflow and offer short term local currency denominated debts. In the case of Mexico sterilisation was done by issuing short-term peso debt (cetes). Table 4 shows the components of the Mexican government's domestic debt. This table shows that the ratio of M3 to GDP grew from 36% in 1989 to 41% in 1993. At the end of 1994 cetes alone represented 100% of net international reserves and M3 was six times larger than reserves. In this case any rumour could easily create a massive outflow of capital.

**Table 4.** Components of domestic debt (\$m)

	1989	1990	1991	1992	1993	1994
<i>Cetes</i>	20437	24445	23567	19047	26084	7456
<i>Bonds</i>	21082	21903	18871	11827	5485	1562
<i>Adjustabonos</i>	1221	4859	12696	11642	10849	5371
<i>Tesobonos</i>	75	408	302	296	1237	17780
<i>Other</i>	3661	3193	24	8	7	2
<b>Total</b>	46476	54808	55479	42820	43662	32170

Source: Sachs et al 1996b



**Figure 13.** M2/Reserves

Source: Keminsky and Reinhart(1996)

## CHAPTER 3

### CASE STUDY - AN APPLICATION TO THE SOUTH AFRICAN 1996 CRISIS

#### Introduction

In this chapter a case study of the evolution of some of the leading indicators with regard the South African 1996 currency crisis is presented. A diagrammatic presentation of the behaviour of the key variables before and after is given. The choice of indicators used is based on the theory already presented in this paper and on the availability of data.

#### Methodology

The methodology adopted in this study is not different from the traditional way of analysing the performance of indicators before the crises period. As noted earlier the purpose of this paper is to find out how the traditional indicators performed during the South African 1996 currency crisis. The methodology adopted here therefore involves observing the evolution of the indicators before the crises year in line with the stylized facts presented in chapter two. The behaviour of the chosen indicators are therefore analysed based on the graphical presentations. The leading indicators observed in this study are net foreign reserves; real effective exchange rate; domestic credit extension; ratio of M2/reserves; imports and exports in dollar terms. Theory and empirical results from the previous chapters show that months before the crisis period there is decline in reserves; excessive domestic credit expansion; real rate appreciation; increase in the ratio of M2/reserves; decrease in imports and exports.

## **Sample**

The sample period for the study runs from 1990-1997. When choosing the sample size there were certain issues borne in mind. First, the fact that South Africa got accepted in the international financial market only in 1990 after the release of President Mandela hence the sanctions imposed were lifted, for example, access to loans and grants. Secondly the country became a democracy in 1994, changing from an apartheid regime. These two factors are known to have hampered economic progress resulting in poor performance of both internal and external macroeconomic variables. It is of no doubt that after the declaration of the transition to democracy and lifting of sanctions, South Africa experienced large capital flows and a boom in investment in addition due to liberalization of the financial market and exchange controls. This shift in the economy had both positive and negative effects. The value of the rand first appreciated due to the large inflows and later depreciated drastically in February 1996, marking the beginning of the crisis period.

## **PRE- CRISIS EMPIRICAL REGULARITIES**

### **Real exchange rates**

The result from the study performed by Keminsky and Reinhart (1996) as shown in figure 7 of chapter 2 concludes that the real exchange rates of most of the countries studied tend to be overvalued months before the crisis period. Chart 1 (see appendix) shows the evolution of the South African real exchange rate prior to the 1996 currency crisis.

The real effective exchange rate of the rand showed a declining trend from 1990 until the end of 1993 when it started to fluctuate. Owing to political uncertainty and the ongoing violence in the run-up to the election in South Africa, both the nominal and real exchange

rate of the rand declined by 4.4 and 6.5 per cent respectively by May 1994. These concerns caused the financial rand to fluctuate widely trading at R5,58 per dollar on April 11 1994, the lowest level recorded since its introduction in 1979. It later appreciated to R4,50 per dollar on 31 August 1994.

In 1994 there were expectations and large- scale speculation about the abolition of exchange controls on the residents which resulted in a persistent strengthening of the financial rand in the international market trading at R3,93 per dollar on October 1994. By the end of 1994 the real effective exchange rate of the rand had declined by 6.6%. After abolition of the dual exchange rate system on March 13<sup>th</sup> 1995, the exchange rate of the rand was relatively stable reflecting some relative weakness of the dollar in the international market.

From end of June to end of August 1995 the rand had appreciated against all the major currencies except the US dollar and the Italian lira. Chart 1 shows this upward moving trend in both the nominal and real effective exchange rates. This trend remained sustained until December 1995 before it started to decline in February 1996 marking the beginning of the crisis.

The results therefore show that months prior to the beginning of the crisis, the rand was indeed overvalued. In February 1996 the Swiss bank made an announcement that the rand was overvalued by 12%. It can then be concluded that the behaviour of the real exchange rate of the rand signaled the 1996 crisis eight months in advance.

### **Net reserves**

According to the paper by Keminsky and Reinhart (1996), periods preceding the crisis are characterized by a gradual decline in the international reserves (see chart 2 appendix). The reserves continue to decline reaching their lowest level during the crisis period before they start rising again.

The evolution of the South African pre-crisis net reserves (Gross Gold and other reserves less foreign central bank reserve liabilities) is shown in chart 2. The figure shows that from 1990 until 1991 net reserves in US dollars terms were fluctuating but gradually rising. At the end of 1991 the net reserves amounted to US \$2.9 billion from US \$ 2.1 billion recorded at the end of 1990. There was however a remarkable increase in the net foreign reserves from January 1992 when net reserves picked up to US \$3.4 billion and kept increasing until the first two months of the third quarter when they started to decline. The total net gold and other reserves fell by US \$1.0 billion in the fourth quarter compared with increases of US \$1.2 billion and US \$ 0.5 billion in 1990 and 1991 respectively. Chart 2 shows a declining trend in the South African net foreign reserves which at the end of 1993 had declined by US \$3.1 billion. The net reserves then were US \$1.0 billion compared to US \$ 2.6 billion recorded in January. A further decline in the net gold and other reserves took place in the second quarter of 1994 causing a further decrease in total net foreign reserves in the first six months recording of US \$ 480 million in April and US \$ 43.6 million in May.

There were reasons for this dramatic decline in net reserves. Firstly, from 1993 to 1994 there were large net outflows of capital not related to reserves and a relatively small current account surplus. At some point in time the net outflow far exceeded the surplus on the current account in the first nine months of 1993. This had an effect of reducing the net gold and other foreign reserves of the country. Secondly, most of the outflows were mainly short term which amounted to approximately US \$ 3 billion in the second half of 1993, and US \$ 1.1 in the first six months of 1994 which was relatively small considering that the country was undergoing a major political transformation. In particular the large outflows in the South African case could be related to continued unfavourable leads and lags in foreign payments and receipts which were fostered by the strength of the US dollar on the international foreign exchange market, and sustained downward pressure of the value of the rand. Internal unrest, political and social uncertainty also contributed to the large outflows in the 1st half of 1994. There was however recorded net inflow of

approximately US \$1.6 billion during the third quarter 1995. The reversal seem to have occurred after the fears of political uncertainty and unrest were over and was apparent that the transition to a new political dispensation would be achieved in a peaceful manner. The inflow consisted mainly of short term funds not related to reserves.

The net reserves, however, picked up momentum and by the end December were recorded at US \$ 1.7 billion. The net reserves kept rising until February 1995. In April the net gold and the other reserves of the Reserve bank declined by US \$1.1 billion and equally increased by US \$1.6 billion in May. By the end of December 1995 net reserves were recorded at US \$4.3 billion and US \$ 4.2 billion in January 1996.

In summary the analysis depicts two scenarios:

- 1) The net reserve trend as in figure (a) shows that first signal was given in April 1994 and the second in April 1995 . In both cases reserves were drastically declining and there were large capital outflows.
- 2) The declines were short-lived with reserves picking up momentum in a short period of time within one to two months.

In this case a policy maker following this trend would not have differentiated between a false signal and a good signal. The net reserves later on rose continuously and only started to decline marginally in January. This trend is different from the one depicted in figure 11 where reserves decline until the crisis period. In the South African case net reserve were increasing until the beginning of the crisis period and only started to decline a month before. The implication is that the decline in the level of net reserves was sudden and hence failed to signal the crisis well in advance.

### **Domestic credit expansion**

Chart 3(appendix) shows the behaviour of domestic credit expansion as a potential indicator, during the South African 1996 crisis. The theory and the empirical evidence from the last two chapters has shown that crisis periods are preceded by excessive domestic credit expansion. The empirical study by Keminsky and Reinhart (1996) on 15 developing and 5 developed countries shows that domestic credit tended to expand rapidly a few months before the crisis period and start to decline earlier than the beginning of the crisis period. A trend of the behaviour of domestic credit expansion before the 1996 crisis period is given in chart 3. The trend shows a steady growing credit extension from 1993 to April 1994. It should be recalled that during this period there was large capital outflows and monetary aggregates were increasing at a slower rate. The rate of growth in total domestic credit extended had decreased from 10.4% in December 1992 to 9.6% in December 1993. From the first quarter 1994 the rate had increased further recorded at 24.2% in May and 22.2% in September.

Monetary aggregates which by 1992 and mid 1993 were well below the guideline started to increase during the third quarter of 1993 but were still within the guideline of 6 - 9 percent. Growth in broadly defined money M3 started to accelerate rapidly in the first three months of 1994 and exceeded its upper limits. Total credit hence rose to R.2 .8 billion by December 1994 from 2.6 billion in 1993. By the fourth quarter of 1995 total credit extension by all monetary authorities had risen to R3.2 billion. The money supply guideline which was increased to 6 -10% by first quarter 1995 was already exceeded by April. M3 showed grew rapidly more than expected. This was a period of large capital inflows and by the third quarter of 1995 the inflow consisted mainly of long term capital. Credit extension to the private sector was the fastest growing sector during this year largely because of strengthening in consumer confidence following the successful

outcome of the April 1994 elections and credit becoming available to individuals who did not previously qualify for bank loans.

Hence from the above analysis a turn off point of the slow growing credit extension was from the third quarter of 1993 when broadly defined money supply first exceeded its upper guideline limit as shown in the figure. Mortgage advances, overdrafts, instalment sale, credit and other loans and advances constituted about 88 percent of the increase in credit extension to the private sector during the third quarter of 1995 with 63% credit having been extended to the household. This was higher compared to 46% in 1994 and 59% in 1993. Generally credit extension to the private sector was mainly for the financing of private consumption expenditure.

From the above analysis it can be concluded that periods preceding the crisis period (February 1996) were indeed characterised by rapid increases in domestic credit extension. The first signal was given as early as the first quarter of 1994 with M3 increasing and exceeding its upper guideline limit of 10%. South Africa's money supply during tranquil period was slow due to a sluggish economic growth during 1991 -93. A recovery of the economy attracted large capital inflows increasing broadly defined monetary aggregates and monetary authorities were extending credit in the form of loans and advances because of the boom, hence the start of boom period. The inflows were mainly in the form of short term capital. Total net capital inflow by the first quarter of 1995 amounted to R13.3 billion and increased to R22.8 billion in the fourth quarter. Outflows experienced during tranquil periods had turned into inflows.

As a leading indicator, domestic credit extension performed well, increasing rapidly from as early as April 1994 until the end of 1995. This gave a lead time of 20 months before the beginning of the crisis period. It can be concluded that the South African 1996 crisis was indeed preceded by significant credit extension.

## M2/ Reserves (gross gold and other reserves)

Chart 4 depicts the movement of the ratio of South Africa's M2 / Gross Gold and other reserves. Theory and empirical evidence show that periods preceding the crisis are characterized by initial increases in the ratio which tends to decline a few months just before the beginning of the crisis. The lead time for this variable was estimated at 13 months (see table 2)

From chart 4 it can be observed that the ratio behaved in a similar pattern. During 1993 the ratio increased in the first nine months due mainly to large capital outflows causing a decline in the country's net gold and other foreign reserves of R5.6 billion. The ratio however started to decline substantially from December 1993 to January before picking up again. The ratio increased continuously until July 1994. 1994 was the election year hence there was large capital outflow owing largely to political uncertainty and the ongoing internal unrest. Total Gold and other reserves declined by R 0.6 billion in the first quarter, concentrated mainly in April. Total net outflow during the first 6 months was recorded at R6.5 billion. The ratio started to decline again in July owing mostly to large capital inflows mostly short term. The total Gross reserves then increased from R7.9 billion in July to R12.4 billion in March 1995. This then resulted in a decline in the ratio. From January 1995 to January 1996 the ratio was basically fluctuating between 15.4 and 19.5 which was on average lower than even during tranquil period. During tranquil period the ratio was ranging between 20 - 24 in 1990; 12 -20 in 1991; and lowest in 1992 at 14 - 18. In the third quarter of 1995 there was long term and short term inflows, and net inflow of capital was large enough to cover the current account deficit. Short term inflow was due to increases in borrowing from abroad by banks for financing of their activities under relatively tight domestic money market conditions. The ratio was therefore falling further during the third quarter of 1995

The dynamics of the relation between the level of the ratio M2 /Reserves are as follows: The ratio M2 / Reserves is used as a measure of strength of the liquidity position of a country. A high ratio means that the country is highly vulnerable to a currency run in case of an attack. Large increases in M2 coupled by low international reserves make the banks vulnerable in case of a crisis because reserves would not be enough to cover the level of M2. Hence M2 should be within reasonable levels and reserves should be high enough to cover short term bank liabilities. The above analysis shows that whilst M2 was continuously increasing , reserves were also increasing hence the ratio was falling.

The ratio of M2/ Reserve generally was not a good leading indicator before the 1996 crisis. The ratio which was rising in the first quarter 1994 started to decline as early as the second quarter 1994 until January 1996 when it started to pick up again in February. Chart 4 shows that M2/Reserves was on a declining trend for most of the pre-crisis period (as reserves were falling). It was only in the second month or so before the crisis that it rose significantly. The ratio of M2/Reserves therefore failed as a good leading indicator during the 1996 South African currency crisis.

## **Exports**

According to a study by Keminsky and Reinhart (1996) export trends tend to fluctuate a lot but decline and reach their lowest before the crisis period. Eventually they start rising again due to depreciation of the domestic currency.

The trend of exports before the 1996 South African crisis is shown in chart 5(a) and 5(b). The movement before the crisis period was upward not downward. After a four year recession period, exports started to pick up momentum and by 1993 the value of merchandise exports had increased. Merchandise export value rose from US \$ 17.0 billion in the fourth quarter of 1992 to US \$ 19.0 billion in the fourth quarter of 1993. The value of net gold export (seasonally adjusted and annualized also increased to US \$

7.3 billion from US 6.1 billion in 1992. The volume of gold exported also increased by 8 percent in the third quarter of 1993 with merchandise exports volumes fluctuating but on average increasing.

During the first 6 months of 1994 the economic recovery experienced in 1993 faltered. This was a period when the country was undergoing a major political transition. There was political uncertainty about the outcome of political developments; ongoing violence in the run up to elections; work stoppages and labor unrest. These factors adversely affected both domestic production and export volumes of manufactured goods.

Export later recovered in the third quarter rising to US \$ 18.5 billion and US \$21.6 billion in the 1<sup>st</sup> quarter 1995 from US \$ 17.0 billion recorded in the second quarter. The high value of exports was mainly due to a rise in the export price of goods and rand against the dollar. Most of the country's exports are primarily denominated in US dollars hence a depreciation had a positive effect on the export industry.

The upward movement of the curve from the second to the third quarter marked a large rise in the value of merchandise exports of about 4 percent and a 20% increase in the volume during the first nine months of 1995. Figure (e) Shows that the value of export continued to be rising until January 1996 and only declined from February, the month the crisis started. This marked the beginning of the crisis with the rand trading at R3,74 per dollar and depreciated of even further trading at R4,70 by December 1996. According to the signals approach a good indicator should give a sign in advance to enable the policy maker to take pre-emptive measures. Table 2 shows that exports gave on average a lead time of 15 months which is good enough. In this analysis exports seem to have not given a signal that there was going to be a crisis in the near future. In fact export performance was still good with marginal increases until March 1996 when they started to drop to US \$ 22.0 billion but picking up in the third quarter of 1996. The trend exhibited in chart 5(a) and (5b) means exports would not have performed well as leading indicator.

## Imports

The signals approach indicates that imports gave on average a lead time of 16 month. (see table 2) The empirical regularities from the previous study by Keminsky and Reinhart (1996) show that imports tend to exhibit a downward trend during the pre-crisis period and start to pick up momentum after the crisis period. A possible explanation of such a trend, according to the authors may be due to the slowdown in economic activity which tended to characterise periods before the crisis episodes in most of the countries in the panel. The study observed that growth of imports even remained below that of normal periods throughout the post crisis periods. Prior to the crises episodes output declined and terms of trade deteriorated marking a slow down in economic activity.

The authors therefore concluded that the behavior of imports for these countries was confusing and difficult to justify. It was therefore found necessary to eliminate imports as a good indicator. In chart 6(a) and 6(b) (see appendix) an evolution of South Africa's value and volume of imports is shown. It is clear that the trend shown is the opposite of that observed by the above authors. Tranquil periods exhibited a steady but moderate increase in the net value and volume of imports. Import value started to show a sharp increase during the third quarter of 1994 which marked the pre -crisis period and was never interrupted until January 1996 when a slight decrease in the value was recorded at US \$ 28.06 billion by March 1996.

Import value therefore rose from US \$ 19.28 billion in the fourth quarter 1993 to US \$ 22.23 in the fourth quarter 1994. The rise in the value of merchandised imports was due to:

- (1) Substantial rise in the price of imported goods. The increase in the price of imports seem not to have had an effect on the quantity of imported goods. The volume of merchandise imports rose by 4% in 1993 as a whole with high importation of machinery, electrical equipment and transport equipment. The volume rose by a further 2% during the first quarter of 1994 and the value also rose by 2 %. Surprisingly import volumes which could have been expected to

decline were rising at a more higher rate of between 5 and 15.5 % during 1994 as a whole.

From end of June 1995 until end of August , the rand had appreciated against all major currencies except the US dollar and the Italian Lira. This appreciation of the rand was due to the strengthening of the US dollar against the Japanese yen, German mark and Natherlands guildler in the last half of august 1995. This might have contributed to the increase in import volumes around that period.

According to the Reserve Bank annual Economic Report (1994) the large increase in the volume of imports between 1993 -1994 were probably due to factors such as

- 1) South Africa's high marginal propensity of imports.
- 2) The placement of outdated and absolute equipment.
- 3) A rise in fixed investment and an accumulation of inventories.

The strong rise in inventory accumulation reflected partly the speculative purchase ahead of an expected further depreciation of the rand. Hence despite the depreciation which normally is expected to have a negative effect on the volume of goods imported, the South African import volumes tended to be rising rapidly, reducing the balance on the current account.

In summary imports performance before the crisis did exhibit the expected trend . The signal was therefore given. A policy maker following this trend would have wrongly concluded that there would be a crisis in the very near future. Imports performance strongly supported the fact that the rand was overvalued making it cheaper to import giving a lead time of 19 months. The balance in the current account was therefore continously deteriorating. Exports on the other hand failed to give signals of a future crisis.

## CHAPTER 4

### POLICY IMPLICATIONS

#### Policy Implications Specific to the South African situation

In the preceding chapter, an analysis of the pre-crisis behaviour of the chosen indicators is given. The behaviour of most of the indicators, was different from the behaviour exhibited by figures from the stylized facts discussed in chapter 2. This implies that

- 1) the indicator do not really surface as good leading indicators of the 1996 South African crisis.
- 2) the economic and political reforms that took place before the crisis had a strong effect on the performance or behaviour of the indicators.

As leading indicators domestic credit expansion; real effective exchange rate and imports performed very well during the 1996 South African crisis. The general implication is that leading indicators may be good for some crises. Therefore the nature of the crisis is important.

South Africa is an economy that has just opened up to the international market and hence undertaking structural reforms which are bound to have an effect on the macroeconomic policies. There is therefore a need to monitor movements of capital flows and ensure that the exchange rate regime is flexible enough to avoid attacks on the currency.

In conclusion three out of six indicators performed well as leading indicators of the February 1996 South African currency crisis.

## General policy implications

Whilst most studies on currency crisis focused mainly on crises in countries with fixed exchange rate systems, the South African 1996 currency crisis episode shows that the behaviour of some of the leading indicators before the crises exhibited a different pattern. The literature and the models already discussed in Chapters 1 and 2 indicate that currency crisis will normally be preceded by

- a) severe depletion of foreign assets held by central bank and monetary system
- (b) real exchange rate appreciation (overvaluation)
- (c) excessive credit expansion
- (d) increases in the ratio of base money to international reserves  $M2/Reserves$
- (e) ratio of fiscal deficit to international reserves.

The implications of these findings is that without having to look at the causes of the crisis (external and internal shocks) stabilisation reforms in most developing countries are often followed by sharp remonetization and financial deregulation. The base money and other narrowly defined monetary aggregates tend to rise quickly as a proportion of international reserves. This same trend was observed in Mexico after 1987. Financial liberalisation probably coupled with reduction in reserve requirement caused a rise in the money multiplier (M1). This is a naturally an acceptable trend that shows financial maturity. However there are repercussions to such development. If such increases are not met by somewhat similar increases in foreign reserves, the ratio of domestic liquid assets to foreign assets may rise to unacceptable levels, and financial deepening may increase financial vulnerability. This is stressed by Calvo (1996) where he emphasised that, devaluation is costly for economies which are financially vulnerable, like Mexico.

But why would financial liberalisation be a disadvantage? When a country liberalises its financial system it must ensure that its financial system is resilient enough to adjust to an increasing global environment. Commercial banks and non-banking financial institutions should acquire sufficient know-how, technologies, expertise or human capital to perform prudent asset-liability management and risk control. This has been pointed out as one of the major contributing factor in the East Asian crisis. In his presentation at the Western Economic Association International 3rd Biennial Pacific Rim Conference in Bangkok, January 16,1998 Professor Kawai noted that, “when financial deregulation and cross border capital flow liberalization were pursued, the Thai Financial system was not sufficiently resilient to adverse macroeconomic fluctuations and asset price gyrations. Commercial banks and finance companies lacked capabilities to efficiently manage their portfolio risks, and the authorities did not have an adequate framework of supervision. An implicit commitment by the authorities to rescue financial institutions in distress clearly created moral-hazard problems on the part of financial institutions.” Pp 162

Hence domestic financial market deregulation coupled with liberalization of financial capital flows and foreign exchange transaction can amount to commercial banks and financial companies borrowing large amounts of short term capital from abroad and extend loans aggressively for domestic investment not only in tradable industries but also non-tradable sectors such as real estates, construction and consumer loans. As long as the economy continues to grow at a fast rate such dramatic shifts impose no problems in recovering such loans. If there is a sudden shock which causes a slow down in economic growth and a collapse in the asset market, commercial banks and other financial institutions may find themselves in difficulties.

### **International reserves and monetary aggregates**

Reserve adequacy is conventionally measured by the equivalent number of months worth of imports. This measure was used during times when there was low capital mobility e.g.

Bretton Woods. With high capital mobility experienced between many developing and developed countries there is need to take into account the ratios of monetary aggregates to reserves. Calvo (1996) argues that monetary aggregates may differ across countries, but most important is that short term public debt should always be part of these aggregates. Further Calvo says the weight to be attached to the public debt should depend on who the holders are; (i.e. non-citizens or citizens) currency domination of the debt (foreign currency and domestic currency denominated) and finally explicit or implicit exchange rate regime.

It is well known that all M2 or at least all short-term deposits are implicitly or explicitly covered by government guarantees and are hence a liability of the government to be redeemed with either local or foreign currency at the time of a speculative attack against a currency. Short term government debts plus bank deposit need to be within reasonable levels so that the ratio of obligation to liquid assets does not send the message of weak government liquidity position. In the case of Mexico, the government short term obligation to liquid assets ratio reached worrisome proportions and the short term debt were mostly foreign denominated in dollars. Thus many countries, mostly developing, have gross foreign assets not enough to cover all of M2 plus short term debts. In this case most countries are vulnerable and there is a potential for self-fulfilling runs on their pegged exchange rate. It is therefore very crucial that movement of international reserves and monetary aggregates are observed as indicators of currency crisis.

### **Capital flows**

There is an important lesson to learn from the recent attacks in Argentina, Chile, and Mexico, that capital inflows should not be mistaken as permanent when they might be in fact transitory. Unfortunately though inflows may have positive economic effect they also have a characteristic of lasting for relatively extended periods of time and also exhibiting infrequent occurrences (Calvo 1996). In the above mentioned countries capital flows

were partly linked to well-advised structural reforms (which often have relatively permanent character) hence the policy makers wrongly inferred that such inflows had an unrealistically high permanent component.

Capital markets are sensitive to short-run financial turbulence and are quick to forget the existence of good structural reforms. The cost associated with reversal of inflows to outflows may be higher than the benefits of inflows, hence the key lesson is that it is better to underestimate than overestimate the permanence of capital flows. As a lesson, the policymaker is better off keeping a “cool head” and restrain the fervour of ‘animal spirit’ during capital inflows (Calvo 1996). This means that a country should ensure that it has a positive fiscal balance during capital inflows in order to generate enough public sector savings to be used during periods of capital outflows. This extra savings, in case the country gets rationed out of the capital markets, can be used to save the ship from sinking.

The rapid and growing integration of the emerging market countries into global financial markets during the 1990s has brought with it several currency crises most recently involving the Thai baht and the Czech koruna. This has brought with it a new challenge to reassess the nature of speculative attacks, the appropriate policy defences, role of internal financial support and the degree of flexibility of exchange rate. Similarly this is a new challenge to look further into ways of combating the attacks in light of the indicators discussed. One other thing that needs to be considered is the fact that some developing countries, mostly in Africa, may find themselves faced with a crises due to political issues like change of government, coup etc which may cause massive capital outflows. Investors need a stable political social and economic environment . Any sign of instability may puts pressure on the international value of the local currency sending a message of panic to the investors. In such situations political variables become good leading indicators.

The structural changes that have helped improve access of emerging markets countries to international financial markets have increased the intensity and duration of speculative attacks. Institutional investors nowadays have the capacity or means of taking substantial short position in weak currency through spot, forward and currency options markets. Hence it is important that there is enough international reserves and complex intervention strategies to offset such attacks. Culprits to such attacks are countries with little flexibility in their exchange rate. Many countries have resorted to using managed exchange rate arrangement as nominal anchors to their domestic price level and to maintain balanced external position. However such type of regimes demand that the macroeconomic policies be consistent at all times and requires a financial market system that is sufficiently strong and flexible enough to allow for an effective defence of the exchange rate. In particular macroeconomic policies must be used to avoid overvaluation of the currency, unsustainable current account deficits and excessive capital inflows.

## CONCLUSION

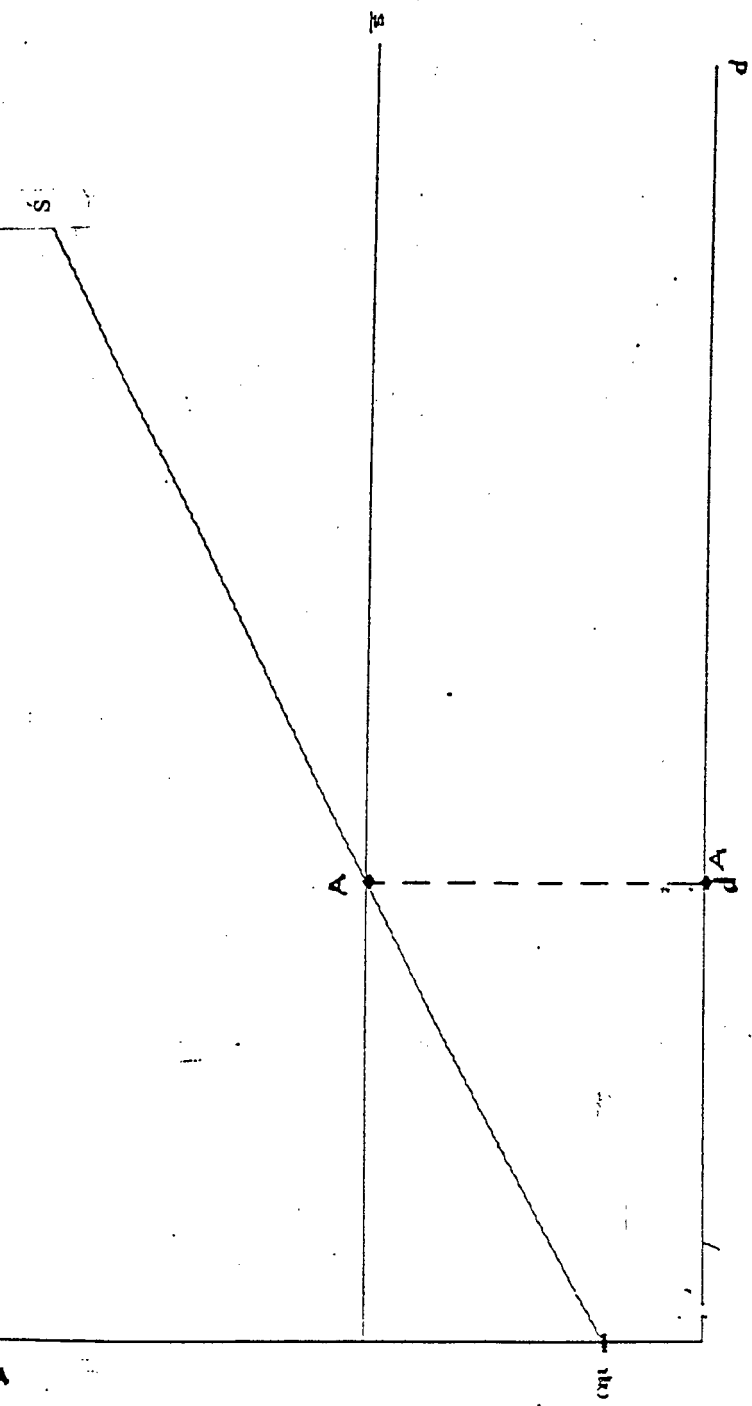
In this paper I have tried to look at the theoretical and empirical literature and models of speculative attacks of currency crises. The main aim behind this was to have an overview of the attacks and identify the key variables which according to the literature and empirical studies can be used as indicators of a crisis. The early models associated speculative attack on fixed exchange rate regimes with credit expansion, which led to a depletion of international reserves. Eventually the peg is abandoned with floating exchange rate becoming the optional regime. The new models having become aware that the government gets involved by sterilising the expansion of credit, then started to relate attacks to the inconsistency in government behaviour which tends to change the agents expectation in order to bring the economy to equilibrium. Such models therefore suggest that such an economy is bound to experience multiple equilibria. Because of such nonlinearity in government behaviour attacks on the economy's currency become self-fulfilling.

This paper aims at finding out how leading some of the indicators from the review by Lizondo, Keminsky and Reinhart (1997) and the study by Keminsky, Lizondo and Reinhart (1996) were during the 1996 South African currency crisis. The review by Keminsky, Lizondo and Reinhart (1997) shows that the indicator of currency crisis are numerous and the ability of a group of variables to detect the probability of a crisis depends on the country of study. Amongst the list of indicators to consider are qualitative indicators like financial liberalisation, political stability, economic stability and social stability. One other point to note is that most studies from the review used different variables so a general conclusion cannot be made concerning the best indicators (see review by Keminsky, Lizondo and Reinhart 1997).

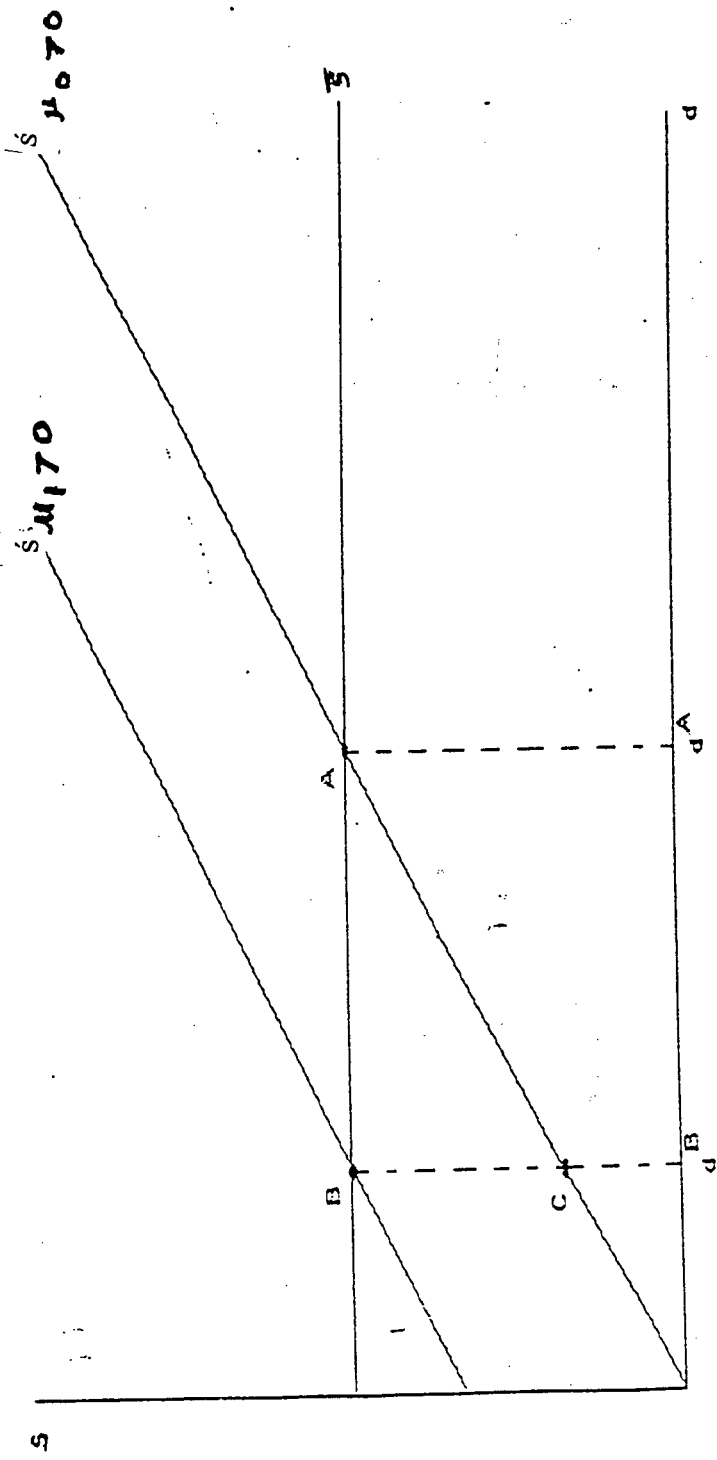
According to this review a number of indicators were significant but only six performed better than all the others. The main question is whether these indicators would still perform well in most African countries with pegged exchange rates. In addition there are political economic instability and lower capital inflows coupled with large capital outflows. The result of the study on the South African crisis (1996) has shown that indicators may perform well in one country but may fail to signal a warning in another country. This then means that one has to consider and

observe the behaviour of a group of indicators from different sectors of the economy rather than just concentrating on the financial and balance of payments sectors.

# APPENDIX

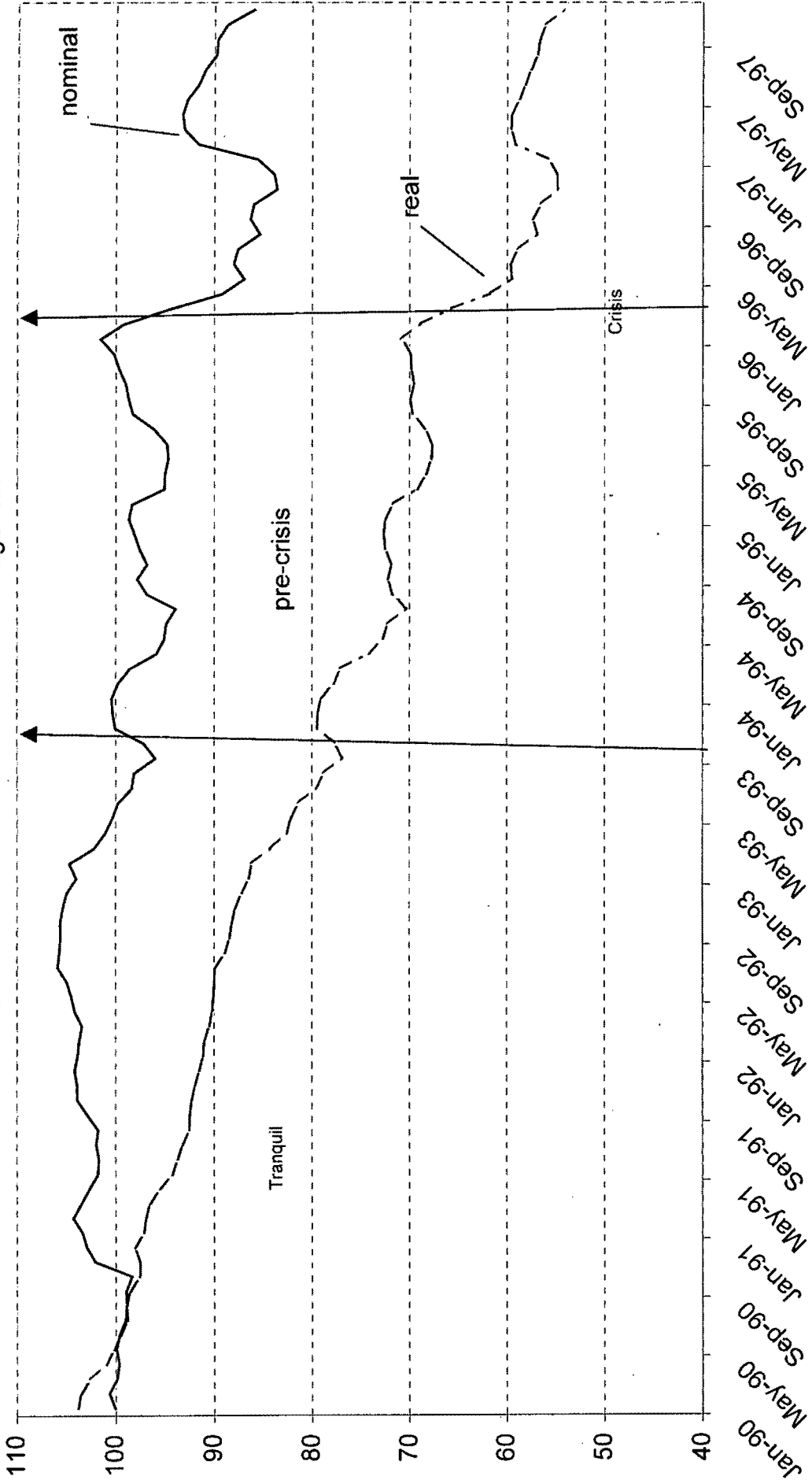


Attack times in a certain model



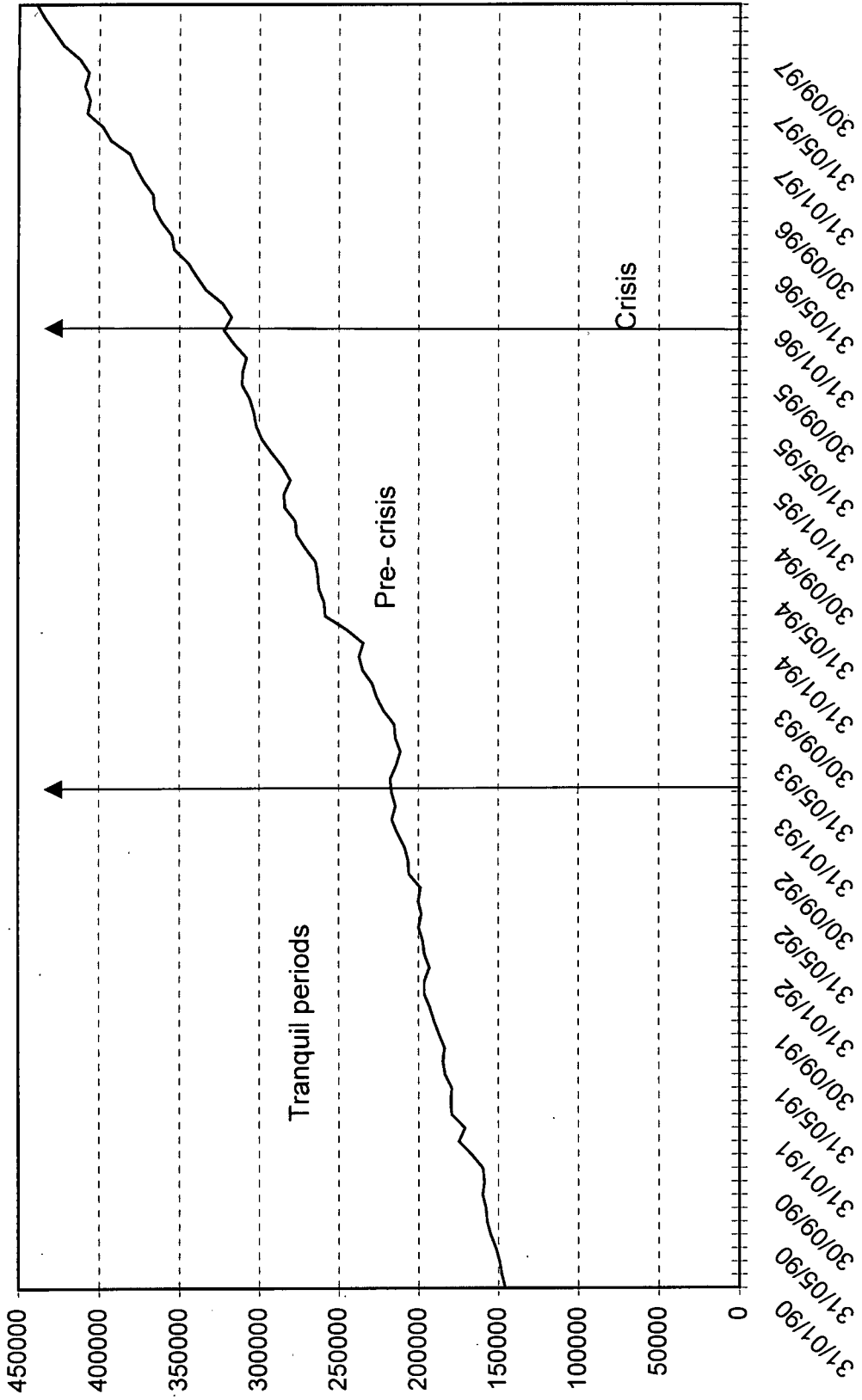
Attack times with attack- conditional policy shift

chart1 real and nominal effective exchange rate

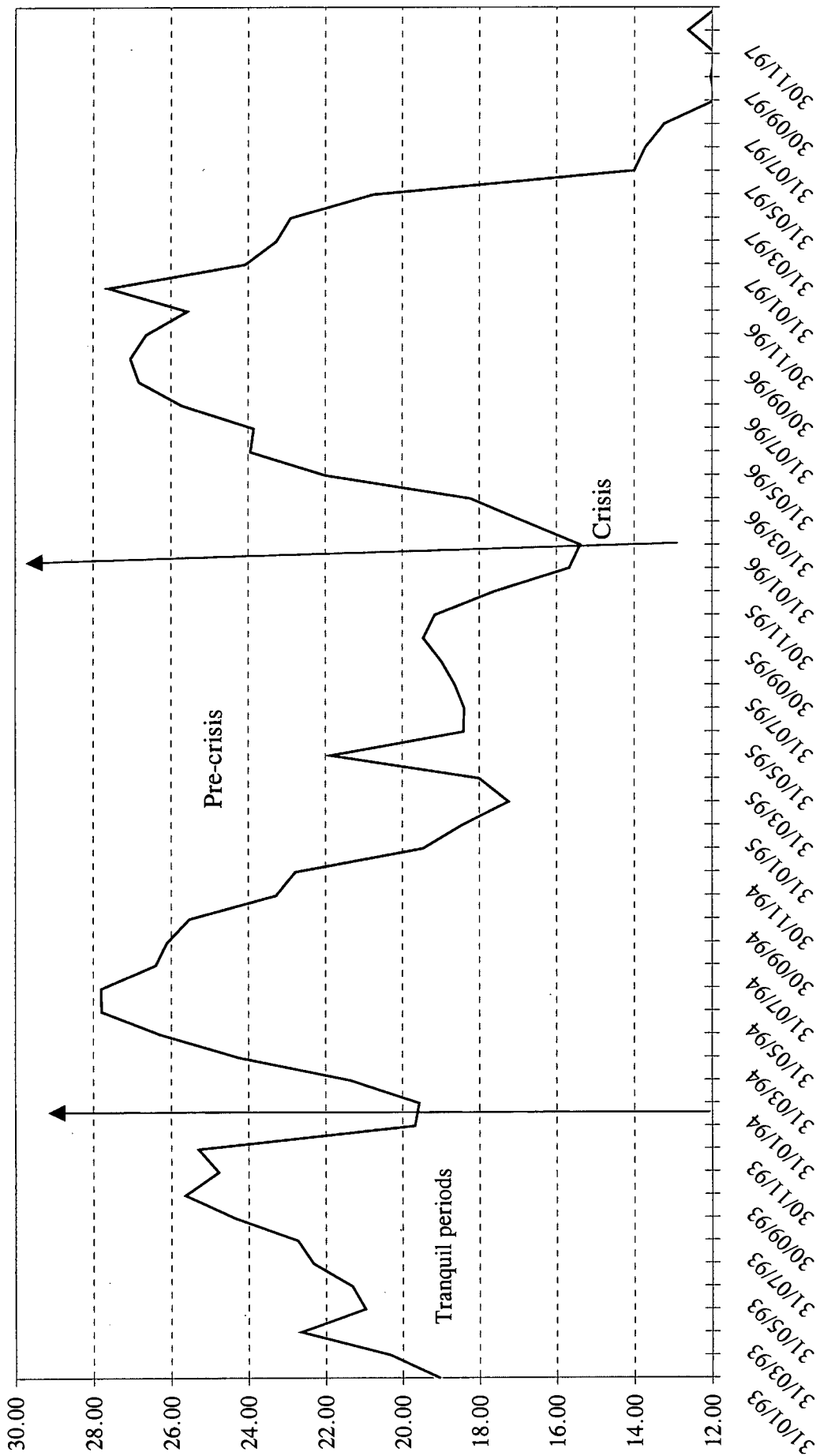




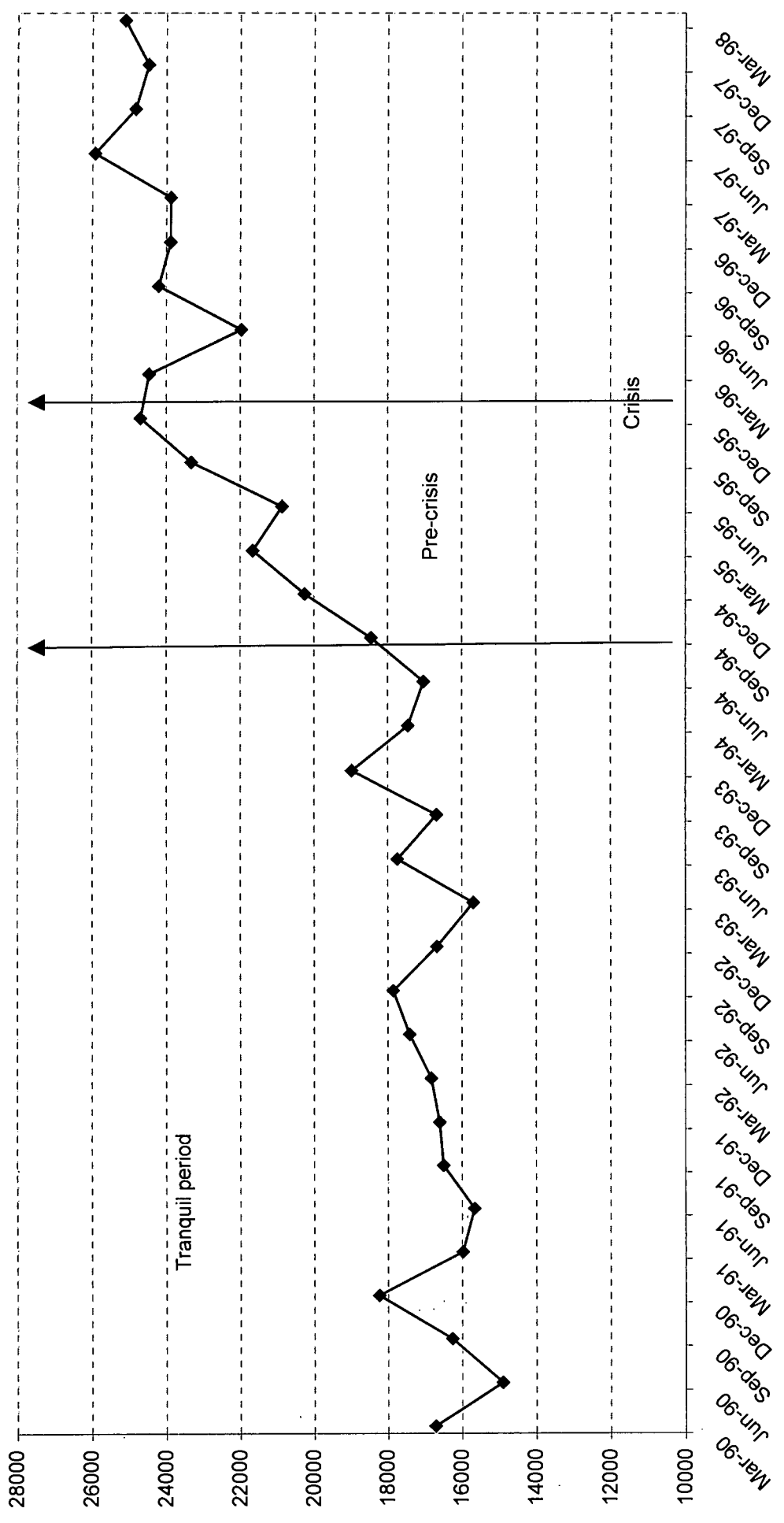
Total credit extended by all monetary institutions (Unit: R millions) [Source: SARB Quarterly Bulletin (S-022)]  
chart 3



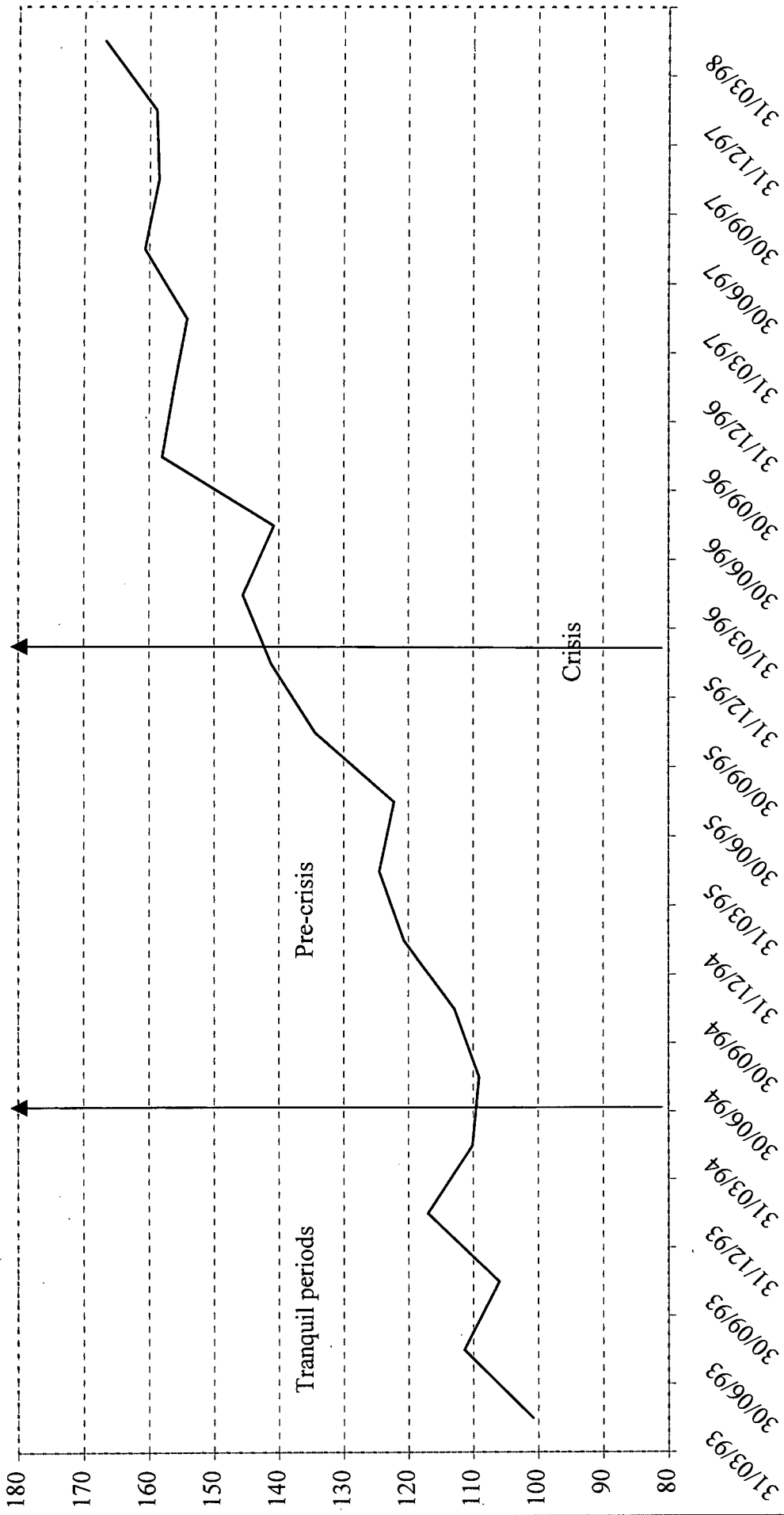
Ratio M2/reserves  
chart (4)



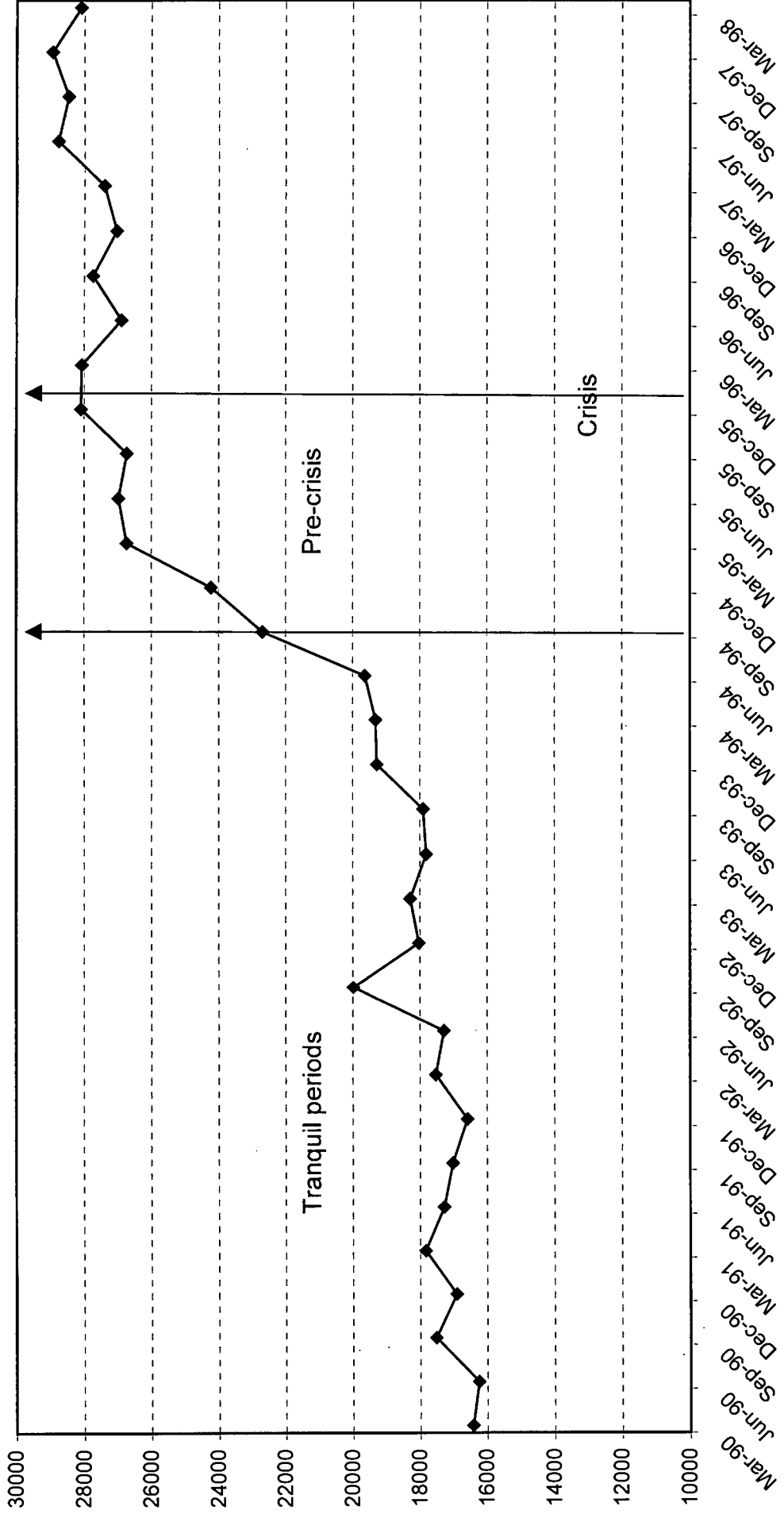
Value of exports(US Dollar-million)  
chart 5(a)



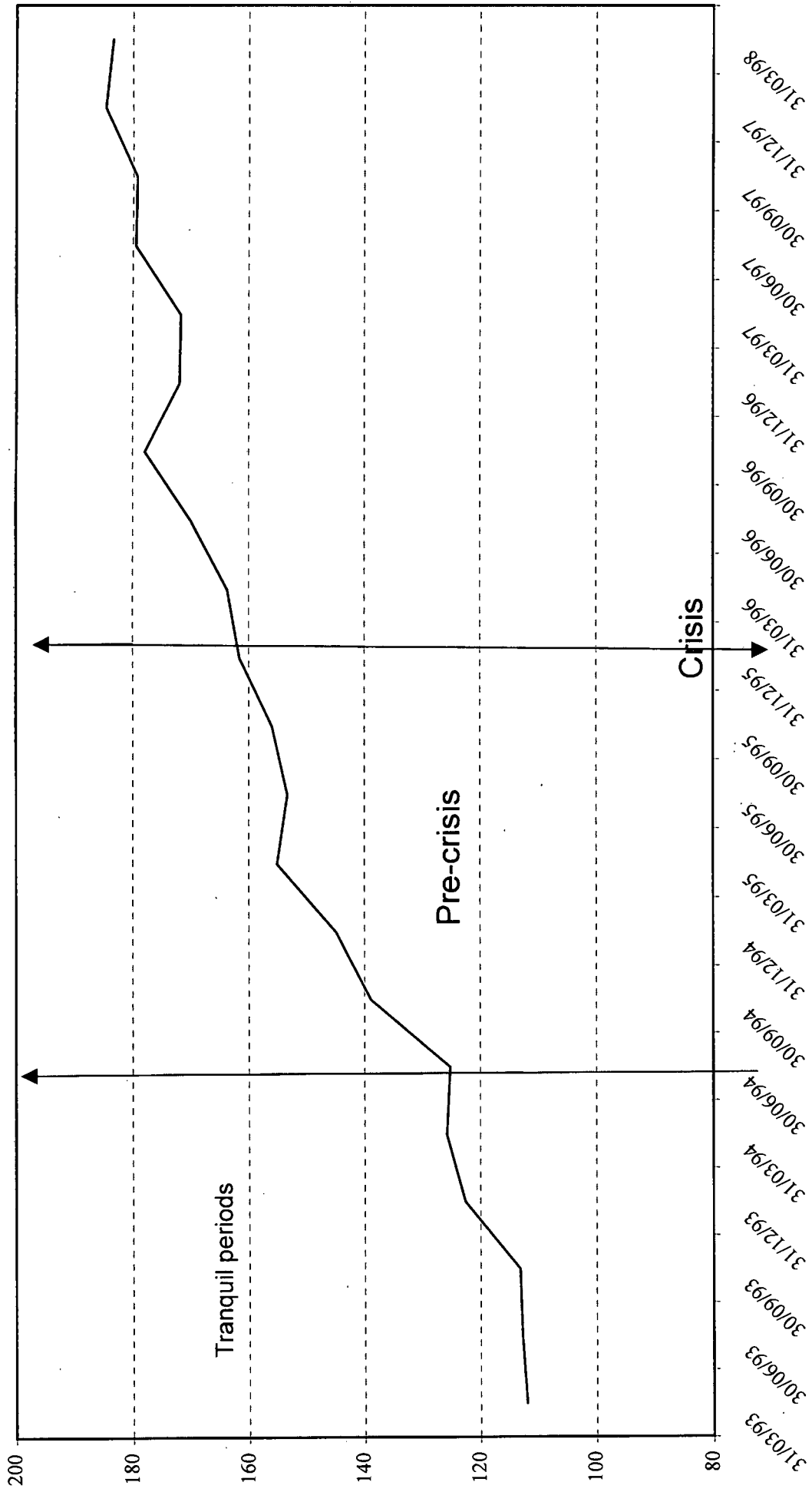
Volume of exports including gold (rand-million)  
chart 5(b)



Value of imports(US dollars-million)  
chart 6(a)



Volume of imports and services (rand million)  
chart 6 (b)



**Table 1****Performance of Crises Indicators**

	Regression Studies		"Signal" Approach (Percentage of Crises called)	
	Number of Studies considered	Statistically Significant results	Balance of Payments crises	Banking Crises
International reserves	13	12	75*	81
Real exchange rate	12	10	57**	58**
Exports	3	2	85**	84*
Imports	2	1	54	60
Terms of trade	2	1	79	95
Credit Growth	7	5	56*	50
M2/reserves	2	2	80**	77
Fiscal deficit	5	3	n.a.	n.a.
Political	4	3	n.a.	n.a.

Sources: Based on Kaminsky and Reinhart (1996); and Kaminsky, Lizondo, and Reinhart (1997).

Notes: \* means that the indicator has a noise-to-signal ratio of less than 75 percent.

\*\* means that the indicator has a noise-to-signal ratio of less than 50 percent.

n.a. indicates variable was not considered in the cited sources.

**Table 2**  
**Average Lead Time**

Indicator	Number of Months in Advance of the Crisis When First Signal Occurs
Real exchange rate	17
Imports	16
M2 multiplier	16
Exports	15
Terms of Trade	15
International reserves	15
M2/international reserves	13

Source: Keminsky; Lizondo and Reinhart (1997)

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