# Testing the Relationship between Public and Private Transfers: Empirical Evidence from South Africa

14 August 2015

Thesis submitted in partial fulfillment of the requirements for the degree of Masters of Commerce (Applied Economics Specialisation)

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CHNMAT004

Word count: 23,531



## Abstract

Financial transfers between individuals living away from their households play an important role in the reallocation of resources, particularly in developing countries. Likewise, the involvement of the State in society and public transfers of resources have been extensively documented as to their alleviation of poverty and inequality and long-term impacts on social welfare. Research has, however, shown a negative relationship between these two types of transfers.

This paper adds to the literature by analysing this 'crowding out' hypothesis in a South African context, using the country's relatively generous state pension program and history of migratory remittance transfers as its basis. I use data from the first three waves of the National Income Dynamics Study, a nationally-representative panel survey from South Africa. To overcome problems of endogeneity, I use pension age-eligibility to instrument for reported pension receipt and use a sharp regression discontinuity design around the pension age-eligibility threshold to see the impact of pension receipt on the level of remittances received. The exogeneity of pension age-eligibility is critical. I first conduct my analysis using cross-sectional regressions on each wave at a household level before running an analysis on pooled panel data at an individual level. I use various transformations of the dependent variable and a range of different estimators to overcome the large presence of zero observations in and non-normal distribution of the data.

Results are robust across models and support the hypothesis that public transfers displace private transfers to individuals and households. This effect is less pronounced for women than for men, potentially due to differing household composition between genders. The policy implications for this finding are two-fold: firstly, the state pension is reaching people is does not intend to target, reducing income to the elderly but potentially increasing the incomes of economic migrants; secondly, evidence of the benefits of pension receipt on both the elderly and the people with whom they live likely understate the true benefits per Rand of the program.



## Acknowledgements

First thanks must go to my supervisor, Ingrid Woolard, whose patience, humour, and insight played a critical role in ensuring this paper was finally completed. My family, who shouldered most of my nerves, constantly encouraged me, and I would be nowhere without the countless early morning breakfasts from my trusted housemates, Sam and Anton. I would also like to thank my friends for their tolerance of my situation and for their input, particularly Matthew Butler-Adam whose crazy genius provided me with some key direction when I needed it most. And lastly to Cara and Okmalum, my two favourites and the two coolest cats in town. None of the above should be prejudiced for aspects of this paper that are sub-par, which are due to the author alone.

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# 1. INTRODUCTION

Globally, the rise of spending on state support programs has become an important feature of most economies. The twin goals of alleviating various types of poverty and redistributing wealth lie at the core of these changes, which have become a permanent feature in most developed countries. Those developing countries that could afford to do so have rolled out significant public transfer programs of their own. Accordingly, the topic of public transfers has become a central debate in the literature on economic and social development. Simultaneously, the past few decades have seen increased attention given to exchanges between and within households. More specifically, understanding how vulnerable groups in society distribute (often truly scarce) resources provides important insight into how their needs are addressed and risks are managed. This private transfer re-allocation of resources between individuals is seen as a vital social support mechanism, particularly in developing countries where other safety nets may not be as strong and where rural to urban migration by workers in search of economic opportunities has resulted in the need for channels through which resources can be transferred back home.

Given the importance of both public and private transfers to society, it is important to understand the relationship between them. Investigation into this has shown evidence of inter-relation, where changes in one affect the other. At the core of these analyses are hypotheses concerning the drivers of private transfers between individuals and between households. Understanding what motivates these transfers informs an understanding of how they may react with the introduction (or increase) in state support programs. Two hypotheses have been investigated in the greatest detail. The first is an altruism hypothesis, founded primarily on Becker's (1974) theory of intra-household allocation of resources, which posits that individuals value the wellbeing of other members of the household in their own sense of happiness. Resources are transferred from one individual to another seen as being in need. The second is an exchange hypothesis, in which resource transfers between individuals are part of a dynamic, inter-temporal reciprocation of benefits. Evidence of both has been presented in the literature, with rigourous econometric analysis aiming to tease out the truth. Country and social context is seen as an important factor interpreting results found.

South Africa provides an interesting case study for the interaction between public and private transfers. The country's grant system plays an important part of the government's socio-economic development agenda. A long history of legalized racial discrimination and extreme economic inequality forms the basis of extensive social support programs which extend to many

vulnerable groups in society, including children, disabled people and the elderly. At the same time, this history of disenfranchisement and divided spatial living patterns has resulted in a labour system characterized by migrant workers who were forced to leave their homes in predominantly rural areas to seek work in cities. Remittance transfers therefore played and continue to play a role in supporting families. While discriminatory laws have been abolished, these patterns of work-seeking and monetary transfers have taken a long time to change, and only recent evidence shows a decrease in their importance to the welfare of the household (Posel, 2004). The significant roles both public and private transfers play in South African society makes understanding their interaction critical. How one responds to the other has important policy implications in terms of both targeting effectiveness and developmental impact. This paper aims to test this relationship. More specifically, it looks at changes in remittances received by households and individuals in response to the receipt of the state pension. Given that resource transfers within households are likely strongly influenced by individual decisions taken in the population, the pension provides a useful econometric tool to use given its near universal access.

The paper is structured as follows. In the first section I provide an overview of the crowding out hypothesis being tested, with an emphasis on the drivers of resource allocation between and within households. I present a review of the literature related first to determining what these drivers are and then to evidence of crowding out that has been found. An extension of Becker's (1974) theory is presented which models the utility inter-dependence between members of the household. This forms the theoretical framework for the hypothesis I test. Following this, I present an overview of the South African context, focusing first on the state pension program and then detailing the background to remittance transfers in society. Having explored the international and local literature on the topic, and provided background to the population from which data will be drawn, I present the methodological approach to my analysis. This is followed by a description of the data that I use and a presentation of results. Finally, I end with a discussion on my findings and conclude the paper.

The data I use in my analysis is drawn from a nationally representative panel survey in South Africa that has thus far collected information over three waves. I employ a number of strategies to test the hypothesis of crowding out. I run a series of regressions on cross-sectional data from each of the separate waves, testing at a household level the relationship between remittance and pension receipt. I run these regressions using first OLS and then a negative binomial regression model. The latter to account for both the presence of large number of zero observations in the dependent variable and its apparent non-normal distribution. Age-eligibility is

used as an instrument for reported pension receipt, due to concerns over endogeneity in the latter. I then shift my focus to a balanced panel of pooled individual observations across the waves. I run OLS and Tobit regressions testing the response of remittances received to the receipt of the pension, again using age-eligibility to instrument for reported pension receipt. I use untransformed and then transformed data in an attempt to deal with the same concerns around zero observations and non-normal distribution. I then use a Hurdle Model to explore the difference between selection into positive remittance receipt and then the amount received. Finally, I present a number of robustness checks for various changes in the household that the literature suggest may stem from new pension receipt and which may simultaneously impact the level of remittances received. The policy implications are important and are discussed in my conclusion.

# SECTION I: THEORY AND REVIEW

# 2. UNDERSTANDING PRIVATE TRANSFERS WITHIN 'STRETCHED' HOUSEHOLDS

## 2.1 A Basic Model of Utility Inter-Dependence

Private income transfers are an important component of most modern day economies. Research over the past few decades has shown that this is the case in both developed and developing countries, playing an important role in the transfer of wealth amongst individuals and households. Further, private transfers, or remittances, may comprise a large proportion of recipients' incomes and may be crucial to ensuring the survival of very poor households (Cox, et al., 1997). Much of the literature and empirical research investigating transfers within the household take the theories developed by Becker (1974) and Barro (1974) as their starting point. To understand the drivers of private transfers between individuals and households, it is useful to assess their presence through a lens of utility maximisation theory. In particular, understanding how different individuals or household members might factor in the utility of other members of the household provides an important basis for understanding the reasons why resource transfers occur. Becker (1974) was one of the first to postulate a model that incorporated this theory of utility interdependence. His work in this regard has become core to modern analysis of altruism. In their respective analyses of the subject, Jensen (2003) and Cox et al. (1997) articulate a basic form of Becker's theory, presenting a model of utility interdependence that lends itself to understanding why private transfers between households might occur. The simplified model looks at a household consisting of a parent, *p*, and a child, *c*, over two periods. Preferences for both the parent and child are characterised by utility interdependence, written as follows:

$$U_i(C_i, C_{-i}) = U_i[V_i(C_i), V_{-i}(C_{-i})],\ i = \{c, p\} \quad (1)$$

where $U_i$ are utilities, $V_i$ and $V_{-i}$ are own and others' utility and subutility functions (assumed here to be increasing and concave in their compositions), and $C_i$ and $C_{-i}$ are consumption functions. Put simply, interdependence implies that the utility of one individual is dependent, even if only partly, on the utility of the other. Altruism is mutual, such that the utility of the parent and child, respectively, at a particular moment in time is

$$U_p = U_p\left[V_p(C_p), V_c(C_c)\right] \tag{2}$$

$$U_c = U_c\left[V_c(C_c), V_p(C_p)\right]$$

where of the parent's well-being depends on both its own consumption and the consumption of the child, and vice versa. Further, consumption for both the parent and child can be described in terms of the budget available to each, as represented by

$$C_i = Y_i + T_i,\ \ i = \{c, p\} \tag{3}$$

where $T_i$ is net transfers given by person *i* (transfers received minus transfers made) and $Y_i$ represents pre-transfer income. Each person's consumption includes both their own income and a net transfer from the other. As a caveat, for simplicity's sake it is assumed that capital markets are imperfect in the model; that is, resources cannot be transferred from the future to the present, or vice versa. Parents cannot save for retirement and young children cannot borrow against their future income. Both of these are reasonable assumptions in an environment with low employment prospects, low incomes and, hence, low potential for saving for the future. Consequently, there is also no asset accumulation or borrowing in the model (Cox, et al., 2004). In the situation described, we must understand what it is that prevents either the parent of the child from suffering when their income is very low. The answer lies in the utility interdependence aspect of the relationship between parent and child, which leads to income sharing in the household. To make this clearer, Stark (1993) proposes this case of utility interdependence stated using altruism parameters, $(\alpha_p, \alpha_c)$ such that:

$$\begin{aligned} U_p(C_p, C_c) &= (1 - \propto_p) V_p(C_p) + \propto_p V_c(C_c) \\ U_c(C_c, C_p) &= (1 - \propto_c) V_c(C_c) + \propto_c V_p(C_p) \end{aligned} \tag{4}$$

The utility of each party is affected by its own consumption as well as the weighting it applies to the utility of the other. The greater the emphasis placed on the other's well-being, the stronger the effect of transfers to that party. In a single period situation, where the child transfers resources to the parent, the consumption functions for the parent and child can be written as

$$C_p = Y_p + T \tag{5}$$

$$C_c = Y_c - T$$

After inserting these equations into the utility functions in line (4), the first order condition for utility maximization becomes

$$V_p'(C_p) = (\frac{\propto_p}{1-\propto_p})V_c'(C_c) \quad (6)$$

As per Jensen (2003), the utility of the decision maker is therefore maximized when the weighted marginal utilities of the two parties are equal. If the pre-transfer income of the parent and child are unlikely to correspond with this optimum level, transfers between them are the means by which they equate their marginal utilities. It is important to note that this model holds for the situation where the parent and child co-reside as well as where they do not; transfers can therefore be understood to occur both within and between households. Likewise, the model can be extended to include multiple household members and can incorporate inter-temporal concerns around time.

## 2.2 Alternative Motives for Private Transfers between Households

The model outlined above represents a theory of utility interdependence in which household members are 'caring', in that each receives some utility from the wellbeing of the other. Models of social interactions like this represent an understanding of private transfers based on altruism, or altruistic motives. Understanding the motives driving this model are not hard to imagine: it is natural to assume that parents' care for their child will extend to looking after them when they are young and unable to provide for themselves. Likewise, children looking after their parents when the latter are old and unable to work also appears normal. While evidence suggests that altruism may indeed be present in individuals' interactions with one another, other reasons may be driving private transfers between individuals and within households.

A number of alterative motives for private transfers have been proposed in the literature. If children are provided with resources by parents as an insurance mechanism to ensure care in old age, then it could be that transfers form an informal risk sharing arrangement between the parent and child. Conversely, at a later stage in life, transfers from children to parents may form part of the work required by the former to earn inheritance from the latter. In both cases altruism may not be the primary motive driving these transfers, rather than individuals acting in their own self-interest. More abstract, but no less plausible, is the idea that the very act of giving by either the parent or the child provides utility because of social norms that require such acts to occur. In communities where strong social bonds exist, this can be a key factor driving transfers between individuals and their immediate family, more distant family and friends.

Empirical work relating to these alternative motives for private transfers has resulted in a variety of findings. Perhaps the most explored alternative motive for private transfers in the literature, and encompassing some of the theories postulated above, is the idea that these resource

transfers are part of an exchange for services. In this 'exchange' motivated model, parents make transfers to children in return for services received from them. In some earlier work, Cox (1987) examines the US economy and looks for evidence of both altruistic and exchange-based motives for private transfers. He finds little support for the former and more consistency with exchange-based models of private transfers. These findings were supported by later work (Cox, et al., 1997) in Peru which again found consistency in exchange-based rather than altruistic models of private transfers. In both cases, the empirical strategy looks at transfer amounts received by households relative to their pre-transfer income. Results tend to show that, conditional on receiving transfers, the relationship between transfers and income is generally non-monotonic, being positive at low levels of income and negative at larger levels. This finding is consistent with the exchange-based hypothesis where the transfer is provided in exchange for some service. Increases in the income of the transfer recipient is likely to increase the implicit price of the recipient's 'services' (Albarran & Attanasio, 2002).

A number of subsequent studies, however, point in the opposite direction. Cox et al. (2004) focus on the Philippines and find altruistic preferences driving transfers between households. The authors also find evidence of effective risk sharing, where private transfers are used to compensate for the risk of shortfalls in household resources. McGarry (1999), in assessing data on transfers from parents to children in the US, finds that private transfers go disproportionately to less well-off children and that differences in the level of transfers arise from differences in levels of income. Kazainga (2006) adds further evidence from a developing country context, Burkina Faso, a country with low levels of income and a tradition of gift exchange. Results suggest that the altruistic hypothesis holds for middle income households but not at a low income level. This implies that crowding out from public transfers targeting poor households is therefore likely to be minimal for low income households. Risk sharing was also found to be irrelevant to transfer received.

While the empirical work mentioned above provides only a selection of the work that has been conducted in this area, it nonetheless provides a good overview of the variation in results that have been obtained and the difficulty in establishing a single coherent hypothesis for what drives private transfers between households. Importantly, this reinforces the need for a broader understanding of the societies in which public and private transfers are occurring. Those countries where family support structures are relied upon, for example, may lean more towards altruistic preferences than those where state support mechanisms are larger and already institutionalized. In the latter, private transfers may not be as widespread or as large a fraction of income as in the former, which are likely to be developing countries with smaller systems of public redistribution

(Cox, et al., 2004). Country context and alternative motives for private transfers between households can thus imply very different outcomes for public policies that redistribute income.

## 2.3 A Crowding Out Hypothesis

In a paper theorizing the impact of expansionary fiscal policy on the net wealth of society, Barro (1974) develops a model of social interactions similar to that in the altruistic model described above, one based on shared utility and overlapping generations. However, the author builds on this theory, by introducing the concept of intergenerational altruism that goes beyond finite lives and assuming that households behave like infinitely-lived dynasties (Jensen, 2003). This has important implications on understanding how different types of transfers affect household behaviour. Thus far, the concern had been exclusively on private transfers between individuals and/or households. Barro's theory paved the way in understanding how the presence of public transfers in society – the transfer of resources from governments to citizens – might affect how private transfers take place. Government transfers that change how the distribution of resources takes place across generations, such as social security programs, may reverse private transfers within families (Jensen, 2003).

In relatively recent times, the concept of a state playing an active role in the welfare of its people has emerged. In particular, between 1960 and 1985 the proportion of GDP dedicated to social expenditures in the developed world increased as welfare programs expanded; in Europe this ratio doubled and for other OECD countries this grew by as much as 40-50% (Congleton & Bose, 2010). In developing countries, many of which emerged from colonial rule during the latter half of the 20$^{th}$ century, the use of subsidies and cash transfer programs also began to increase in importance. The effectiveness of state programs became a topic of great interest, particularly in relation to cash transfers to the most vulnerable sections of society. Research was dedicated to assessing the effects of these programs on a range of factors, including on children's socio-economic outcomes, the empowerment of women and the improvement of the condition of the elderly. At the same time, concerns around the prospect of "crowding out" surfaced; that is, where income increases from state sources displace other income streams to the household. Taking the model described by equations (2) and (3) further, Cox et al. (1997) describe a two period model in which the parent and child overlap for both periods[1]. As with line (3), the model configuration for pre-transfer income can be described as

[1] While the same reasoning that follows can be extended to multiple periods, a two-period situation is used for descriptive purposes here

$$\text{Period 1:} \quad Y_{c1}\text{: low } Y_{c2}\text{: high} \tag{7}$$

$$\text{Period 2:} \quad Y_{p1}\text{: high } Y_{p2}\text{: low}$$

where $Y$ again denotes income and different periods are denoted by the numerals *1* and *2*, respectively. As a simple example, the first period scenario describes a situation in which the child is too young to provide for themselves and is taken care of by parents. Conversely, in the second period, the parent is now too old to provide for themselves, and must be looked after by the child. A reasonable assumption to make is that the parent transfers resources to the child in the first period and the child then makes transfers to the parent in the second[2]. Transfers motivated through altruism would get around the issue of an imperfect capital market. An important feature of the model is that an increase in the recipient's pre-transfer income is always met with a decrease in the amount of transfers received. From line (3), it can be seen that

$$\frac{\partial T_c}{\partial Y_{c1}} < 0 \tag{8}$$

$$\frac{\partial T_p}{\partial Y_{p2}} < 0$$

Consider the first period, when child income is low and parent income is (relatively) high. In this case, the altruistic parent will transfer income to the child. Given the model, as well common sense, it can be seen that children with higher income $(Y_{c1})$ require smaller transfers $(T_c)$ to reach a level of consumption that the parent thinks is optimal. The partial derivative of this is

$$\frac{\partial T_c}{\partial Y_{c1}} = -1 + \frac{\partial T_c}{\partial Y_{p1}} \tag{9}$$

On the right hand side of line (9), the first term (constant) implies that a Rand increase in $Y_{c1}$ is met with an identical Rand decrease in $T_c$, if first period total family income $(Y_{c1} + Y_{p1})$ is held constant. Importantly, though, since an increase in $Y_{c1}$ also raises total family income (and which is therefore not constant), the reduction in $T_c$ will be less than Rand-for-Rand provided the income elasticity for parental giving is positive, which is likely to be the case (Cox, et al., 1997). The findings from the model and its derivations are important for two reasons. First, they indicate that, in circumstances where giving between parents and children are based on altruistic motives, exogenous increases in income to one party are offset by a reduction in transfers from the other. Second, the magnitude of line (9) can be quite large or quite small; that is, the responding change

[2] Note, transfers here refer to *net* transfers by each party

in transfers to exogenous increases in income is not known in theory. Cox et al. (1997) provide the example of a model with Cobb-Douglas preferences and equal weighting of parent and child utility, which would imply that a Rand increase in $Y_{c1}$ prompts a fifty-cent reduction in $T_c$. The same understanding of the model above would apply to second-period transfers, in which the outcome would be the same, but with the roles of the child and parent reversed.

## 2.4 Empirical Testing of Crowding Out

Research into the changes experienced in private transfers to the household in the face of public grant receipt have been explored in a number of developed and developing country contexts. The purpose of this section is less a summary of work that has been undertaken rather than a more detailed look at specific pieces of analysis that hold useful lessons for understanding the underlying drivers of crowding out in households. Cox & Jakubson (1993) investigate the effectiveness of public transfers on alleviating poverty while taking private transfers into account. While altruistic motives imply that public transfers to the household are effectively neutralized by corresponding reductions in private remittances received, the authors find more complex empirical outcomes using data from the USA. Their empirical findings suggest that, rather than supplanting them, the effects of public transfers can actually be magnified by private responses when seen in the context of exchange-based motives. The authors calculate poverty rates that subtract social transfers from total income to understand the extent of income poverty in the absence of grants. More specifically, their question revolves around whether private households would step in should public assistance programs be removed. If so, then private safety nets would render public transfers redundant, and vice versa. Using official poverty cutoff rates, which vary by age and a range of factors, the authors generate a private-transfer-counterfactual poverty rate (Cox & Jakubson, 1995) that removes from total income public transfers and calculates and adds in private transfers induced by their removal. The authors compare this rate with a no-response counterfactual, which simply subtracts public transfers from total income. A significant difference between the two rates would suggest some form of altruistic safety net that compensates for reductions in public cash transfers received. The results are small and insignificant, with no evidence of this safety net found. This supports the hypothesis that public cash transfers have strong redistributive effects which are not negated by private household action. Further, certain findings in the paper suggest that private behavioural responses might actually reinforce the distributional effects of public transfer programs due to intra-household exchange considerations. These findings are important in that they have implications for public policy. Firstly, studies which implicitly assume no private transfer response when assessing the effectiveness of anti-poverty programs are likely to be reasonably

accurate. Little or no crowding out means poverty rates are not biased due to changes in private transfers to households. Secondly, with the effects of altruistic and exchange-based motives working in the opposite direction, the effects of public transfers can be either reinforced or diminished. Knowing which motives are at play is therefore vital in understanding the broader effects of spending on social programs.

As with studies looking at motives for private transfers, understanding the crowding out effect in developing – rather than developed – country contexts is also important. Albarran & Attanasio (2002) use data from the evaluation of the well-known PROGRESA program in Mexico to show the degree to which an intervention such as this displaces private transfers to households. Social programs targeted to the poor often fail to fully consider the interaction of their interventions on existing household arrangements. This has implications in understanding both the best use of scarce resources and in the long term effects on social interactions these interventions may have. A challenge empirically testing for these effects is that recipients of these programs tend not to be a random sample of the population; by the nature of their design, they either target resources to the most vulnerable sections of the population or are driven by political pressures that refuse exclusion of any deserving groups. Comparing recipients and non-recipients can therefore be difficult given the likely presence of unseen influences that cause the two groups to fundamentally differ from one another. It becomes difficult to determine what the level of private transfers given and received by households would have been in the absence of public intervention. The authors attempt to address these issues using the randomisation that was an inherent part of the PROGRESA design. The rollout of PROGRESA was conducted first on a selected group of villages with the explicit purpose of properly assessing the program's impact over a period of time. A set of villages was therefore randomly excluded from the program which allowed for the direct evaluation of the effect of the program on parameters of interest. In this case, it introduced exogenous variation among different sample groups, allowing for the identification of the effect of the intervention on private transfers in monitored households.

The program had three components; health, nutrition and education. Simply, along with a range of in-kind programs, beneficiary households received cash grants conditional on a range of outcomes, including visits to health centres and attendance at school. The program represented a considerable support for beneficiary households, with an average grant amount totaling around 21% of beneficiaries' income, but with the potential to reach up to approximately 60% of average household income for the poorest households (Albarran & Attanasio, 2002). While PROGRESA is therefore not a pure transfer program as subsidies depend on actions taken by recipients (the

conditionality resulting in a potential selection bias amongst observed households), the program was nonetheless seen as having an overall positive income effect on recipient households. In assessing private transfers, the authors find that treatment villages receive lower transfers than control villages. Further, within treatment villages, due to delays a number of households did not become beneficiaries and continued to experience relatively higher remittance transfers than those that did. Overall, the authors find that both the likelihood of receiving private transfers and the amount received conditional on receiving are significantly negatively affected by the program.

Cox et al. (2004) find strong effects of crowding out in the Philippines, with results consistent with altruistic preferences, risk sharing, or both. The authors find that attempts to help the poor might be undone by private responses, which benefit richer households in particular who no longer have to support poorer family members. Using data from Germany, Reil-Heid (2006) finds a negative correlation between private transfers received by individuals who receive financial support and public transfers they receive. While the evidence on crowding out appears mixed, there are good indications that displacement of private by public transfers does indeed occur, and is more likely to happen in developing countries and to poorer households. Country context appears to play an important role in understanding if and why crowding out of private by public transfers may occur.

# 3. THE SOUTH AFRICAN CONTEXT

South Africa, one of the largest economies on the African continent, provides an interesting subject for an analysis of the crowding out hypothesis for two reasons: firstly, due to the country's large social grant system; and secondly to its entrenched system of migratory labour. This section looks at each of these factors in closer detail and explores work on transfer displacement that has been done in South Africa.

## 3.1 The South African Older Persons Grant

A large component of the social welfare system in South African includes unconditional cash transfers aimed at the elderly, at children, at orphans and at people with disabilities. According to 2015 Budget Review presented by the National Treasury (2015), it is expected that by 2017/2018 up to 17.5 million beneficiaries will be receiving social grants. Evidence conducted as to their effectiveness suggests that this public spending has had a large impact on poverty reduction in South Africa, with the benefits accruing disproportionately to the poor; the poorest quintile's share of total income made up of grants stands at around two-thirds of total household income

(Leibbrandt, et al., 2010). Cash grants are therefore an important government policy tool in the country and issues surrounding the use of grants as a measure of alleviating income poverty and inequality are fraught with political difficulty. While criticism around the sustainability of maintaining such a large public transfer program is noted, it is not the focus of this paper here. The relevance of social grant effects on household socio-economic outcomes is, however, central to this paper; given that many studies assessing their impact tend to ignore the potential for crowding out of remittances received.

The South African Older Persons Grant (OPG) (formerly known as the Old Age Pension) is a non-contributory cash transfer from the government to elderly men and women in South Africa. The history of the pension reveals much about South Africa's fractured history. Introduced in the 1920s as a safety net for poorer, elderly white people not covered by pensions through employment, transfers were only extended to non-white people in the 1940s and 1950s (Jensen, 2003). Benefit levels for the latter were extremely low and far below those of white beneficiaries. It was only in the late 1980s, that a pressured government commitment to racial equality in the pension raised the amounts paid to non-whites until they equaled those received by whites. Since the early 1990's payment has not discriminated on race. Until 2008, women and men over the age of 60 and 65 respectively were eligible for its receipt. Since then, gender discrimination was phased out and age-eligibility was equalised, such that both men and women over the age of 60 are now eligible for its receipt. Eligibility is subject to a means test based on the income and assets of the recipient but, given the high proportion of poorer households in the non-white population, means testing is not seen as being particularly effective and is rarely enforced (Case & Deaton, 1998). The current maximum amount receivable of R1,410[3] represents approximately twice the per capita median monthly income for Africans (Ardington, et al., 2013). The transfer is available to individuals regardless of their labour market participation or other endogenous factors, thus removing the incentive for households to rearrange their composition to take advantage of the extra income (Hamoudi & Thomas, 2006). The OPG is therefore a very generous form of social assistance and one that has been shown to play an important role in poverty alleviation.

Case & Deaton (1998) present initial evidence of the impact of the OPG on households. Data drawn from a nationally representative survey conducted in 1993 is examined to understand the effect of pension receipt on the outcomes of the elderly. Then, as now, the pension was a relatively large cash sum paid to all South Africans above a certain age and irrespective of previous contributions. Given the rapid increase in the size of the pension during the previous decade as

[3] With an additional R20 per month for individuals aged over 75

the apartheid regime collapsed, it was reasonable to assume that most African recipients at the time had little expectation that a pension of this level would be available during their occupational lifetime (Case & Deaton, 1998). The unanticipated and large nature of the scheme therefore provided a good opportunity for analysis, which showed that the pension had significant impact on household welfare and was effective in reaching poor households. Benefits were seen to extend to both the elderly and co-resident children. These findings are part of a larger body of evidence which suggests that spending on cash transfers has had a significant impact on improving socio-economic outcomes and reducing the effects of income-poverty in South Africa. Findings further indicate that income poor households share these benefits disproportionately, given that a far larger share of total household income is derived from social grants. This is particularly important given that many poorer households in South Africa are already operating close to established poverty lines. For example, much of the literature has focused on the positive impact of cash grant receipt on children within the household, resulting in better anthropometric health measures, increased likelihood of school enrolment and school attendance, higher levels of educational attainment, reductions in child labour, and increased resilience against parental death (Duflo, 2000; Edmonds, 2006; Case, 2001; Case & Ardington, 2004; Hamoudi & Thomas, 2006; Aguero et al., 2006; Budlender & Woolard, 2006).

Duflo (2000) examines the impact of the OPG on measures of child health and nutritional upbringing. Her analysis uses the expansion of the pension system that took place during South Africa's transition to democracy as an exogenous identifying assumption. Controlling for the gender of the pension age-eligible recipient, the author compares children in poorer homes which contain a pension-eligible person with households that do not and finds that the presence of woman eligible for the OPG improves the health scores of girls, but not boys. The presence of a pension-eligible man in the household is not seen to have an effect on either boys' or girls' health outcomes. Case (2001) looks at a small sample of households in the Langeberg District in the Western Cape, South Africa to understand the trickle-down effect within households of the OPG. The analysis finds that when extra income from the OPG is pooled in households, children were seen to be significantly taller due both to improved nutritional status and to improved sanitation facilities within the household. Given that the majority of households pooled the income received through the OPG, the impact of the additional income on the community is significant. Case & Ardington (2004) assess the effect receiving the OPG has on softening the negative impacts on child educational outcomes as a result of maternal death. The results from the analysis indicate that the presence of a pension-eligible female in poorer households mitigates against reductions in enrolment and grade-progression (although not in income spent on schooling) seen for those

maternal orphans that do not co-reside with a pension-eligible female. Male pension eligibility, however, is associated with the opposite: a negative effect on grade progression and no significant impact on enrolment and school-related expenses. Edmonds (2006) employs a regression discontinuity design to identify changes in children's schooling and child labour due to receipt of the OPG. His analysis finds that households that become pension age-eligible (that is, a member of the household becomes age-eligible to receive the OPG) are associated with lower levels of child labour, increases in school attendance and improvements in educational attainment, relative to similar households not eligible for pension receipt. These effects, though, are limited to pension-eligible men, not women, and outcomes are seen to be larger for boys than for girls.

## 3.2 Economic Migrants and Remittances in South Africa

Apartheid-era spatial planning in South Africa resulted in the uprooting of large sections of the population and the forced relocation of many to remote designated areas in the country. While the purported purpose of this policy was the segregation of racial groups, at its core was continuation of the indentured labour system that had arisen with the discovery of precious metals in the preceding century. Areas for non-white population groups were away from core economic centres, with the result that workers were forced to leave their homes and travel to find work, primarily in urban areas and industrial zones. South Africa's apartheid-era planning system therefore created a geographical disconnect between non-white workers and their places of employment. Segregation laws meant both the forced relocation of non-white individuals away from urban areas and restrictions that prevented these workers from migrating with their families. Further, in these urban areas, non-white individuals were required to live in townships at the edge of towns and cities, far away from urban centres, further reinforcing the disconnect between where people lived and where they worked (Hendler, 2015). The result was a system of migratory labour, where workers would retain a permanent home base, often in more rural areas, to which they would temporarily return after spending the majority of their time working in far-away urban and industrial hubs.[4] While this "circular, or oscillating migration" (Posel, 2010) labour system had existed prior to the introduction of the Group Areas Act of 1950[5], the institutionalisation of race-based segregation policies during the apartheid-era consolidated the migratory labour system in South Africa and

[4] Those responsible for earning in households – and forced to migrate to find work – are primarily men, with women, children and the elderly remaining at home. While this point is important, this gender dynamic is not central to the theme of this paper and is not discussed further.

[5] The Group Areas Act was the title for three acts of parliament enacted under the apartheid government in South Africa. While it was first promulgated in 1950, it was implemented over several years during which it was amended a number of times, repealed and re-enacted. Along with a number of other discriminatory laws, it was repealed on 30 June 1991 by the new democratic Measures Act (1991).

entrenched structural inequality in many ways. It made it virtually impossible for poorer households to earn enough to escape poverty and removed conditions in and around the household conducive to overcoming inter-generational transfers of poverty and dependence. While the country's new democratic dispensation has removed this race-based legislation the migratory labour system in South Africa largely persists to this day (Posel, 2004).

Migratory labour systems often develop in parallel with those facilitating remittances from workers to distant households. To support their families, migratory labourers send resources (usually in monetary form) back to their homes far away. Remittances from workers to their homes therefore provided strong, and sometimes the only, support mechanisms for families. Discriminatory legislation in South Africa therefore institutionalised an occurrence that is often found in low-income countries, where most remittances to households originate from economic migrants working away from home. Todaro (1969) and Harris & Todaro (1970) present a utility migration model in which household members migrate if, after taking into account migration costs and other utility inputs, their expected utility from migrating is greater than the expected utility from remaining at home. Take, for example, a household composed of a parent and child where the latter is able to migrate to work. If the child chooses to migrate due to expected higher utility elsewhere, then higher incomes at home could lead to a reduced need to migrate. This would be the case if the well-being of the parent or the benefits from co-residing with her/him were a factor in the child's utility function. While this example focuses on reduced migration by children through improvements in their parents living situation, the same reasoning and logic could see reductions in remittances rather than reductions in migration, given slight adaptations of the model.[6] The same model can also be extended beyond the parent-child relationship, looking at cases where one partner in the household (husband or wife), who is the breadwinner, migrates to earn income elsewhere. Posel (2001) finds, for example, that while recipients can vary from being parents, children and spouses, the most frequent and significant remittances go more to spouses than other identified recipients. The utility taken into account at home can also be broadened to include a larger family grouping and a wider range of social norms and factors. In a society such as South Africa, in which strong cultural norms exist that put the onus on the household head to provide and care for her/his immediate and extended family, these social factors may play a large role in driving migration and remittance flows. These social norms can be strong enough to determine

[6] For example, costs of returning home might be prohibitive or the utility value of remaining in a higher income area might still be higher than home, with an equalisation of marginal utilities taking place through reductions in remittances rather than fully returning home. This might be the case if, for example, migrants develop new ties in urban areas that compete with the requirements of family in their rural household (Posel, 2001).

how resources are transferred within the household itself, such that remittances are targeted only to household members with valid claim, and where channeling these resources to family members seen an invalid claimants would result in potential loss of remittance income (Flaherty, 1995 in Posel, 2001).

These utility migration models are compatible with the utility interdependence model presented earlier. In particular, they align with a setup incorporating altruistic preferences where the utility of other individuals in the household are part of the migrant's own utility function. Apartheid-era planning entrenched the geographical dichotomy between places of residence and places of employment, forcing economic migrants to move far away from homes to seek work. Remittance flows back home likewise became part of the socio-economic configuration, such that even though discriminatory laws were repealed and restrictions lifted with the advent of democracy in 1994, structural inequality remains. From 1993 to 2002, Posel (2004) found that temporary internal labour migration in South Africa did not decline, something to be expected since families were given the legal freedom to migrate. A number of reasons have been put forward for this, including that temporary migration patterns take time – sometimes generations – to change. More recent evidence has, though, shown this pattern to be changing. Comparisons of national-level panel data with earlier national household surveys has shown that, since around 2005 the extent of labour migration and remittance receipt has fallen significantly in recent years in South Africa (Posel, 2010). While comparability may be limited due to differences in survey composition used in this assessment, there is evidence to suggest that increases in receipt of public cash grants by households have resulted in a reduction in the contribution of remittances to household income. This corresponds to outcomes predicted by the combined utility migration model and altruistic private transfer models in situations of significant increases in income of the household at home.

## 3.3 Evidence of Crowding Out in South Africa

Given the evidence of potential crowding out of private by public transfers to households more generally, investigation is necessary into whether South Africa's large social cash transfer system experiences similar outcomes. This has implications from both a public policy and research point of view. Beneficiaries being targeted may not be receiving the full benefit of the transfer and findings on the effectiveness of these cash transfers may not be accurate. Posel (2001) tests three hypotheses for the determinants of remittances in South Africa: altruistic behaviour based on recipient need; altruistic behaviour based on biological relatedness between household members and the migrant; and competing urban opportunities with migrants' self-regarding motivations for

remitting[7]. Inherent in this setup is the testing for altruistic or exchange (or service)-based preference drivers of remittances outlined earlier. Results show that remittances are found to increase with the earnings of migrants, an outcome consistent with both types of motivating preferences. However, a negative relationship is also found between levels of remittances and the level of recipient pre-transfer income, indicating the migrants remit more to those households more in need. Additional model outputs show that households that have access to sizeable and secure sources of income receive reduced remittance transfers. Taken together, these findings support the hypothesis of altruistic motives as the drivers of private transfers to households. There is also evidence, however, that migrant's altruistic behaviour is linked to certain specific types of kindred relationships.

In another important paper on the subject, Jensen (2003) also investigates whether government transfer programs displace private transfers to households in South Africa. In particular, he focuses on cash transfers that take place through the Government's Older Person's Grant (OPG)[8]. Using a basic model of utility inter-dependence within households similar to that described in the opening sections of this paper, the author hypothesises that those households that receive the OPG receive lower levels of remittances relative to similar households that do not receive this grant, ceteris paribus. If true, this would indicate evidence of 'crowding out'; namely, that Government cash transfers displace private transfers to households that receive them. To test for this effect, the paper utilises the large increase in the OPG that took place between 1989 and 1992 as South Africa transitioned to democracy to act as an exogenous driver of changes in remittances to households that took place over the same period. The author focuses the analysis on a rural, income-poor region, using household surveys in Venda, a former homeland in South Africa. The data consist of two identical cross-sectional surveys, administered to approximately 600 households, conducted in 1989 and 1992 by the Bureau of Market Research at the University of South Africa. Two endogeneity concerns are recognised that prohibit a simple comparison of remittances received by pensioners and non-pensioners to test for displacement: firstly, factors other than age are likely to inform pension take-up by individuals eligible for its receipt; and secondly, given that pension receipt is determined by a range of demographic and wealth effects may provide a reason for expecting differences in remittance levels between the two groups. The author therefore uses gender differentiated age-threshold discontinuities as well as time-series variation in the total amount of the pension to generate a difference-in differences-in differences (DDD) estimator as a strategy to test for crowding out. The identifying assumption underlying the

[7] To secure a share of rural household output or claim to land, for example.
[8]Formerly known as the state Old Age Pension

model is that "other than receipt of the pension, there were no other factors that affect the level of remittances received that changed between 1989 and 1992 in a way that would differentially affect men and women at the exact gender-specific pension age thresholds" (Jensen, 2003). The results of the DDD analysis provide strong evidence for crowding out, with a relatively large and statistically significant impact on remittances received by both pension-eligible women and men. On average, it was found that for each Rand of pension income received lead to a 0.3 and 0.26 rand reduction in private transfers for women and men respectively. These results were found to be robust, with further investigation revealing no changes in migration, labour supply or household composition in the presence of new pension receipt.

An interesting approach by Maitra & Ray (2003) examines the impacts of public and private transfers on the behaviour and welfare of households in South Africa. The authors use data from the South African Integrated Household Survey to examine changes in spending patterns in the household. Specifically, the authors focus on whether pensions and private transfers received by the household have different impacts on expenditure patterns measured by the share of income spent on a range of goods and services. While both resource flows are shown to contribute to reduced incidences of poverty in the household, results indicate that private transfers received by households have a significant impact on expenditure patterns while the receipt of public pensions has little effect. One reason put forward for this finding involves the crowding out of remittances received by the household by public cash transfers, the two of which may be seen as substitutes for one another. The authors take the analysis a step further by allowing for the endogeneity of transfers to the household, relaxing the assumption that public transfers are exogenous in the model when calculating the determinants of private transfers. As with other studies in South Africa, evidence is found that increased pension receipt results in reduction in remittances received. However, these results are qualified; this crowding out effect is found only in the case of poorer households. For non-poor households, public and private transfers are seen as complements, moving in the same direction. These findings above have important policy implications. Large scale cash transfer programs like those in South Africa which have distributional considerations in mind may not be as progressive as believed both because part of the resource flow accrues to migrants rather than the elderly and because of the asymmetric crowding out effects experienced by poor and non-poor households.

The above results must, however, take into account the relative importance of remittance flows to poor and non-poor households. Once way of measuring this is to evaluate the share in income derived from different sources. Leibbrandt et al. (2010) use data from 1993, 2000 and 2008

and break the income of South African households across the income distribution into different components, including: labour market, remittances, capital, government, and other sources. The data shows that remittances play a far larger role in the income for poorer households than wealthier households. The share of income derived from public sources is also higher for poorer households, whereas higher income households obtain the bulk of their earnings from the labour market. This suggests that South Africa's public transfer programs have contributed to reducing poverty, especially for the most vulnerable households, and that fears of social grant programs being inherently regressive may be allayed. However, assessing the relative shares of these components over time shows a growth in the contribution of government grants to poorer households' incomes. For the poorest households, the income share from public grants increases from 15% to 29% to 73%, reflecting the increase in the number of state grants being provided over the 15 year period (Leibbrandt, et al., 2010). These contributions from public sources have steadily replaced the contribution of remittances to total income, which saw a corresponding decrease for poorer households. The effect of these changes can be seen to be significant and large, providing support for the hypothesis that increases in cash transfers from government to the household comes at the expense of remittances received. Analysis by Jensen (2003) builds on this, showing that the distributional effects of the OPG are therefore overstated when crowding out is not taken into account using poverty measures that look in isolation at the contribution of grants to income in the household.

Findings of a negative relationship between public and private transfers have two important implications for analysis and policy-making: firstly, social grants may not be having as large an impact on poverty reduction as thought. Research looking at distributional effects of social grants tends to picture household income distribution and inequality as simply 'with-and-without' the social grant contributions. Ignoring the response of private transfers means that the distributional and inequality-reducing impacts of social transfers may be overstated. Secondly, and conversely, analysis of the impact of public cash transfers on socio-economic outcomes in the household likely understates the true effect of grant receipt. Real increases in household income lower than predicted means that the 'developmental return' per unit of public cash transfer is higher than analysis suggests. A plausible extension of this finding to public transfer programs beyond the pension implies that benefits from social grant programs seen in the literature thus likely form a lower bound in terms of impact. The discussion on the theory and the literature surrounding the relationship between public and private transfers has set the basis for the analysis to follow. The section that follows presents evidence using recent national-level panel data from South Africa to add what it can to the debate.

# SECTION II: EMPIRICAL ANALYSIS

## 4. METHODOLOGY AND DATA

### 4.1 Approach

The primary consideration for this paper is to test for the displacement of private transfers – or, remittances – to households by public transfers. A number of different theories seek to explain the underlying drivers of private transfers between households, the two most prominent being altruistic and exchange-based preferences, or motives. In the former, care for the recipient's wellbeing results in the transfer of resources, while in the latter these resource transfers are motivated by the expected receipt of future benefits. Given an understanding of the cultural and social context of South Africa, and resting on previous research that has been undertaken, this paper aims to test the altruistic hypothesis. In this paper I test what impact receiving government grant funding has on the level of private transfers an individual or household receives from other sources. In line with the hypothesis of altruistic motives, I expect that the increases in income from grants will result in reductions in the level of remittances received.

At the core of this hypothesis is the assumption that this increase in public transfer income is exogenous. However, it is to be expected that individuals may change their behaviour in anticipation of or in response to the receipt of cash grants. An analysis using the reported receipt of the grant may therefore be biased as those factors that cause some to take up grant receipt and others not to may be omitted. Further, in using survey data, it may be the case that certain individuals that do receive the pension report not doing so or, conversely, report receiving the pension when in fact they do not. Either way, if this misreporting is systematic then results using reported pension receipt will again be biased. Similar to other papers assessing pension impact, I use age eligibility for the pension to instrument for reported pension receipt in my analysis to help overcome these issues. As explained earlier, pension eligibility is determined primarily by age (along with a means test that is, in practice, not rigourously reinforced) which can reasonably be assumed to be exogenous. The models presented in this paper therefore revolve around the impact pension age-eligibility has on receipt of remittances, with the identifying assumption being the pension-eligible age of an individual and not reported pension receipt as the exogenous income increase. Using a regression design with the age cutoff as a discontinuity, I therefore test the impact that an exogenous income transfer in the form of the pension has on the level of remittances received. By

comparing individuals just above and just below the age-eligibility threshold, and controlling for various individual and household level characteristics, the discontinuity design allows for the true impact of the grant to be ascertained by removing external factors that may otherwise bias results.

I use three strategies in my analysis. The first strategy I present involves regressions at a household level for each separate wave. These test the relationship between the level of remittances received by the household and the presence of household members of pension-eligible age. Regressions are run using OLS as well as a negative binomial model, the latter in an attempt to account for the large number of zero observations and non-normal distribution in the dependent variable. The second strategy uses pooled data from all three waves and looks at the impact on remittances received by individuals who become eligible for the pension. I transform the dependent variable to have a more normal distribution, while still retaining the zero observations. I run OLS and Tobit regressions on both the untransformed and transformed data. My third strategy attempts to deal even further with the large number of zero observations in the data. I use a hurdle approach to model separately selection into positive remittance receipt and, conditional on it being positive, the level of remittances received. Regressions in all three strategies use age-eligibility to instrument for reported pension receipt to sidestep issues of endogeneity. All regressions also employ a discontinuity design that takes advantage of the age-threshold for pension eligibility (argued to be exogenous) to analyse those just above and below the cutoff. Finally, I present a series of regressions testing the robustness of the model by looking at a number of potential changes within the household linked to pension receipt that may explain some of the findings.

Data used in the analysis is drawn from a nationally-representative panel survey in South Africa that surveys individuals over three waves, at three separate points in time. The data contains detailed information at both an individual and household level, including on employment, income and a range of demographic factors. This dataset provides the opportunity to test the relationship between public and private transfers in a South African context where large social spending and a history of migratory remittance transfers play important roles in society.

## 4.2 Methodology: Cross Sectional Analysis across Waves

The first identification strategy looks at each wave in isolation. I conduct a cross-sectional analysis on each wave separately, testing at the household level the relationship between household member eligibility for the pension and remittances received; that is, the relationship between public and private transfers received by the household. While cross-sectional analyses lack the empirical

explanatory power of panel data, I use this analysis here to gain an initial understanding of the results that may be expected from the theories discussed so far. Importantly, it allows for the testing of hypotheses using the household as the unit of analysis; evaluation at the household level becomes far more difficult when the data is pooled given that the data used tracks individuals – and not households – over time. Individuals are free to move between and begin their own households. Using the same panel data as I use in this paper, Grieger et al. (2014) provide evidence of short-term residential and household compositional change in South Africa. Between the first two waves of panel, 10.5% of the population moved residence and 61.3% experienced changes in household composition. Using fixed and random effects for households in the pooled data, for example, is therefore harder to do given that they are defined only in terms of the individuals that currently reside there. The response of the private remittance transfer between households to the income derived from the state's OPG is tested by comparing the level of remittances received by households that contain at least one person of pension-eligible age with the level of remittances in households with an adult that is not yet age-eligible for the pension. The model's explanatory power draws on the discontinuity around the pension-eligible age. Actual receipt of the pension may be influenced by factors other than eligibility alone; age-eligibility thus serves as a suitable exogenous instrument for pension receipt. Two methodological approaches are employed. The first uses OLS estimation and the second a maximum likelihood estimator in the form of a negative binomial regression. The latter is used due to the non-normal distribution nature of the dependent variable, discussed further below.

The first model tests for crowding out using a standard OLS model, where the level of remittances received by the household is regressed on indicators of whether households contain members who report receiving the pension or not. Reported pension receipt is used here for explanatory purposes, while its instrument is discussed next. The assumption made is that without receipt of the pension, remittances received by these respective households would be similar. More formally, this regression model can be written as

$$Y_h = \alpha + \beta_{pr} PR_h + \gamma X_h + \varepsilon_h \tag{10}$$

where $Y_h$ is the level of remittances received by household $h$ and $X_h$ represents demographic and economic characteristics of the household, including household size, total number of children in the household younger than 16, age and age-squared of the household head, the level of education of the household head, log of household income, an indicator for urban household geotype, and a full set of provincial indicators. The variable $PR_h$ represents the key explanatory variable, namely whether a member of household $h$ reports receipt of the state

pension. My hypothesis predicts that households with a pension recipient receive lower remittances, on average, than similar households that do not have a pension-eligible member, ceteris paribus. The coefficient of interest is thus $\beta_{\mathrm{pr}}$. The OLS estimator I use can be summarised in general terms as minimising

$$\sum_{h=1}^{n}(y_h - \hat{\beta}_0 - \hat{\beta}_1 x_1)^2 \tag{11}$$

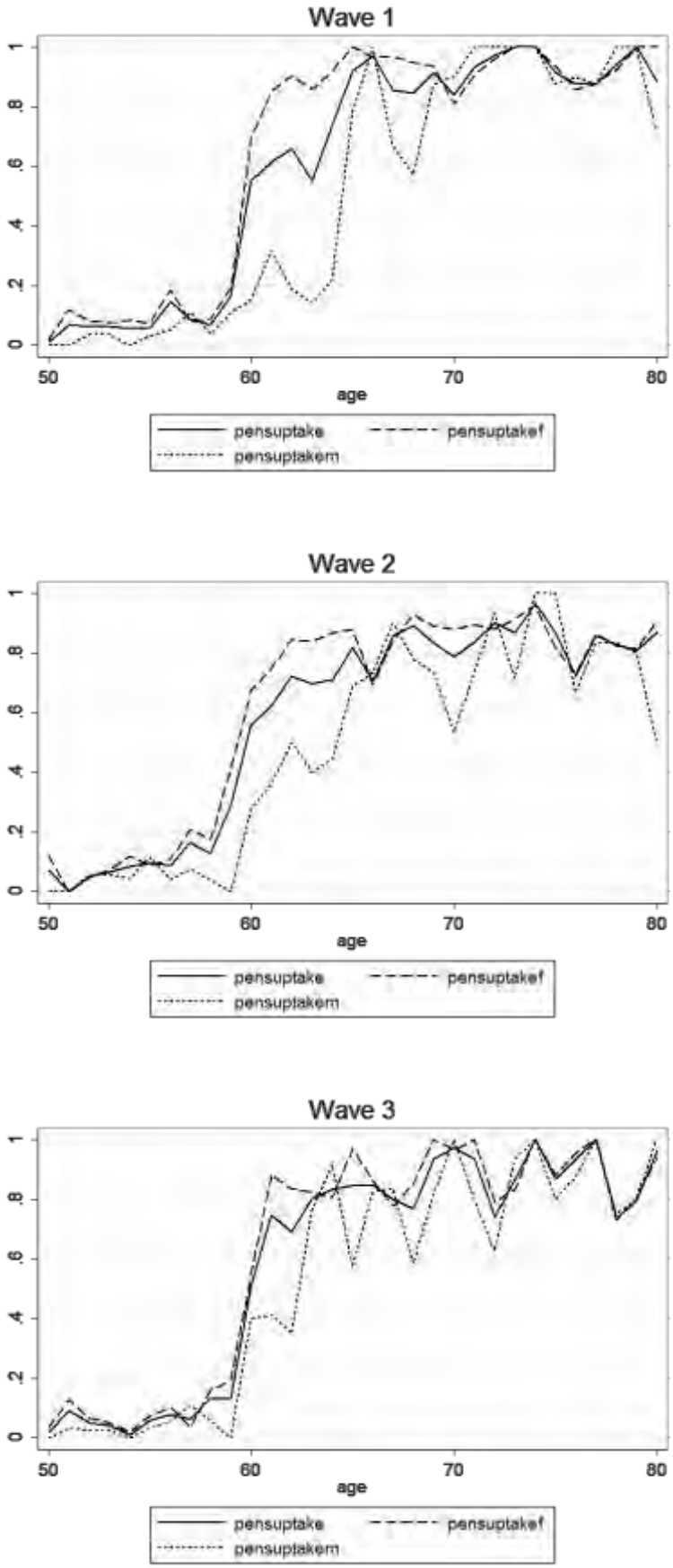
and assumes, among others, that $\mathrm{E}[\varepsilon|X] = 0$ and $Var[\varepsilon|X] = \sigma^2 I_n$; that is, the errors in the regression have a conditional mean of zero, and errors are homoskedastistic and uncorrelated between observations. Further, the assumption of normality, $\varepsilon|X \sim \mathcal{N}(0, \sigma^2 I_n)$, while not necessary for OLS validity, makes OLS inefficient if violated. The assumption of a zero-conditional mean and that of homoscedasticity is violated in the presence of omitted variable bias. Given potential endogeneity in reported pension receipt, I address this using age-eligibility as an instrumental variable.

### 4.2.1 Age-Eligibility as an Instrument for Pension Receipt

The strategy employed in this paper is to assess the response of private transfers received by households to the receipt of the OPG by members within that household. This can be done, as shown in its most basic form above, by comparing the level of remittances received by households that contain at least one pensioner, with remittances received by households with an adult(s) who is not yet pension-eligible. The influence of a range of other characteristics – generally those related to a household's socio-economic status and member composition – are also controlled for given evidence which suggests they may have an impact on results. Identification of pensioners is done by using questions included in the survey data that ask an adult whether she/he receives the OPG.

**Figure 1** below shows reported pension receipt by individuals' ages. Each graph indicates the proportion of African individuals at each age in the data who report actual receipt of the OPG. The graphs include calculations for all respondents in the sample, as well as those for men and women respondents separately, and are shown for each of the three waves of the dataset. A significant change can be seen around the pension age-eligibility threshold, for both men and women. At the age of 60, when age-eligibility for the pension is reached, the number of people reporting receipt of the OPG increases. The rapidity of the change, while not representing full OPG take-up in the sample, lends credence to the potential use of a sharp regression discontinuity design to explain changes around the age-cutoff.

**Figure 1: Average reported receipt of the South African state pension, by age and wave**



There are, however, two points to note. The first is that some respondents (both male and female) just below the age of 60 report receipt of the pension. This may represent inaccurate reporting in the data or may be a result of relative flexibility in the application of the age-cutoff for pension receipt. This effect is, however, not large and is not expected to influence the analysis[9].

The second point is that there appears to be a difference between the magnitude of the change and in the level of uptake for men and for women. Average reported pension receipt increases more gradually for males than it does for females. This finding could have implications for the accuracy of my analysis, and may be explained by, among others, two main factors. Firstly, the pension eligible age for males has been lowered over the past decade during which the data was collected. Whereas before, the age of pension eligibility was 60 for women and 65 for men, since 2008 the eligible age for males has decreased until the ages of eligibility for both men and women were equalised at 60 in 2010. NIDS survey data was first collected in 2008, implying that there may already be some evidence of these changes when assessing proportional pension uptake, but that we would still expect to see lower proportions of men than women reporting pension receipt around the 60 year age cutoff. This is apparent when looking at the graph for Wave 1 which shows a sharp spike around age 65 for men, but which shifts left over the next two waves to indicate earlier take up. Secondly, lower reported pension-uptake by men around the age-eligibility cutoff may be due to the fact that men are more likely than women to continue working past the age of 60.

Given the magnitude of changes noted around the age threshold, endogeneity in the reported receipt of the pension is therefore an analytical issue of concern. This is also the case in theory, for while it would seem straightforward to simply compare the level of remittances received by households in which a pensioner reported receiving the OPG with households in which no member reported receipt of the pension, take-up of the OPG might be a decision endogenous to the household (Edmonds, 2006). Using reported receipt as an explanatory variable could cause the model to suffer from omitted variable bias if individual behavioral change – which is not able to be controlled for in the model – influences the receipt of the pension. Non-monetary factors, such as effort and patience levels, motivation, or health circumstances, for example, may make it less likely that a particular individual will actively go and receive the pension. In the case where these factors also positively affect the likelihood of receiving remittances (or the level of remittances received), then households that actually receive the OPG are likely to be positively correlated with

[9] This is because the proportion of those aged below 60 who report pension receipt is relatively small, at 3.38% of the total sample used in the panel analysis.

the level of remittances received. In this scenario, estimates of the impact of the OPG on private transfers to households will therefore exhibit an upward bias. Problems also arise in the accuracy of reported pension receipt. If survey data systematically under or over-reports pension receipt due to, for example, perceptions around the nature of the survey interview or interviewer, then estimation using this data will likely also be biased. It is not apparent here why certain income- and age-eligible individuals choose not to receive the pension or, conversely and perhaps more interestingly, why certain age-eligible individuals choose not to report receipt of the pension. In general then, using survey responses to questions involving pension receipt may result in untrue estimates of the impact of the pension on households remittances received.

One way of dealing with this analytical problem is to focus on individuals' eligibility for the pension rather than their actual reported receipt. The fact that individuals become eligible for the OPG once they reach a certain age generates a discontinuity around this age threshold that is useful to exploit. The rationale underlying this uses the fact that, below a certain means-test threshold that is rarely enforced in practice[10], as the OPG depends solely on a person's age, eligibility for the pension is determined entirely by an individual's date of birth. Whether age-eligibility is an appropriate instrument for reported receipt of the OPG must be tested. In equation (10) earlier, if $PR_h$ is a potentially endogenous variable representing reported OPG receipt in the data, then the use of an instrument ($P_h$) must ensure that two important assumptions hold:

$$\text{Assumption (IV1):} \qquad Cov(P_h, \varepsilon) = 0 \tag{16}$$

$$\text{Assumption (IV2):} \qquad Cov(P_h, PR_h) \neq 0$$

The first assumption states that the instrument must not be correlated with the error term from the original regression that includes the endogenous variable. While this relationship cannot be explicitly tested, it can be strongly argued that the assumption of exogeneity of age-eligibility holds true and that pension-eligibility determined by age is not correlated with the error term. It is reasonable to assume that an individual's date of birth is unrelated to any relevant personal characteristics (Hamoudi and Thomas 2005). This approach has been used in a South African context in a number of different papers, including research on labour migration (Ranchod, 2009), child health and education outcomes (Duflo, 2000), labour market outcomes of youth (Ardington, et al., 2013), child labour and schooling responses (Edmonds, 2006), and remittance receipt (Posel, 2001; Jensen, 2003; Case & Deaton, 1998; Maitra & Ray, 2002). To test the second assumption, I

[10] It is not practically enforced because the proportion of households falling below this means threshold is high, particularly for African households in South Africa.

run a regression of reported pension receipt on a variable indicating the number of people age-eligible for the pension in the household and find a large, positive and significant correlation. The strength of the IV (IV2) is tested by the F-Statistic on this regression of the instrument on the endogenous variable in question. Results indicate a test statistic of F(1,9510) = 11,624.18 (with Prob > F = 0.000), confirming the second assumption above.

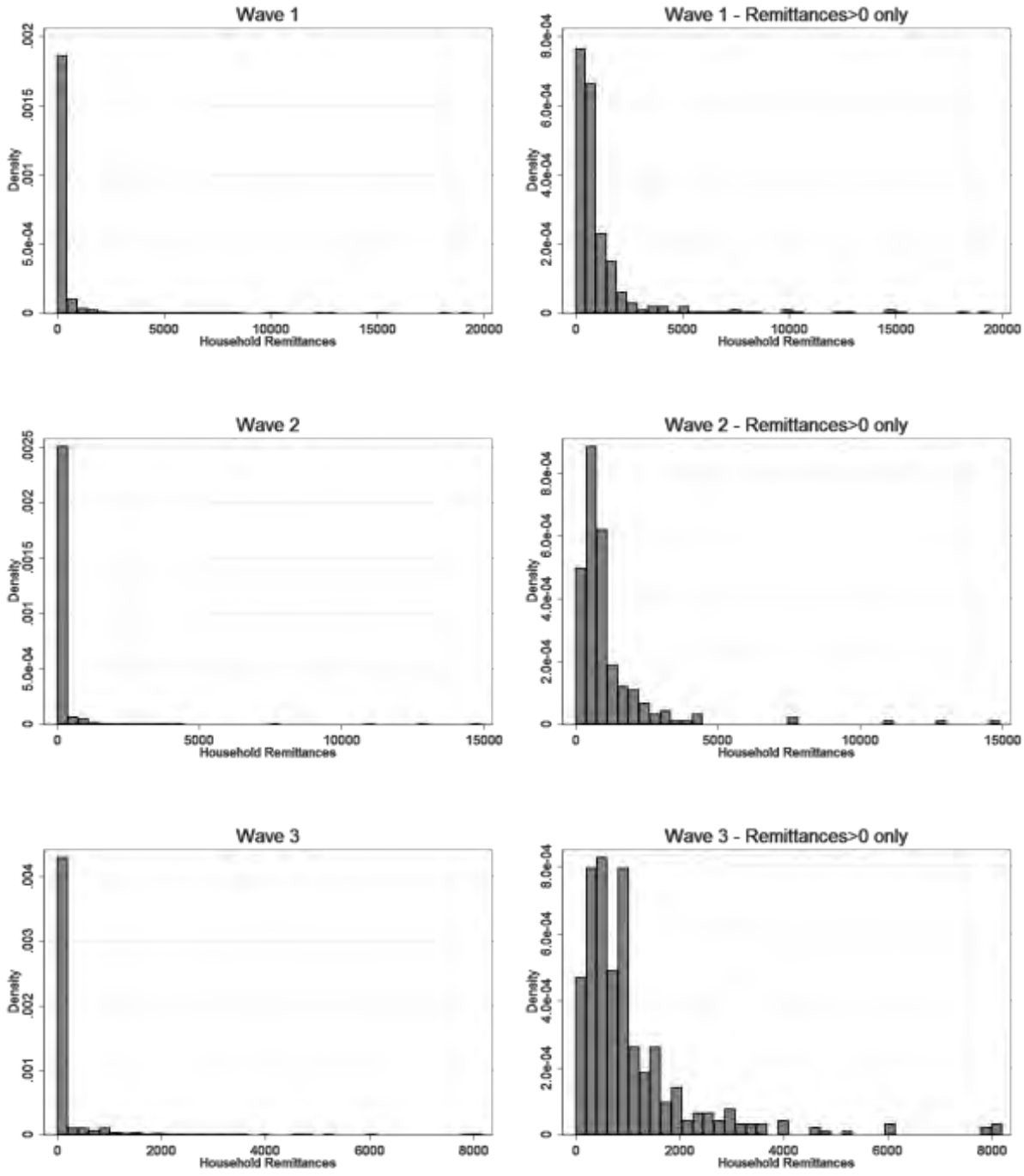
Hence, in equation (10) I replace the indicator for reported pension receipt in the household ($PR_h$) with a variable ($P_h$) indicating the total number of people of pension-eligible age resident in the household. While actual reported receipt of the pension may be influenced by factors other than eligibility alone, age-eligibility thus serves as a suitable exogenous instrument for pension receipt. A model using a discontinuity design can therefore draw explanatory power from the change in pension-eligibility around the age cutoff. More specifically, the core approach taken in this paper is thus to use a sharp regression discontinuity design in testing the hypothesis put forward. Simply, this design compares the level of remittances received by those aged just above the pension age-eligibility cut-off (60 years) separately to those aged just below.

Pension eligibility is therefore used to explain difference in the level of remittances observed between households with similar characteristics, the identifying assumption being that no factors other than pension receipt influence the amount of remittances received.

### 4.2.2 Distribution of the Dependent Variable

The assumption of normality in the dependent variable is violated if the error term is not normally distributed. This is a potential problem for the model here, as shown in **Figure 2** below which looks at the distribution of remittances received by households in each of the waves. Two points in particular are evident across all three waves: firstly, a significant proportion of households report no remittance receipt; and, secondly, the frequency of remittance receipt reported decreases as the value of remittances increases. Further, this decrease in frequency happens at a decreasing rate, implying a distribution that is not normal but is skewed towards zero. It would therefore be more appropriate to use a different method that better accounts for the presence of zero observations.

**Figure 2: Distribution of variable 'total household remittances received', by wave**




One approach is to use a Poisson estimator more sensitive to the mean which will shift the mass of the distribution left in the case where a significant proportion of the observations are zero. While a Poisson approach is generally used for count data, Wooldridge (2010) notes that even if the dependent variable is continuous, as long as it is non-negative and has no natural upper bound (as is the case in the remittances variable here) Poisson estimators can still be used effectively and will still present consistent, asymptotically normal coefficient estimates. The same applies whether

or not the Poisson distribution holds. However, an important restriction on the dependent variable in the Poisson model is the requirement that the variance is equal to the mean:

$$\mathrm{Var}(y|\boldsymbol{x}) = \mathrm{E}(y|\boldsymbol{x}) \tag{12}$$

This stems from the fact that all probabilities and higher moments of the Poisson distribution are based entirely on the mean, which is often violated in the case of non-negative continuous variables (Wooldridge, 2010). When the variance exceeds the mean, the model is said to be 'overdispersed'. As in the case here, where there are excessive zero observations the requirement that the variance of *y* equals its mean is unlikely to hold and the Poisson model is no longer appropriate. One way to address this is to introduce an individual, random effect into the conditional mean of the Poisson model, which represents the unobserved heterogeneity in the data (Greene, 2008). A negative binomial model that includes this random effect relaxes the variance/mean equality assumption and allows for the mean and variance to be different. One form of the negative binomial distribution with $\lambda$ as the mean of the distribution and $\alpha$ as the over-dispersion parameter takes the form

$$\Pr(\mathrm{Y} = \mathrm{y}|\lambda, \alpha) = \frac{\Gamma(\mathrm{y}+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left[\frac{\alpha^{-1}}{\alpha^{-1}+\lambda}\right]^{\alpha^{-1}}\left[\frac{\lambda}{\alpha^{-1}+\lambda}\right]^{y} \tag{13}$$

with the log-likelihood function to be maximised shown by

$$\mathrm{L}(\beta|\lambda, \alpha) = \prod_{i=1}^{N}\Pr(y_i|x_i) = \prod_{i=1}^{N}\frac{\Gamma(\mathrm{y}+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left[\frac{\alpha^{-1}}{\alpha^{-1}+\mu_i}\right]^{\alpha^{-1}}\left[\frac{\mu_i}{\alpha^{-1}+\mu_i}\right]^{y} \tag{14}$$

where

$$\mu_i = \mathrm{E}(y_i|\boldsymbol{x_i}) = e^{(x_i\beta)} \tag{15}$$

The key difference between the Poisson and negative binomial models is thus simply the inclusion of $\alpha$, which is assumed to follow a Gamma distribution. In the case where $\alpha = 0$, the negative binomial distribution is the same as the Poisson distribution. The larger $\alpha$ is, the greater the overdispersion and the further the distribution mass shifts to the left. After finding evidence of overdispersion in the Poisson model, I therefore run the model presented in line (10) using a negative binomial regression to account for the skewness of the data.

A second, simplified regression model creates dummy variables for adults' ages in the neighbourhood of the pension discontinuity, and includes them in a regression on the level of remittances received by households. This provides a useful, intuitive understanding of the impact

of the pension on monetary transfers received by households: by comparing households in which an adult is present who just qualifies for the pension (on or just above the age eligible threshold) with other similar households in which an adult only just fails to meet the eligibility requirement (just below the age threshold) means that, on average, the only difference between the remittances received by households can be attributed to the receipt of the OPG. Let $Y(gender, age)$ indicate the average level of remittances received by households that contain at least one pensioner of a given gender {M, F} and age {60-64, 65-69, 70+}. The model exploits the age thresholds to create a regression discontinuity design in the forms

$$Y_h = \alpha + \beta_1 Age(60-64) + \beta_2 Age(65-69) + \beta_3 Age(70+) + \gamma X_h + \varepsilon_h \quad (17)$$

&

$$Y_h = \alpha + \beta_1 Female(60-64)_h + \beta_2 Female(65-69)_h + \beta_3 Female(70+)_h + \delta_1 Male(60-64)_h + \delta_2 Male(65-69)_h + \delta_3 Male(70+)_h + \gamma X_h + \varepsilon_h$$

where $Y_h$ is the average level of remittances received by household $h$ and $X_h$ represents other demographic and economic characteristics of the household. The first equation presents the discontinuity using households containing a pension-eligible individual of either gender, and the second separates the sample into households with either a pension-eligible female or male present.[11] Individuals are grouped together in 5-year age-range indicators (for example, all those aged 54-59 are grouped together, age 60-64 etc.), such that the independent variables of interest are understood in line with the following example: $Female(60-64)_h$ is an indicator equal to 1 if a household contains at least one female adult member aged between or equal to 60 and 64 years, and 0 otherwise. Only those households with at least one adult member aged 50 or older are included in the regression sample. This is important as the discontinuity design aims to compare similar households around the age cut-off. Households with only younger adults present are likely to be very different to those with members close to retirement (and pension-eligible) age. After including an indicator for whether the oldest person in the household is male, the base group against which the pension-eligible households are compared in the model therefore include households with an adult female aged between 50 and 59. The two models are important in understanding both the effects of pension receipt on household remittances received and the gender differentials in these effects.

[11] Across the waves, only a small proportion of households have both a male and female person of pension-eligible age present. These households will therefore reflect both of these individuals in the model.

The hypothesis being tested is whether, on average, households with at least one person age-eligible for the pension receive lower remittances than households with similar characteristics that are not eligible for the pension but have a member near the age-eligible threshold. Evidence of this would be negative, statistically significant coefficients $\beta_2$ for female pensioners and $\delta_2$ for male pensioners. As with the previous model, the RDD design is run using OLS and negative binomial estimation methods.

## 4.3 Methodology: Panel Analysis using Pooled Data

The second identification strategy pools data from across the waves and uses this sample to explore the relationship between public and private transfers. The use of cross-sectional data makes it difficult to infer causal relationships between variables. In using cross-sectional data in the manner described in the previous section, it is necessary that both the pension and remittances are strictly exogenous in the sample. This assumption is violated and results biased if, *inter alia*, pension and remittance receipt in the household are spuriously correlated through dynamics not controlled for in cross-sectional analysis. One way of attempting to overcome this endogeneity problem is to control for as many other relevant factors in the analysis as the data allows. However, while certain important influences may be included in a regression model, there are certain factors likely to lead to biased results that may not be as easily controlled for. For example, if certain households are more likely to actually collect pensions they are entitled to, then the effects of these omitted variables would cause the results of any analysis between the two factors to be biased. It may be that households that are more likely to have offspring that are working away from home (and/or more likely to be sending monetary transfers home) have greater positive agency in the collection of the pension. Addressing endogeneity concerns related to reported pension receipt by using age-eligibly as an instrumental variable (as described in the previous section) may not sufficiently control for these unseen influences.

Panel datasets offer an alternative approach, generating more powerful means of establishing causation by observing respondents over time. By comparing respondents before and after an event or an intervention has occurred, for example, unseen variables do not need to be controlled for as they are expected to be constant over time. I therefore use panel data analysis in an attempt to deal with potential issues inherent in the cross-sectional analyses conducted. The data used follows respondents over three waves using an individual-specific identifier. Whereas the cross-sectional analysis looked at the household as the unit of analysis, this is more difficult using data that tracks individuals, not households, over time. Pooling data and analysing at a

household level would require assumptions to be made about what exactly constitutes a household. While assumptions could be made (using household size and composition, for example), this may be problematic and it is unclear how exactly the household should be defined, which would be necessary should the aim be to compare the same households over time or control for time and household specific effects. However, as discussed earlier, the data is structured such that respondents may leave households between waves to start new households, join different households of move away entirely.

Given these difficulties, my analysis of the pooled data takes place at the individual level. The amount of remittances received at a household level that was used as the dependent variable in the previous analysis is an aggregate of total remittances received by all individual adult members of the household.[12] Information on remittances is contained in a survey questionnaire for adult household members aged 15 or above. A question is asked as to whether the respondent receives remittances or not and details each of the different remittance sources and the amount received. Remittances may be sent as monetary transfers or in-kind. My analysis here focuses on monetary transfers only given difficulties associated with valuing in-kind items. The dependent variable I use in the analyses that follows are the total amount of remittances received by an adult respondent. One econometric issue of concern I address later is again that the dependent variable contains a large number of zero values. Similar to the cross-sectional household level analysis outlined earlier, reported pension receipt in the data may not be exogenous. It may instead be influenced by a number of unobserved factors that would, if not controlled for, lead to biased results.

The primary explanatory variable used in the analysis is therefore an indicator of individual age-eligibility for the state pension, which instruments for reported pension receipt. It was argued earlier that age-eligibility for the pension serves as a suitable instrumental variable for its receipt and the same logic is used here. The empirical strategy again takes advantage of the reality that individuals cannot choose their date of birth. This makes a strong case for the fact that whether a person is eligible for the pension (over the age of 60) or not is exogenous to the model. Caution must, however, be taken in assuming perfect exogeneity, with two concerns in particular worth noting. Firstly, another requirement for OPG eligibility is a means test that stipulates that single individuals must not earn more than R64 680 per year or have a combined income of more than R129 360 if married.[13] Given the income-poor nature of most state pension applicants, this means

[12] In each of the waves, a small proportion of remittances are imputed. See the NIDS website (www.nids.uct.ac.za) for further information on this. In this paper I use remittance data with full imputations.
[13] Further, individuals must not own assets worth more than R930 600 if single, or R1 861 200 in combination with a partner if married.

test is rarely enforced in reality. In the sample used here, no individuals eligible for the pension earned above the wage threshold, whether individually or combined. Selection into or out of the sample based on the means test exclusion criteria is therefore not an issue in the analysis here. The second concern involves potential behavioural changes by individuals who are about to or have recently become age-eligible for pension receipt. Results will be biased if these behavioural changes associated with pension receipt influence the level of remittances an individual receives. To test this, I run a series of regressions of pension-eligibility on a range of dependent variables that might be expected to influence remittance receipt, including levels of employment in the household, changes in the number of children living in the household, and changes in household composition.

The analysis here looks to test the relationship between public transfers (as measured by receipt of the OPG) and private transfers (as measured by monetary remittances received) to individuals. The estimation approach is based on the theoretical discussion presented earlier, and on line (9) in particular, which describes the equality in marginal utilities of different household members under an altruistic-driven hypothesis of private transfers. My identification strategy again rests on using pension age-eligibility as an instrument for pension receipt in a regression on the level of remittances received. I compare the level of remittances received by individuals aged 60 or just above who are eligible for the pension with those aged just below who are not eligible. The identifying assumption is again pension-eligibility which explains the differences observed between the two groups. This is done at an individual level using the pooled panel data which allows for the inclusion of fixed and random-effects in regression models.

The use of panel data implies potential endogeneity in the final sample. This is because individuals across all waves are treated as unique, even though they may be the same respondent at different points in time. I therefore use random effects in my regressions to control for this potential endogeneity. As a check for robustness, I also use a model that includes fixed effects instead, while being cognisant of its limitations with respect to the data being used (namely, the pooling of responses from the same individuals over time). I briefly compare the results from the two models including random and fixed effects, respectively, and conclude that fixed effects is not useful and random effects is more appropriate to the regression design. I continue to use random effects in my base model and all other models going forward.

Remittances received by adults are a function of their pension age eligibility, where *i* is the individual respondent and *t* is the period in the model

$$Y_{i,t} = \alpha + \beta_1 P_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \quad (18)$$

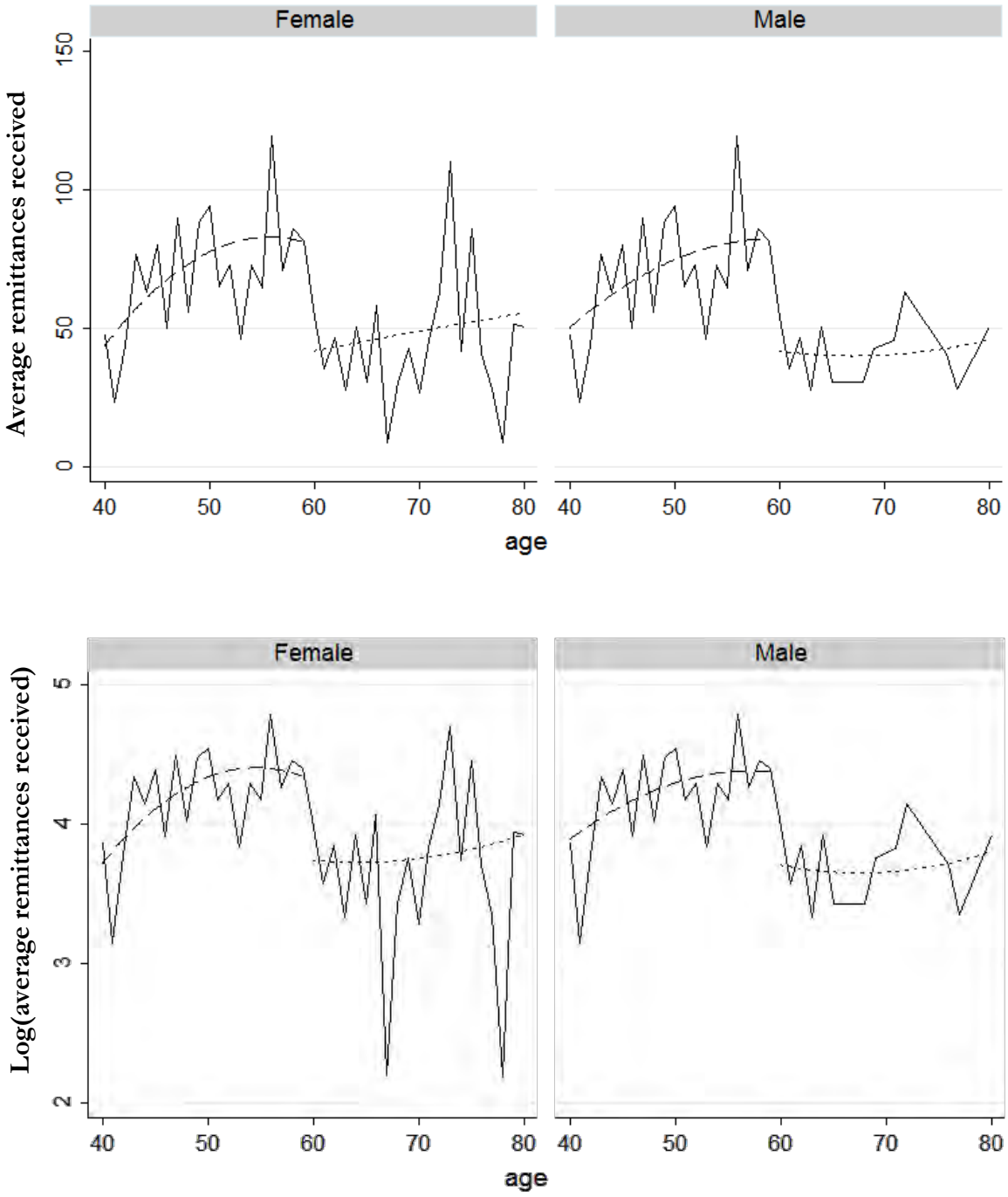
This is the estimator applied to the different cross sections earlier, except now the analysis is being conducted at an individual rather than household level, and is dynamic rather than static. The variable $P_{i,t}$ is an age-eligibility indicator equal to one if individual $i$ is 60 or older in time $t$. I use this indicator as an instrument for reported pension receipt in a 2SLS regression. I include a regression that uses actual reported pension receipt for comparative purposes. Controls are captured by $X_{i,t}$ which consists of a range of household and individual level variables, including the number of members in the individual's household, the number of children younger than 16 in the household, log of non-remittance household income, age and age-squared of the household head, education of the household head, an indicator if the person is a male, an indicator if the person lives in an urban area, province dummies and dummies for the panel period. Some specifications may also include an individual fixed or random effect, $\mu$, such that

$$Y_{i,t} = \alpha + \beta_1 P_{i,t} + \gamma X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (19)$$

In addition, I again use a sharp regression discontinuity design around the age-eligible threshold, which is identical to the second model described by equations (17) using age-groupings but uses individual- and time-related observations rather than observations at a household level.

To better understand the effectiveness of the overall methodological approach in the pooled data, the graphs in **Figure 3** explore the change in remittances around the pension age-eligibility threshold for the pooled sample. The first graph shows average remittances received by respondents' ages, broken into male and female respondents respectively. While the graph shows a high degree of volatility, a decrease in the average remittances received for those aged 60 and above can be seen, relative to those aged just below 60. This applies to both male and female respondents. The second set of graphs plot instead the log of mean remittances on the y-axis in an attempt to remove some of this volatility. The change around the age-threshold is again confirmed. All graphs plot a quadratic fit line for ages below 60 and another for ages 60 and above. The trend lines show increases in average remittances received leading up to age 60 and thereafter a relatively flat trajectory at a lower level. These trends look similar for men and for women and support the use of a sharp regression discontinuity design in the regressions that follow.

**Figure 3: Average level of remittances received by respondent, by age and gender**




A cause for concern mentioned earlier relates to the distributional nature of the dependent variable being used. The graphs in **Figure 4** below show the distribution of remittances received by individuals in the sample. Looking at the first graphs on the variable in its current untransformed form, two aspects in particular are likely to have an impact on the econometric models used and must be addressed. The first concern relates to the significant number of zero observations in the sample. It is not possible to simply drop these zeros and include in the analysis

only those that receive remittances; this is likely to lead to selection bias. The second concern relates to the highly non-normal distribution of the dependent variable. Both of these factors suggest that OLS may not be an appropriate estimator to use in the current circumstances.

One way of addressing the issue of non-normal distribution is to transform the data to change the distribution of non-zero observations. A simple log transformation that is often used when dealing with skewed distributions in income data is not appropriate here due to the high number of zero observations, which would then be dropped from the sample (log of zero is undefined). In line with the literature[14] I therefore transform the data in two ways, both of which also allow for the retention of zero-observations while making the distribution of the dependent variable more appropriate for analysis. In the first, I take the log of remittances received 'plus one' which redistributes the non-zero observations while keeping those that report zero remittances received. While potentially useful, this method may not be regarded as technically correct in that in allocates remittance values to those that do not actually receive any remittances. An alternative approach is the Inverse Hyperbolic Sine (IHS) transformation, defined as

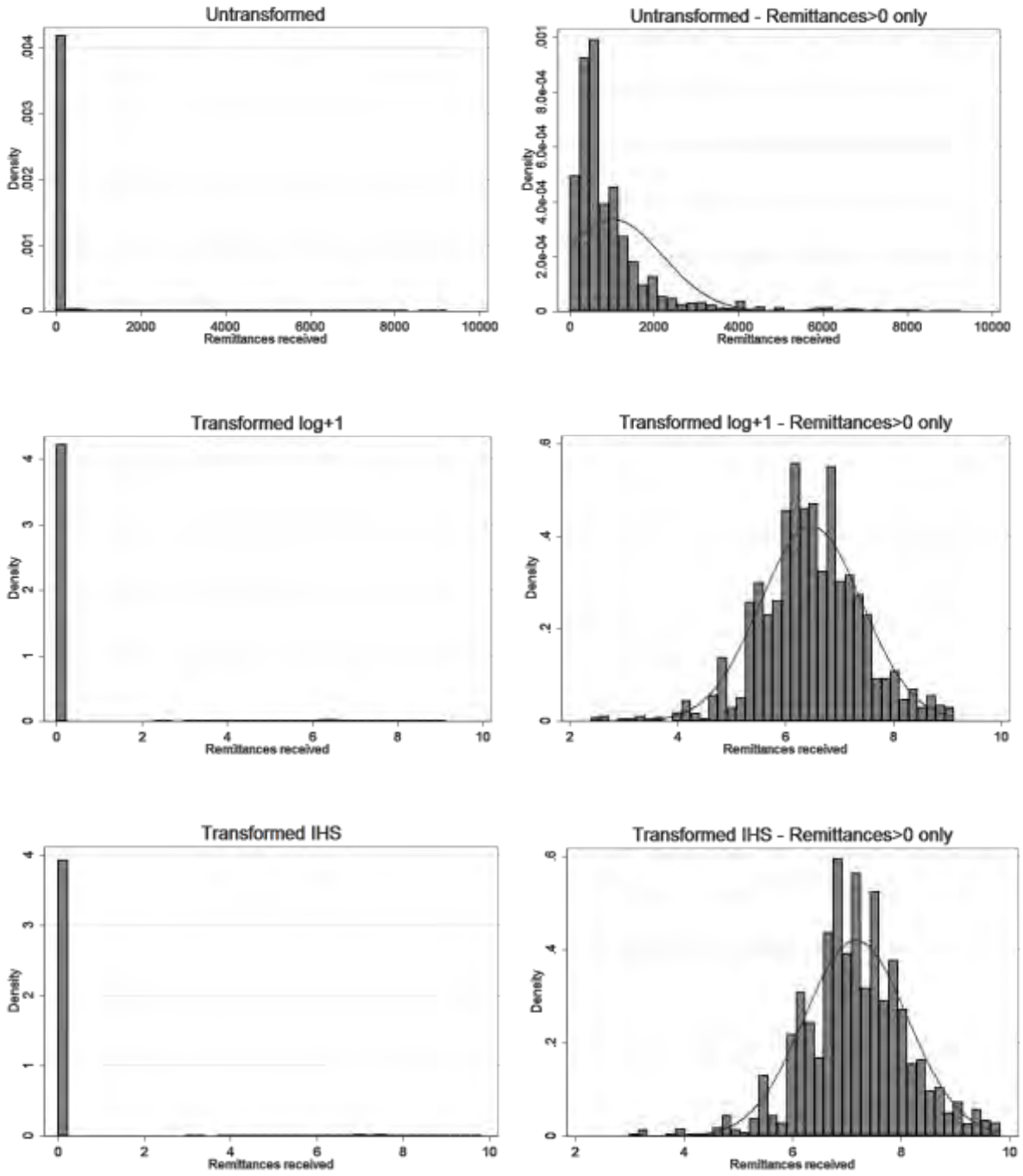
$$sinh^{-1}(y_i) = \log(y_i + (y_i^2 + 1)^{1/2}) \qquad (20)$$

Mackinnon & Magee (1990) describe in detail this transformation which is increasingly being used to deal with zero and negative values when transforming data.[15] Like the log transformation, the IHS transformation has the effect of pulling extreme positive values towards other transformed observations and behaves like the log transformation for large enough values (Burbidge, et al., 1988). Other than when *y* is very small, the IHS can be interpreted in the same way as a standard logarithmic dependent variable, except that the IHS is defined at zero. A feature of the IHS transformation is the fact that the log-likelihood function for IHS is therefore also defined for zero values of the dependent variable (Burbidge, et al., 1988). This is a characteristic that will be useful later on when using estimators from the maximum likelihood family. **Figure 4** presents the distributions of the untransformed dependent variable and these two transformations. Compared to the original distribution, the values of remittances received now follow a distribution pattern that, while still containing a large number of zero observations, is more normally distributed for positive values of remittances received. OLS regressions on panel data using these

[14] See Cameron & Trivedi (2005) for a discussion on these micro-economic approaches.
[15] This is particularly useful when dealing with income data. See, for example, Pence (2006) and Friedline et al. (2015). The IHS transformation was first proposed in Johnson (1949).

transformed variables provide the base model used in this paper, the results of which are tested for robustness through other changes to the data and econometric techniques.

**Figure 4: Distribution of dependent variable 'individual remittances received'**




While I have dealt with the distributional concerns surrounding the dependent variable, the large presence of zero observations poses challenges to traditional methods of estimation. Wooldridge (2010) discusses the potential bias in using OLS when dealing with data containing many zero observations in the dependent variable. The remittances variable here represents a

corner solution response type of limited dependent variable, where the variable is equal to zero for a significant proportion of the sample but which is otherwise generally continuously distributed over a range of positive values. While using a linear model may, in fact, be a good approximation of the data, there is the possibility of obtaining negative fitted values, leading to negative predictions of *y* (Wooldridge, 2010). This is impossible in the variable being used here. I therefore explore different methods of estimation for the now transformed data that aim to account for this.

Case & Deaton (1998), in analysing the impact of pension income on various expenditure items in households in South Africa, suggest that in situations where the presence of zeros renders OLS inappropriate, this can be dealt with by estimating Tobits instead. The Tobit estimator presents maximum likelihood estimates of coefficients by maximizing the log-likelihood for a random sample (Tobin, 1958). Tobit models provide a useful estimation option which present non-negative predicted values for *y* but which still satisfy the classical linear model assumptions (Wooldridge, 2010). Given the relatively normal distribution of the transformed variable for observations above zero, I therefore use a Tobit estimator in addition to OLS estimation methods. Tobit results are usually larger than OLS coefficients which is consistent with the presence of genuine censoring (Case & Deaton, 1998). I run the Tobit regressions on the pooled data and include random effects.

While the Tobit model is often the standard approach used in modelling a dependent variable that indicates a sizeable number of zero values, it is important to understand what this zero represents. The zero can either be an answer given to a particular question or an absence of an answer as the question was not posed to the respondent. In the former situation, having zeros in the model simply represents a form of censoring, with zero as the lower limit. In the latter, it is apparent that the zero value does not represent censoring but is the outcome of a discrete decision made (Greene, 2008). This latter situation is the case in the data here, where zeros in the amount of remittances received represent those who do not receive remittances at all.[16] What causes some individuals to receive remittances and others not may have implications on the outcome of the analysis. More specifically, there is a need to take into account the fact that separate processes may determine selection into positive remittance receipt and the level of remittances received (for those that receive remittances). The regression models presented thus far do not address this need.

[16] By contrast, censoring would suggest that people actively receive remittances amounting to zero, which is a contradiction. It is noted that the zeros in the dependent variable here have been created by recoding information on remittances from missing to zero for those individuals that do not report receiving remittances.

A strategy I therefore use here, as an alternative to the censored Tobit, is a hurdle model approach. The hurdle model allows me to model separately the reasons underlying the receipt of remittances from the level of remittances received. Further, the hurdle model helps address the difficulties associated with the distribution of the transformed data, which retains zero observations and is seen to be not normally distributed when looking at the sample as a whole. The hurdle model embodies a two-tier approach: the first determines selection into positive remittance receipt; and the second explains the level of remittances received, conditional on this positive remittance receipt. In the first tier I therefore run a Probit estimator with the dependent variable equal to 1 if an individual receives some positive remittance income. In the second tier, a truncated regression model (with a lower limit equal to 0) is then run on a restricted sample that includes only those respondents who reported positive remittance receipt. This second tier model assumes a normal distribution of the dependent variable that has been scaled upward so that the distribution integrates to one over the restricted range. The dependent variable I use in the second tier is the IHS transformed variable which, as shown in Figure **4**, has a relatively normal distribution for remittances greater than zero. I also present a separate hurdle model that includes the log of non-remittance household income in the analysis given the inverse relationship between remittances and income expected under the hypothesis being tested. These regressions are run on the pooled data with standard errors clustered at the household level.

## 4.4 Data

Data used in this paper is drawn from the National Income Dynamics Study (NIDS), South Africa's first nationally representative panel study. The NIDS dataset contains surveys at both the household and individual levels. The household level survey asks a knowledgeable adult to list all individuals usually living in the household as well as provide household level information. The individual level surveys are comprised of, *inter alia*, an adult questionnaire (asked directly to an adult household member directly) and a child questionnaire (a sufficiently knowledgeable adult or caregiver is interviewed on behalf of the child). NIDS surveys, as per their mandate, contain a strong focus on income in the household and are thus useful for this analysis. Questions pertaining to income levels and sources, as well as a range of different individual and household-level socio-economic factors, are asked consistently across the surveys.

The purpose of using the NIDS dataset for this analysis is two-fold. Firstly, this paper aims to expand the literature on the relationship between public and private transfers using recent, detailed, comprehensive, and good quality survey data. Few datasets meeting such criterion on a

national scale currently exist in a developing country context. NIDS is rigorously collected, validated and published by the South African Labour and Development Research Unit (SALDRU), University of Cape Town, and is regarded as a sound set of data. The data therefore provides a good opportunity for analysis; its strong focus on income in the household has already provided the basis for a large body of research[17], including that focused on the impacts of South Africa's social grant system. That NIDS is nationally representative also allows for the testing of the relationship between public and private transfers on a scale in South Africa that few studies have thus far been based. Secondly, thus far NIDS has been conducted over three waves, beginning in 2008, with intervals of around three years between each survey. This provides an opportunity to use both cross-sectional and panel data techniques in analysing the data. Given that the NIDS project is expected to continue in the future, further surveys will also allow for the building of evidence over time and continuous testing of hypotheses.

The data is set up to allow for analyses testing the response of private transfers received by individuals and households to the receipt of public cash grants. I run cross sectional analyses on each wave separately before analysing pooled data from all three waves. For the purposes of this paper, the analyses are limited to African[18] individuals and households only. This is due to the fact that there are far more observations for African respondents in the sample (given their higher relative proportion of the population[19]) as well as due to their typically higher response rates in comparison to other racial groups (Ardington & Leibbrandt, 2010). To identify the race of a household for the cross section regressions, race information collected in the adult questionnaire was mapped onto the household. African households were then identified by including those for whom the race of the household head was African.[20] Further, the sample includes only individuals over the age of 50 in the pooled data and only households in which at least one member is over the age of 50 in the cross sectional analysis. Evidence of migration into and out of households between waves may have an impact of results, as will problems of attrition. I therefore limit the panel data analysis to a balanced panel sample, only including those individuals for whom information is available in all three waves.[21] All variables relating to income and remittances have been adjusted using deflators provided with the NIDS data. These are based on the national

[17] For a summary of this research, visit the NIDS website (http://www.nids.uct.ac.za/publications/citations)
[18] While the racial classification 'African' comes with its own set of socio-political dynamics, this term has been used here to align with that used in the NIDS surveys.
[19] National census statistics indicate that African people represent over 80% of the South African population. In the pooled NIDS sample here, African people represent around 85% of people in the sample.
[20] I note there are a small number of mixed-race households in the sample but this is not expected to alter results.
[21] I conduct a separate analysis using an unbalanced panel of all observations across the waves, with results similar to those presented in this paper. Regressions using unbalanced data for the paper's baseline regression models can be found in Appendix 1.

headline CPI index and account for changes in the real value of money between the waves. All regressions contain an indicator for each wave to account for exogenous changes that impact individuals over time. Prior to running the full regression analysis, the tables below present selected summary statistics that provide an initial basis for testing the crowding out hypothesis. The first table looks at data at a household level for each of the separate waves. The second table uses pooled data from the three waves and is presented at the level of the individual.

In **Table 1,** A 'pension-eligible' household is one in which at least one adult within the household is aged 60 or above and is thus age-eligible for the pension. Across the three waves, households with at least one person of pension-eligible age present are seen to be bigger and have a higher proportion of household members younger than 16. This accords with a large body of evidence, some presented earlier, that suggests that the elderly in South Africa play a large role in raising of children. Households with pension-eligible people also have older household heads and have heads with less education, on average. Households with older people of pension-eligible age tend to be poorer on average; total income and total non-remittance household income can be seen to be lower across all waves, but only significantly so in waves 1 and 2. Average remittances received in the full sample are significantly lower for pension-eligible households in wave 3 only, and the same applies to the restricted sample which includes only those households that receive a positive level of remittances. The lack of significance in the statistical difference (between pension-eligible vs non-eligible households) may be due to the small proportion of households that report positive remittance receipt. Overall, the direction of the various differences support the hypothesis that pension receipt results in reductions in remittances received.

**Table 1: Summary statistics of household characteristics, by wave**

| | Wave 1 | | | Wave 2 | | | Wave 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Not pension-eligible | Pension-eligible | | Not pension-eligible | Pension-eligible | | Not pension-eligible | Pension-eligible | |
| Urban | 0.809 | 0.778 | ** | 0.803 | 0.793 | | 0.806 | 0.792 | |
| Household size | 4.433 | 4.934 | *** | 4.938 | 5.562 | *** | 4.86 | 5.299 | *** |
| Fraction of household aged <=16 | 0.29 | 0.324 | *** | 0.304 | 0.326 | *** | 0.305 | 0.325 | ** |
| HH head's age | 51.67 | 67.61 | *** | 46.99 | 63.05 | *** | 46.88 | 58.3 | *** |
| HH head's education | 4.813 | 2.839 | *** | 5.533 | 3.151 | *** | 6.24 | 4.374 | *** |
| *Household income* | | | | | | | | | |
| Total | 3,958 | 3,515 | *** | 5,043 | 3,889 | ** | 4,983 | 4,326 | |
| Total *less* remittances | 3,777 | 3,300 | *** | 4,923 | 3,806 | *** | 4,797 | 4,192 | |
| *Remittances received by households* | | | | | | | | | |
| Proportion of HH reporting remittance receipt | 0.149 | 0.163 | | 0.081 | 0.077 | | 0.146 | 0.121 | |
| Full sample | 181.2 | 215.6 | | 107.3 | 76.25 | | 171 | 125.2 | ** |
| Restricted sample ^ | 964 | 1,047 | | 1,207 | 903 | | 1,177 | 1,035 | * |
| Observations | 1,254 | 1,371 | | 1,510 | 1,567 | | 1,628 | 1,751 | |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 using a Mann-Whitney two-sample statistic. The sample is limited to African households in which at least one adult is over the age of 50. ^ Restricted sample includes only those households that report positive remittance receipt.

In comparing different groups in **Table 2,** I make use of different person types based on pension-eligibility status. A 'pension-eligible' person is an individual who is aged 60 or above and is thus eligible for the South African state OPG. The first two columns present means for the sample broken into those individuals eligible for the pension and those not. The last two columns look only at those who are eligible for the pension, separated into males and females. No difference is apparent in the proportion of pension and non-pension eligible people living in urban versus rural areas. This is interesting given the role of remittances in urban to rural resource transfers and suggests that this driver of remittances may not be as important as it used to be. Pension-eligible individuals are seen to live in households that are slightly larger, on average, and that have a higher proportion of children under the age of 16 living in the household. This accords with evidence that suggests that grandparents and the elderly play a sizeable role in raising children, in particular for those children who have lost a parent. Ardington & Leibbrandt (2010) explore the relationship between orphanhood and children's education outcomes in South Africa and find that shifts in the pattern of care giving for orphans show an increasing reliance on grandparents as caregivers. Schatz & Ogeunmefun (2007) find evidence that older women play a vital role in caring for grandchildren in South Africa (and granddaughters in particular) in response to HIV/AIDS deaths

of their mothers. The age of the household head is higher in pension-eligible households, which is expected given that this roll generally falls on the most senior member of the household. The education of the household head is also seen to be lower in pension-eligible vs non-eligible households, most likely a reflection of the previously unequal education system during the apartheid-era. The statistics involving remittances present a first look at the relationship between remittances and the pension. Total household income is lower in households although the difference is not significant, likely due to the volatility in the household income variable. Average non-remittance household income is, however, significantly lower for households in which a pension-eligible person is present. The same is true when grant income is also removed.

**Table 2: Summary statistics from pooled panel data**

| Variables | Not pension eligible | Pension eligible | | Pension eligible only | | |
|---|---|---|---|---|---|---|
| | | | | Females | Males | |
| *Household demographics* | | | | | | |
| Urban | 0.812 | 0.801 | | 0.804 | 0.793 | |
| Household Size | 4.946 | 5.097 | *** | 5.106 | 5.054 | |
| Fraction of household aged <=16 | 0.294 | 0.324 | *** | 0.337 | 0.282 | *** |
| HH head's age | 50.88 | 63.23 | *** | 63.37 | 62.75 | *** |
| HH head's education | 5.263 | 3.438 | *** | 3.356 | 3.719 | *** |
| | | | | | | |
| *Household income* | | | | | | |
| Total | 4,906 | 3,974 | | 3,783 | 4,621 | *** |
| Total *less* remittances | 4,755 | 3,855 | * | 3,663 | 4,503 | *** |
| Total *less* remittances *less* grant income | 2,699 | 1,866 | *** | 1,735 | 2,317 | *** |
| *Remittances received by individuals* | | | | | | |
| Full sample | 70.66 | 44.89 | *** | 52.98 | 18.16 | *** |
| Restricted sample ^ | 1,062 | 939.6 | | 920.5 | 1,175 | |
| | | | | | | |
| Observations | 4,742 | 4,233 | | 3,268 | 965 | |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 using a Mann-Whitney two-sample statistic. The sample is limited to African individuals aged 50 or older. ^ Restricted sample includes only those individuals that report positive remittance receipt.

Looking at remittances more specifically, average remittances in the full sample are significantly lower for adults of pension-eligible age than those below the age cutoff. The large number of zero observations in the remittance variable, however, make these means artificially low. Looking at a restricted sample including only those who report positive remittance receipt, the means are higher overall and lower for pension-eligible individuals, on average. This result is, however, not significant which is again a likely manifestation of the volatility inherent in income-related variables in the sample. Differences in findings based on gender indicate that pension-eligible women tend to live in bigger households and with more children than do pension-eligible

men, and in households with lower levels of income. Looking at the restricted sample, women report lower levels of remittances than men, although the result is not significant. Overall, the findings provide some evidence that receipt of the pension is linked to lower levels of remittances received. This is similar to other findings from South Africa by, among others, Jensen (2003) who finds similar patterns in income at a household level, and Posel et al. (2006) who find that the receipt and value of remittances is greater in households that do not receive the state pension than those that do.

# 5. RESULTS

## 5.1 Cross Sectional Regressions across Waves

**Table 3** shows the results of cross-sectional regressions on data from the three waves. This is the first identification strategy which analyses at household level the relationship between remittances and pension received. Columns (1) and (2) represent OLS regressions from Wave 1, columns (3) and (4) from Wave 2, and columns (5) and (6) from Wave 3 data. Further, columns (1), (3), and (5) represent the discontinuity design including the number of pension-eligible individuals of either gender in the household, while columns (2), (4), and (6) represent a sharp regression discontinuity design using age-groupings around the pension age-eligibility threshold for women and men respectively. Across the waves, each pensioner in the household is associated with a reduction in average remittances to the household of between R63 (w1) and R48 (w3), all else equal. This result is significant for waves 2 and 3 but not wave 1. Given that the average remittances received by households with no pension-eligible members is around R205 (w1) and R160 (w3), this represents an approximately 30% reduction in average remittances received due to the receipt of the pension, all else equal.

Looking at households that contain female and male members aged just above the eligibility threshold, while the coefficients on all terms are negative, the level of significance varies across the waves. In waves 1 and 3, households with women aged just above the threshold are seen to significantly reduce average remittances received by between R66 and R100. The presence of a male household member aged above the cutoff is significant only in wave 2, with an associated decrease in remittances of around R90. In almost all regressions, increases in household size are seen to significantly reduce remittances received, while having additional children aged below 16 in the household is seen to increase average remittances received. The latter can generally be explained by parents sending money home for children staying with relatives (who are often elderly

as noted earlier) while the former is more complex. It may represent the fact that, holding the number of children in the household constant, larger households mean fewer adult members are working away from home. Overall, results are marginal and coefficients on the higher age brackets must be viewed with caution given the small sample numbers with which they are associated. The results are also relatively small; while average remittances for households with no pension-eligible members is R205 (w1) / R160 (w3), conditional on receiving remittances this average increases greatly to R1,281 (w1) / R1,165 (w3). This shows a clear skewing of the means towards the left by the large number of zero observations observed in the remittances variable and suggests OLS is not a good estimator in this situation. The low R-squared numbers for all regressions support this.

**Table 3: Regression results from cross-section waves (OLS)**

| Variables | Wave 1 | | Wave 2 | | Wave 3 | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| No. of pensioners in HH | -63.18 | | -48.47*** | | -49.84** | |
| | (40.08) | | (18.05) | | (20.55) | |
| Age6064fhh | | -100.1* | | -33.35 | | -66.15** |
| | | (57.44) | | (28.82) | | (26.41) |
| Age6569fhh | | -86.11 | | -59.76** | | -86.96*** |
| | | (71.61) | | (26.32) | | (28.14) |
| Age70upfhh | | -176.1** | | -38.85 | | -29.63 |
| | | (79.45) | | (31.64) | | (38.69) |
| Age6064mhh | | -31.47 | | -90.21*** | | -42.48 |
| | | (57.36) | | (27.47) | | (43.39) |
| Age6569mhh | | -109.5 | | -79.05*** | | -47.57 |
| | | (74.24) | | (25.21) | | (38.01) |
| Age70upmhh | | -1.159 | | -74.69*** | | -22.72 |
| | | (107.4) | | (26.92) | | (45.89) |
| Household size | -126.6** | -122.8** | -31.54* | -30.15 | -55.13** | -57.51** |
| | (54.57) | (54.86) | (18.24) | (18.58) | (27.49) | (27.58) |
| Number of children <=16 in household | 38.22** | 37.66** | 13.75* | 13.38* | 22.86*** | 23.99*** |
| | (15.19) | (15.38) | (7.074) | (7.162) | (8.538) | (8.456) |
| Constant | -2,075*** | -2,073*** | -731.6*** | -753.7*** | -926.8*** | -959.9*** |
| | (464.1) | (460.7) | (222.0) | (231.3) | (177.8) | (190.4) |
| Observations | 2,622 | 2,622 | 2,788 | 2,788 | 3,140 | 3,140 |
| R-squared | 0.075 | 0.077 | 0.021 | 0.023 | 0.036 | 0.037 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. The sample is limited to African households in which at least one adult is over the age of 50. Dependent variable in all regressions is 'total remittances received by household'. Controls not shown: urban, head's age, head's age-squared, head's education, log of household income, province dummies. Income and remittance variables are deflated. Age group indicators can be interpreted as with the following example: *Age6064fhh* is an indicator equal to 1 if a household contains at least one female adult

**Table 4** on the following page presents results of the same regression models as above but using a negative binomial estimator from the Generalised Linear Models (GLM) family. This estimator follows a Poisson distribution but includes a random effect ($\alpha$) that makes it able to account for overdispersion of the dependent variable; in the case here, this makes it more sensitive to the number of zero observations and consequent lower means in the data. An $\alpha$ of zero indicates no overdispersion in the data. To test this, I assess likelihood ratio tests of $\alpha$ in all regressions and confirm the presence of overdispersion in the dependent variable, implying a negative binomial regression is preferred to a Poisson regression.[22]

Regression coefficients presented are calculated marginally at the average. Results are seen to be generally more significant than the previous OLS regressions, suggesting a better model fit. Evaluating the coefficient on the variable representing the number of pension age-eligible members in the household in column (1), (3) and (5) at their sample averages, indicates a reduction in remittances for each pensioner in the household of around 34% in wave 1, 26% in wave 2, and 29% in wave 3.[23] These results broadly support those found earlier. The coefficients in columns (2), (4) and (6) from regression designs using age groupings around the age-cutoff are negative for both females and males and generally significant. An interesting point to note is the relatively small coefficient and lack of significance for men aged 60-64 in wave 1, but which is larger and significant in waves 2 and 3. Further, the coefficient for men aged 65-69 in wave 1 is significant and far larger in magnitude. Taken together these suggest that the lowering of the pension eligibility age for men that took place between the waves had a significant effect on pension uptake for younger men which, in turn, had a shifting impact on remittances over time.

[22] In each case for $\alpha$, Prob>=chibar2 = 0.000 which rejects the null hypothesis that $\alpha$ is equal to zero
[23] Wave 1 mean: 0.617; wave 2 mean = 0.618; wave 3 mean = 0.615.

**Table 4: Regression results from cross-section waves (Negative Binomial)**

| | Wave 1 | | Wave 2 | | Wave 3 | |
|---|---|---|---|---|---|---|
| Variables | (1) | (2) | (3) | (4) | (5) | (6) |
| No. of pensioners in HH | -0.548*** | | -0.416*** | | -0.478*** | |
| | (0.138) | | (0.159) | | (0.107) | |
| Age6064fhh | | -0.473** | | -0.129 | | -0.444** |
| | | (0.205) | | (0.253) | | (0.177) |
| Age6569fhh | | -0.545** | | -0.391 | | -0.732*** |
| | | (0.223) | | (0.309) | | (0.216) |
| Age70upfhh | | -0.722*** | | -0.773** | | -0.503** |
| | | (0.224) | | (0.340) | | (0.199) |
| Age6064mhh | | -0.107 | | -1.377*** | | -0.664*** |
| | | (0.291) | | (0.408) | | (0.227) |
| Age6569mhh | | -0.778** | | -0.711** | | -0.501* |
| | | (0.335) | | (0.340) | | (0.263) |
| Age70upmhh | | -0.669*** | | -0.731** | | -0.391* |
| | | (0.236) | | (0.315) | | (0.228) |
| Household size | -0.0385 | -0.0245 | -0.684*** | -0.693*** | -0.389** | -0.482*** |
| | (0.212) | (0.213) | (0.222) | (0.234) | (0.165) | (0.167) |
| Number of children <=16 in household | 0.148** | 0.146** | 0.131** | 0.171** | 0.162*** | 0.173*** |
| | (0.0589) | (0.0595) | (0.0655) | (0.0675) | (0.0494) | (0.0499) |
| Constant | -5.801*** | -5.707*** | -3.850*** | -3.730*** | -3.373*** | -3.785*** |
| | (0.893) | (0.893) | (1.327) | (1.347) | (1.006) | (1.025) |
| ln(alpha) | 3.832*** | 3.831*** | 4.545*** | 4.538*** | 3.994*** | 3.992*** |
| | (0.0528) | (0.0528) | (0.0669) | (0.0669) | (0.0503) | (0.0503) |
| Observations | 2,622 | 2,622 | 2,788 | 2,788 | 3,140 | 3,140 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses. The sample is limited to African households in which at least one adult is over the age of 50. Dependent variable in all regressions is 'total remittances received by household'. Controls not shown: urban, head's age, head's age-squared, head's education, log of household income, province dummies.

## 5.2 Panel Analysis using Pooled Data

**Table 5** shows regressions on the untransformed dependent variable indicating the level of remittances received by an individual in the pooled panel data. Columns (1) and (2) represent pooled OLS and 2SLS which, while likely biased, provide an intuitive understanding of the model. Columns (3) and (4) present regressions using, respectively, fixed and random effects, and column (5) introduces non-remittance household income into the model. Column (6) provides a discontinuity design using age-eligibility groups (as opposed to a single eligibility indicator) for females and males respectively. Column (7) replicates the regression in column (6) using a Tobit estimator in an attempt to account for distributional issues in the dependent variable which is skewed towards zero. Importantly, all indicators of pension receipt or eligibility show a reduction

in the average level of remittances received, holding all else equal. These results are significant and relatively consistent across the different regression models.

**Table 5: Regression results using panel data, untransformed dependent variable**

| Variables | (1) OLS (pooled) | (2) 2SLS (pooled) | (3) 2SLS (FE) | (4) 2SLS (RE) | (5) 2SLS Income | (6) OLS age group | (7) Tobit age group |
|---|---|---|---|---|---|---|---|
| Pension receipt | -48.39*** | -69.52*** | -127.3*** | -72.81*** | -67.90*** | | |
| | (9.799) | (14.19) | (45.85) | (14.08) | (14.14) | | |
| Age6064f | | | | | | -31.94** | -25.16* |
| | | | | | | (15.02) | (14.43) |
| Age6569f | | | | | | -41.25** | -40.28** |
| | | | | | | (17.24) | (16.31) |
| Age70upf | | | | | | -46.09*** | -44.24*** |
| | | | | | | (15.57) | (14.44) |
| Age6064m | | | | | | -53.45*** | -58.88*** |
| | | | | | | (18.90) | (18.12) |
| Age6569m | | | | | | -64.13*** | -62.81*** |
| | | | | | | (22.55) | (21.33) |
| Age70upm | | | | | | -72.39*** | -69.92*** |
| | | | | | | (21.05) | (19.21) |
| Indicator(other pensioner in HH) | 3.901 | 4.397 | 28.07 | 5.929 | 11.11 | 6.229 | 3.549 |
| | (9.369) | (9.415) | (21.60) | (10.42) | (10.45) | (11.18) | (10.41) |
| Indicator(male) | -69.84*** | -71.81*** | | -72.71*** | -69.17*** | | |
| | (7.382) | (7.606) | | (9.577) | (9.592) | | |
| Household size | -14.05*** | -14.23*** | -10.29* | -14.28*** | -9.097*** | -8.185*** | -8.268*** |
| | (2.678) | (2.684) | (5.292) | (2.802) | (2.954) | (3.061) | (2.882) |
| Number of children <=16 in household | 20.47*** | 20.96*** | 19.62** | 21.13*** | 16.79*** | 16.54*** | 16.35*** |
| | (4.468) | (4.480) | (8.060) | (4.490) | (4.555) | (4.722) | (4.445) |
| Log(non-remittance income) | | | | | -30.78*** | -35.26*** | -34.13*** |
| | | | | | (5.584) | (5.661) | (5.480) |
| Constant | 160.8*** | 168.6*** | 347.9* | 162.8*** | 371.3*** | 381.3*** | 382.6*** |
| | (43.42) | (43.67) | (202.7) | (43.65) | (57.52) | (59.63) | (56.81) |
| Observations | 8,966 | 8,966 | 8,966 | 8,966 | 8,966 | 8,975 | 8,975 |
| R-squared | 0.017 | 0.017 | | | | | |
| Individual RE | | | | Yes | Yes | Yes | Yes |
| Individual FE | | | Yes | | | | |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses; clustered at the household level in columns (1) and (2). The sample is limited to African individuals who are aged 50 or older. Dependent variable in all regressions is 'remittances received by individual'. Controls not shown: urban, head's age, head's age-squared, head's education, province dummies, panel wave dummies. Panel used in regression is balanced with 2, 989 unique individuals in each wave. Instrument used for reported pension receipt in 2SLS regressions is an indicator equal to 1 if individual is of a pension-eligible age. Age group indicators can be interpreted as with the following example: *Age6064f* is an indicator equal to 1 if an adult respondent is female and is aged between or equal to 60 and 64 years, and 0 otherwise.

Column (1) uses actual reported pension receipt as the identifying variable and shows that reported receipt of the pension is associated with a reduction in remittances received. Column (2) instruments for reported pension receipt with a pension age-eligibility indicator (being of a pension-eligible age), which shows a small increase in the magnitude of the previous finding. These regressions are for comparative purposes only; given the potential endogeneity concerns in the use of reported remittance receipt discussed earlier, I use age-eligibility as an instrument for reported pension receipt in all the regressions that follow. Columns (3) and (4) attempt to control for bias due to the pooling of observations across waves which may result in correlation across time. Column (3) presents a regression including individual fixed effects, which shows a marked increase in the magnitude of remittance reduction associated with pension receipt. The regression in column (4) includes individual random – rather than fixed – effects, resulting in a similar coefficient to that of the pooled regression in column (2). This indicates two things. Firstly, it is understood that fixed effects are likely to more efficient than random effects if unobservable characteristics are correlated with the variable of interest. Given the exogeneity of the age-eligibility indicator, this is not likely to be the case here, rendering fixed effects less efficient than random effects. Further, the ratio of number of observations to waves is large, which doesn't allow for much variation when using fixed effects but which comes at the expense of additional degrees of freedom. I run a standard Hausman test which confirms that random effects are preferred to fixed effects.[24] Overall, fixed effects may also not be appropriate given estimation strategy design. Using observations of the same respondents over time will result in strong collinearity between their responses. In this case, fixed effects would pick up only minor variations in the data (e.g. due to date of interview). This again supports the use of random effects to control for variation over time going forward.

Secondly, the similarity between the pooled regression and the regression that includes random effects suggests that serial correlation isn't a real concern. Nonetheless, I use random effects in all regressions that follow given potentially unobserved influences in the error.[25] The negative coefficients found on the constant term – implying impossible negative remittance receipt – have also disappeared in the individual level analysis.

Pension receipt is associated with an average reduction of approximately R73 in the average level of remittances received, a result slightly larger than those found in the cross-sectional

[24] I test the null hypothesis that the difference in coefficients estimated on separate regressions using fixed and random effects, respectively, is not systematic. A chi-squared test results in a Prob>chi2 = 0.0003, implying that the use of fixed effects can be rejected in favour of random effects.

[25] Further, given the sample size here the asymptotic properties of estimates using random effects are likely to hold, implying robustness in the model

regression analysis. Column (5) introduces the log of non-remittance household income into the model. While endogeneity concerns would prefer the use of an instrument, I do not have adequate instruments for non-remittance household income. Nonetheless, it's insertion in the model does not markedly change the estimates of the other variable coefficients. Its coefficient broadly supports the theoretical underpinnings of the crowding out hypothesis being tested; namely that higher levels of income (and, hence, higher utility levels) are associated with lower levels of remittance receipt. Column (6) presents a sharp regression discontinuity design that includes smaller age groups above the discontinuity (noting that the sample is limited to those aged 50 or older). The variables of interest are those indicators for an individual aged 60-64; that is, aged just above the pension-eligible age threshold. The design also separates the age groups into those for females and those for males, to test the gender differential in the effects of crowding out suggested in the literature.[26] The results again indicate significant reductions in remittances received by individuals who are eligible for the pension compared to those who are not. The results are smaller for women than for men. Pension receipt is associated with reductions in remittances received of between R32 – R46 for women and between R52 – R73 for men, and are smaller for younger than for older pensioners. Given the large number of zero observations in the dependent variable, column (7) presents a Tobit estimator of the same regression model in column (6). The results are similar and still significant, albeit of a slightly smaller magnitude.

In turning to the other explanatory variables, the results appear consistent with findings in the literature and are robust across the different regressions. Men receive, on average, significantly smaller remittances than women. Larger households receive smaller remittances, likely due to having more working age people at home. This is consistent with the finding that more children in the household lead to increases in the average level of remittances received. This latter finding may also be a reason women just above the pension age threshold in columns (6) and (7) are more robust to remittance reduction than men, given our findings in the sample statistics earlier that women are likely to live in households with more children than are men. The results presented here appear robust across the different regression models and are similar in magnitude to the cross-sectional regression results earlier. However, there are still considerable distributional issues in the data. The results above use the dependent remittance variable in its untransformed form. The large presence of zero observations and the non-normal distribution of the variable makes it less than ideal when using OLS estimation.

[26] Note, while the regressions model the pension-eligible age threshold as 60 for both women and men, the results are robust to using an age-cutoff of 65 for men in wave 1 data.

**Table 6** present OLS regressions on the two transformed variables (log 'plus one'; IHS) which now follow a roughly normal distribution pattern while retaining the zero observations. Both variables can be interpreted here in the same manner as would a normal logged dependent variable. These regressions represent the core test of the hypothesis of a crowding out of private transfers by the receipt of the government pension. The robustness of these results – which support this hypothesis – are tested in other regressions that follow, using further transformations of the data and different econometric techniques.

Columns (1) and (3) use 2SLS estimators on the respective transformed variables, again using an indicator of pension eligibility (being of a pension eligible age) as an instrument for reported pension receipt. Columns (2) and (4) present the sharp regression discontinuity design using age-groupings around the age cutoff, for men and women separately. The results are slightly larger when using the IHS variable but coefficients are otherwise similar in magnitude and sign for both variables. In columns (1) and (3), pension receipt is associate with a reduction in average remittances received of between 37-41%. These results are significant and are greater in magnitude to those seen thus far using the untransformed remittance variable. In columns (2) and (4), there is a significant decrease in remittances for both men and women above the pension-eligible age cutoff. Women who become eligible for the pension see a reduction in average remittances received of around 11-12% while the number is much larger for men at between 32-35%. The extent of this reduction increases for both genders the older people get and is higher at all ages for men than for women.

**Table 6: Regression results using panel data, transformed dependent variable (OLS)**

| Variables | (1) Log(r+1) | (2) Log(r+1) | (3) IHS(r) | (4) IHS(r) |
|---|---|---|---|---|
| Indicator(eligible for pension) | -0.373*** | | -0.411*** | |
| | (0.0578) | | (0.0637) | |
| Age6064f | | -0.112* | | -0.122* |
| | | (0.0638) | | (0.0706) |
| Age6569f | | -0.230*** | | -0.253*** |
| | | (0.0656) | | (0.0725) |
| Age70upf | | -0.251*** | | -0.276*** |
| | | (0.0569) | | (0.0628) |
| Age6064m | | -0.318*** | | -0.351*** |
| | | (0.0533) | | (0.0589) |
| Age6569m | | -0.418*** | | -0.463*** |
| | | (0.0561) | | (0.0617) |
| Age70upm | | -0.432*** | | -0.477*** |
| | | (0.0576) | | (0.0635) |
| Indicator(other pensioner in HH) | -0.0128 | -0.0499 | -0.0144 | -0.0553 |
| | (0.0427) | (0.0389) | (0.0472) | (0.0429) |
| Indicator(male) | -0.406*** | | -0.448*** | |
| | (0.0395) | | (0.0436) | |
| Household size | -0.0931*** | -0.0905*** | -0.103*** | -0.100*** |
| | (0.0115) | (0.0109) | (0.0127) | (0.0121) |
| Number of children <=16 in household | 0.127*** | 0.126*** | 0.141*** | 0.139*** |
| | (0.0184) | (0.0198) | (0.0203) | (0.0218) |
| Constant | 1.214*** | 1.113*** | 1.344*** | 1.233*** |
| | (0.178) | (0.233) | (0.197) | (0.257) |
| Observations | 8,966 | 8,975 | 8,966 | 8,975 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses (robust in columns 1 and 3). The sample is limited to African individuals who are aged 50 or older. Controls not shown: urban, head's age, head's age-squared, head's education, province dummies, panel wave dummies. Columns (1) and (3) present 2SLS regressions, where indicator of pension eligibility is used as instrument for reported pension receipt. All regressions include individual random effects.

**Table 7** columns (1) to (4) replicate the regression models in Table 6 but, instead of OLS, use a Tobit estimator to test the relationship between pension and remittance receipt. Column (5) further introduces non-remittance income into the model. The Tobit regression assumes a lower bound to the dependent variable (here, zero) and is therefore useful in dealing with the presence of a large number of zero observations in the data. Tobit partial effects at the average can be seen to be smaller in magnitude for the pension-eligibility indicator than when using OLS, suggesting a decrease in average remittances received of between 27-30%, all else equal. Results continue to show a larger decrease for men than for women, and larger reductions for older people relative to more recent pensioners. In general, both men and women appear to experience the effects of

crowding out, while women appear more robust to this effect. The coefficient on the indicator for having another pensioner in the household is small and insignificant. This is most likely due to the small number of multi-pensioner households in the sample. The coefficient on the 'male' variable is large and significant, suggesting that males receive on average up to 45% less remittances than women, ceteris paribus. Larger households experience significantly lower levels of remittance receipt, although this is more than offset should the household include more children. Overall, accounting for distributional issues in the original data using the two transformations here suggests a larger effect of crowding out and a wider, more differential impact between these effects on women and men. However, there is a concern that the large number of zero observations continues to bias results.

**Table 7: Regression results using panel data, transformed dependent variable (Tobit)**

| Variables | (1) Log(r+1) | (2) Log(r+1) | (3) IHS(r) | (4) IHS(r) | (5) IHS(r) |
|---|---|---|---|---|---|
| Indicator(eligible for pension) | -0.271*** | | -0.299*** | | -0.269*** |
| | (0.0417) | | (0.0461) | | (0.0458) |
| Age6064f | | -0.102* | | -0.111* | |
| | | (0.0598) | | (0.0660) | |
| Age6569f | | -0.229*** | | -0.253*** | |
| | | (0.0680) | | (0.0751) | |
| Age70upf | | -0.254*** | | -0.280*** | |
| | | (0.0607) | | (0.0671) | |
| Age6064m | | -0.332*** | | -0.366*** | |
| | | (0.0752) | | (0.0830) | |
| Age6569m | | -0.418*** | | -0.463*** | |
| | | (0.0889) | | (0.0982) | |
| Age70upm | | -0.433*** | | -0.478*** | |
| | | (0.0814) | | (0.0899) | |
| Indicator(other pensioner in HH) | -0.0193 | -0.0521 | -0.0217 | -0.0576 | 0.0222 |
| | (0.0423) | (0.0436) | (0.0467) | (0.0481) | (0.0465) |
| Indicator(male) | -0.415*** | | -0.458*** | | -0.427*** |
| | (0.0392) | | (0.0432) | | (0.0430) |
| Household size | -0.0913*** | -0.0914*** | -0.101*** | -0.101*** | -0.0578*** |
| | (0.0114) | (0.0114) | (0.0125) | (0.0126) | (0.0131) |
| Number of children <=16 in household | 0.124*** | 0.127*** | 0.137*** | 0.140*** | 0.101*** |
| | (0.0182) | (0.0183) | (0.0201) | (0.0202) | (0.0202) |
| Log(non-remittance income) | | | | | -0.258*** |
| | | | | | (0.0247) |
| Constant | 1.196*** | 1.138*** | 1.324*** | 1.260*** | 3.078*** |
| | (0.177) | (0.179) | (0.195) | (0.197) | (0.256) |
| Observations | 8,975 | 8,975 | 8,975 | 8,975 | 8,975 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses. The sample is limited to African individuals who are aged 50 or older. Controls not shown: urban, head's age, head's age-squared, head's education, province dummies, panel wave dummies. All regressions include individual random effects.

**Table 8** presents the results of the strategy incorporating the hurdle model approach. The hurdle model uses a two-tier approach, estimating separately selection into positive remittance receipt and then the level of remittances received, conditional on it being positive. Columns (1) and (3) are Probit estimators on a dependent variable equal to zero if the level of remittances received by an individual is zero, and equal to one if it is positive. Columns (2) and (4) present truncated regressions on the transformed IHS variable, conditional on the first Probit regressions being positive. This latter aspect removes the set of zero remittance observations and assumes that the error terms in the truncated model have a truncated normal distribution; that is, the distribution has been scaled upward over the now restricted range. Regression results report marginal effects evaluated at sample means. The model is appropriate given the reasonably normal distribution of the positive values of the transformed remittance variables for values of remittances greater than zero (see Figure 4). Columns (3) and (4) present the same regression model as the first two columns except include a variable for the log of non-remittance income received by the household.

The coefficients on the pension age-eligibility indicator are consistently negative and significant. Looking at the Probit models, pension age-eligibility is associated with a decrease in the probability of receiving remittances of roughly 30% marginally at the average, dropping slightly when controlling for the level of non-remittance income. The truncated regression estimates on the restricted sample show a negative and significant coefficient of between -0.18 and -0.21. This suggests a decrease of between 18-23% in average remittances received due to pension receipt. This result is smaller in magnitude that most found thus far, suggesting the large presence of zero observations in the data biases results downwards when not accounted for. It must be noted that the hurdle model could potentially suffer from selection bias; unobservable characteristics may be correlated with those individuals more likely to receive remittances than those who do not. An analysis of only those who receive remittances, even though probability adjusted from the Probit model run before, may therefore fail to account for this. Nonetheless, the results are consistent with those found in the different analyses presented thus far; namely, that the receipt of public transfers is associated with a reduction in the level of private transfers received.

**Table 8: Regression results using panel data, Hurdle Model**

| Variables | (1) IHS(r) | (2) IHS(r) | (3) IHS(r) | (4) IHS(r) |
|---|---|---|---|---|
| Indicator(eligible for pension) | -0.297*** | -0.178** | -0.235*** | -0.207** |
| | (0.0462) | (0.0791) | (0.0466) | (0.0823) |
| Indicator(other pensioner in HH) | -0.0745 | -0.0253 | -0.00460 | -0.0448 |
| | (0.0567) | (0.117) | (0.0579) | (0.117) |
| Indicator(male) | -0.695*** | -0.238** | -0.650*** | -0.243** |
| | (0.0573) | (0.120) | (0.0584) | (0.119) |
| Log(household size) | -0.339*** | 0.266*** | -0.150*** | 0.214** |
| | (0.0510) | (0.0999) | (0.0536) | (0.107) |
| Number of children <=16 in household | 0.0815*** | -0.0214 | 0.0537*** | -0.0120 |
| | (0.0169) | (0.0334) | (0.0174) | (0.0344) |
| Log(non-remittance income) | | | -0.290*** | 0.0519 |
| | | | (0.0303) | (0.0378) |
| Constant | -0.856*** | 6.865*** | 1.109*** | 6.543*** |
| | (0.0647) | (0.116) | (0.219) | (0.267) |
| Observations | 8,986 | 8,986 | 8,982 | 8,982 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Standard errors (in brackets) clustered at the household level. The sample is limited to African individuals who are aged 50 or older. Controls not shown: panel wave dummies. Columns (1) and (3) are Probits. Columns (2) and (4) are truncated normal regressions on those finding positive remittance receipt in the Probits.

## 5.3 Robustness Checks

A number of empirical issues require investigation given their potential impact on the unbiasedness of results. Based on evidence from the literature, I explore certain behavioural changes in the household that may be linked to pension receipt. **Table 9** presents the same RDD strategy, but this time testing co-residence patterns and employment in the household.

Columns (1) and (2) present results from a regression with household size as the dependent variable. As per Jensen (2003), it may be that non-resident family members hope to access some share of the increase in household income by moving in with relatives that become eligible for the pension. Klasen & Woolard (2008) find that access to the OPG provides an important safety net in households, which increase in size upon pension receipt as unemployed members move in. Ardington et al. (2009) support this through findings that unemployed resident individuals are drawn to households eligible for the OPG. Alternatively, increased income in the household may free those who were remaining at home to care for the elderly to leave and begin their own households. Results here suggest that neither of these hypotheses is the case here. The coefficients on the eligibility indicators are small and insignificant. Pension receipt for all eligible individuals

and, more specifically, for men and women aged above the eligibility threshold does not seem to be associated with significant changes in the size of the household.

Changes in co-residence patterns may be less to do with the number of people in the household than with shifts in the type of members living there. Grandparents play an important family support role in raising children and it may be that households with elderly members who become eligible for the pension see a shift of more children into the household as families take advantage of the increase in income. Column (2) runs a regression using as a dependent variable the fraction of household members younger than 16. Coefficients on the eligibility indicators are positive and significant, suggesting that the receipt of the pension is associated with a shift towards having more children in the household. This finding is, however, limited to women pensioners aged just above the cutoff and is very small; pension receipt by women sees a rise in the proportion of children in the household by just over 2%.

Another potentially important household response involves changes in employment within the household. Members of a household (other than a pensioner) may work less with the increase in income due to demand for more leisure time. Bertrand et al. (2003) find reductions in labour participation in South Africa and decreases in the working hours of prime-aged individuals when household members become eligible for the OPG. Alternatively, the increase in income may allow those who were staying at home to care for the elderly the opportunity to seek employment. I use reported employment by adults in the household to generate an employment indicator equal to 1 if the household has member that earns a wage through employment, and zero if not. To counter the obvious change that a pensioner her/himself stops working upon receipt of the pension, I also control for individual employment status in the regression. The coefficients are negative and significant, with results suggesting that receipt of the pension is associated with a decrease in probability of employment in the household of just under 5%. This result appears limited to women and not men and is relatively small. Overall, while there is some evidence of shifting household behaviour in response to pension receipt, these results appear to be too small to explain the large proportional decrease in remittances found in the previous analyses.

**Table 9: Robustness tests**

| Variables | (1) HHsize | (2) HHsize | (3) Child16frac | (4) Child16frac | (5) HH employ | (6) HH employ |
|---|---|---|---|---|---|---|
| Pension receipt | 0.0670 | | 0.0244*** | | -0.0482*** | |
| | (0.110) | | (0.00888) | | (0.00745) | |
| Age6064f | | 0.0516 | | 0.0226*** | | -0.0392*** |
| | | (0.0862) | | (0.00755) | | (0.00661) |
| Age6569f | | -0.151 | | 0.0232** | | -0.0429*** |
| | | (0.112) | | (0.00948) | | (0.00794) |
| Age70upf | | -0.152 | | 0.00183 | | -0.0331*** |
| | | (0.121) | | (0.00975) | | (0.00784) |
| Age6064m | | 0.0272 | | -0.00307 | | 0.00262 |
| | | (0.112) | | (0.00980) | | (0.00867) |
| Age6569m | | 0.0755 | | 0.00393 | | -0.00551 |
| | | (0.152) | | (0.0128) | | (0.0106) |
| Age70upm | | 0.637*** | | 0.0209 | | -0.0314*** |
| | | (0.174) | | (0.0140) | | (0.0108) |
| Constant | -0.897** | -0.865** | 0.232*** | 0.233*** | 0.0206 | 0.0167 |
| | (0.381) | (0.382) | (0.0317) | (0.0318) | (0.0219) | (0.0221) |
| Observations | 8,966 | 8,975 | 8,966 | 8,975 | 8,253 | 8,261 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Standard errors in brackets. The sample is limited to African individuals who are aged 50 or older. Controls not shown: Columns (1)-(6): male indicator, HH head's age, HH head's age-squared, HH head's education, urban indicator, province dummies, and panel wave dummies. Columns (1)-(4) also include log of non-remittance household income. Columns (5) and (6) also include household size, number of children younger than 16, presence of another pensioner in the household, and individual employment status. Regressions in columns (1), (3), and (5) use 2SLS, with age eligibility instrumenting for reported pension receipt. All regressions contain individual random effects.

# 6. FINDINGS AND CONCLUSION

This paper aimed to test the relationship between public and private transfers to households and individuals in South Africa. Evidence in many developing countries points to a 'crowding out' effect, whereby receipt of public transfers displaces private transfers received by households. This can be explained by an altruistic-driven hypothesis of intra-household resource allocation, where household members take the wellbeing of other members into account in their own utility functions. This hypothesis is the one I test in this paper in a South African context. South Africa provides an interesting case study for two reasons: firstly, the country has a large public cash grant system that reaches over a third of the population and has grown in its share of poorer households' income; secondly, a history of racial discrimination manifested through geographical displacement has resulted in a labour system strongly reliant on economic migrants who oscillate between predominantly rural homes and urban workspaces. Hence, in this paper I test the relationship between the relatively generous state pension and private remittances received by households. I do this using pension age-eligibility to instrument for reported pension receipt and constructing a discontinuity design around the pension eligible age threshold. Data used draws on three waves of national-level panel data in South Africa. Visual depictions of the data show a general drop off in remittances received around the age-eligibility threshold for both men and women.

Results are relatively robust across the different strategies I use. Pension receipt is associated with a 20-30% reduction in the average level of remittances received by individuals, ceteris paribus. This finding is consistent, although less significantly so, at the household level. The magnitude of results are strongly influenced by the large presence of zero observations in the variable indicating level of remittances received, which is also not normally distributed. Not accounting for these concerns appears to bias results downwards, with larger coefficients (of up to a 40% reduction in remittances) obtained than when I use transformed variables and more appropriate Tobit estimators and a hurdle model. Remittances, like other forms of income, are heavily reliant on the behaviour of individuals under observation. Likewise, remittances transfers rely on the behaviour of the economic migrants from which they arrive. While I find only small changes in household behaviour related to pension receipt, due to data limitations I am not able to scrutinise and control for migrant characteristics in my analysis. Further work in better understanding the situation of economic migrants in relation to this data would therefore be useful.

There are two primary policy implications from my findings, both in South Africa and more generally. The first relates to targeting of the state pension program. Cash grants are targeted at

vulnerable sections of the population, including the disabled, children, and the elderly. The presence of crowding out implies that a proportion of the income increase from the pension accrues to migrants, who retain a greater proportion of remittances, and not to pensioners themselves who experience a corresponding remittance reduction. Put simply, pensioners are not as well off as they might have been given the increase in income due to a corresponding decrease in income from other sources. Conversely, the effect of this is a wider reaching impact by the state pension than on the elderly and their co-residents alone. The multiplier effects in the economy of this cash grant will likely be higher by putting money into the pockets of those who are economically active.[27]

The second policy implication relates to evidence on the effectiveness of the pension program. As outlined in the review section, a large body of research points to the positive developmental impact the OPG has on both the elderly and the people with whom they live (children in particular). Failing to take into account the corresponding decrease in remittances linked to pension receipt means that the socio-economic 'return' per Rand of the pension is likely understated in most analyses; that is, the benefits from pension seen are being generated from a smaller increase in income than the pension-amount taken at face value. The pension program may therefore be a more powerful means of addressing income and other types of poverty than previously thought. Future work in understanding the shifts that take place within households that receive the pension must be cognisant of this. Understanding the intra-household allocation of resources by taking the situation of migrant members into account may also have important lessons for policymakers, including in relation to bargaining within the household.

[27] Note, this may not be the case if the need to send home smaller remittances causes economic migrants to work less

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## Data

**Wave 1 Data:** Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2008, Wave 1 [dataset]. Version 5.3. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2015. Cape Town: DataFirst [distributor], 2015

**Wave 2 Data:** Southern Africa Labour and Development Research Unit. National Income Dynamics Study 2010-2011, Wave 2 [dataset]. Version 2.3. Cape Town: Southern Africa Labour and Development Research Unit [producer], 2015. Cape Town: DataFirst [distributor], 2015

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# APPENDIX 1: RESULTS USING UNBALANCED PANEL

**Table 10: Regression results using unbalanced panel data, untransformed dependent variable**

| Variables | (1) OLS (pooled) | (2) 2SLS (pooled) | (3) 2SLS (FE) | (4) 2SLS (RE) | (5) 2SLS Income | (6) OLS age group | (7) Tobit age group |
|---|---|---|---|---|---|---|---|
| Pension receipt | -44.63*** | -62.19*** | -107.8** | -63.43*** | -57.96*** | | |
| | (8.346) | (12.09) | (44.91) | (12.04) | (12.10) | | |
| Age6064f | | | | | | -25.79** | -23.39* |
| | | | | | | (13.08) | (12.85) |
| Age6569f | | | | | | -29.56** | -29.41** |
| | | | | | | (14.74) | (14.39) |
| Age70upf | | | | | | -32.07** | -32.17*** |
| | | | | | | (12.76) | (12.37) |
| Age6064m | | | | | | -56.95*** | -59.01*** |
| | | | | | | (15.84) | (15.54) |
| Age6569m | | | | | | -54.68*** | -54.54*** |
| | | | | | | (18.85) | (18.41) |
| Age70upm | | | | | | -65.16*** | -64.51*** |
| | | | | | | (16.90) | (16.31) |
| Indicator(other pensioner in HH) | 3.794 | 4.162 | 27.23 | 5.251 | 10.95 | 6.787 | 5.473 |
| | (8.380) | (8.394) | (20.66) | (8.785) | (8.812) | (9.196) | (8.927) |
| Indicator(male) | -69.04*** | -70.83*** | | -71.19*** | -68.33*** | | |
| | (6.340) | (6.538) | | (8.081) | (8.083) | | |
| Household size | -13.71*** | -13.83*** | -9.260* | -13.76*** | -8.865*** | -8.280*** | -8.369*** |
| | (2.327) | (2.330) | (5.055) | (2.385) | (2.504) | (2.544) | (2.481) |
| Number of children <=16 in household | 21.42*** | 21.77*** | 17.69** | 21.76*** | 17.58*** | 17.59*** | 17.58*** |
| | (3.854) | (3.857) | (7.706) | (3.861) | (3.912) | (3.974) | (3.873) |
| Log(non-remittance income) | | | | | -30.99*** | -34.59*** | -34.14*** |
| | | | | | (4.885) | (4.900) | (4.830) |
| Constant | 121.8*** | 128.8*** | 335.0* | 124.9*** | 338.8*** | 343.2*** | 343.8*** |
| | (35.83) | (36.13) | (201.9) | (38.03) | (50.59) | (51.55) | (50.49) |
| Observations | 11,120 | 11,120 | 11,120 | 11,120 | 11,120 | 11,131 | 11,131 |
| R-squared | 0.016 | 0.016 | | | | | |
| Individual RE | | | | Yes | Yes | Yes | Yes |
| Individual FE | | | Yes | | | | |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Robust standard errors in parentheses; clustered at the household level in columns (1) and (2). The sample is limited to African individuals who are aged 50 or older. Dependent variable in all regressions is 'remittances received by individual'. Controls not shown: urban, head's age, head's age-squared, head's education, province dummies, panel wave dummies. Instrument used for reported pension receipt in 2SLS regressions is an indicator equal to 1 if individual is of a pension-eligible age. Age group indicators can be interpreted as with the following example: *Age6064f* is an indicator equal to 1 if an adult respondent is female and is aged between or equal to 60 and 64 years, and 0 otherwise.

**Table 11: Regression results using unbalanced panel data, transformed dependent variable (OLS)**

| Variables | (1)<br>Log(r+1) | (2)<br>Log(r+1) | (3)<br>IHS(r) | (4)<br>IHS(r) |
|---|---|---|---|---|
| Indicator(eligible for pension) | -0.373*** | | -0.412*** | |
| | (0.0499) | | (0.0550) | |
| Age6064f | | -0.109* | | -0.119* |
| | | (0.0569) | | (0.0629) |
| Age6569f | | -0.224*** | | -0.248*** |
| | | (0.0579) | | (0.0639) |
| Age70upf | | -0.236*** | | -0.260*** |
| | | (0.0476) | | (0.0525) |
| Age6064m | | -0.332*** | | -0.366*** |
| | | (0.0435) | | (0.0482) |
| Age6569m | | -0.390*** | | -0.432*** |
| | | (0.0510) | | (0.0561) |
| Age70upm | | -0.420*** | | -0.464*** |
| | | (0.0490) | | (0.0541) |
| Indicator(other pensioner in HH) | -0.00776 | -0.0429 | -0.00878 | -0.0475 |
| | (0.0363) | (0.0327) | (0.0401) | (0.0361) |
| Indicator(male) | -0.408*** | | -0.450*** | |
| | (0.0337) | | (0.0372) | |
| Household size | -0.0944*** | -0.0934*** | -0.104*** | -0.103*** |
| | (0.00985) | (0.00942) | (0.0109) | (0.0104) |
| Number of children <=16 in household | 0.138*** | 0.139*** | 0.152*** | 0.153*** |
| | (0.0159) | (0.0171) | (0.0176) | (0.0188) |
| Constant | 0.992*** | 0.885*** | 1.099*** | 0.982*** |
| | (0.157) | (0.192) | (0.173) | (0.211) |
| Observations | 11,120 | 11,131 | 11,120 | 11,131 |

Significance defined as *** p<0.01, ** p<0.05, * p<0.1 Standard errors in parentheses (robust in columns 1 and 3). The sample is limited to African individuals who are aged 50 or older. Controls not shown: urban, head's age, head's age-squared, head's education, province dummies, panel wave dummies. Columns (1) and (3) present 2SLS regressions, where indicator of pension eligibility is used as instrument for reported pension receipt. All regressions include individual random effects.