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Universal Basic Income, Targeted Cash Transfers, and Progressive Taxation: Reducing Income Inequality in South Africa[1]

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Abstract

South Africa has one of the world's most progressive tax systems, yet income inequality continues to be a major challenge for the country. Several fiscal policy initiatives have been implemented since the end of apartheid to reduce the high levels of inequality and poverty. Despite this, there has been no significant reduction in inequality in post-apartheid South Africa. Universal basic income (UBI) and better progressive taxation can be a new way to address the limited strength of fiscal policies in South Africa. In developing countries, however, data on income is limited for the vast majority of the population working in the informal sector - informal labor is about 86% in Africa (ILO, 2018). Additionally, inclusion in the formal tax system is low. This paper compares the magnitude by which UBI versus targeted cash transfer (TCT) funded by progressive taxation can reduce income inequality in South Africa. Empirically, I conduct a policy simulation exercise to analyze how additional revenue generated from tax progressivity can be used to finance UBI and TCT, and to what extent this can reduce income inequality. Results show that both UBI and TCT reduce income inequality by more than 30% when these policies are accompanied and financed through a progressive taxation; however, UBI performs better in reducing inequality than TCT.

Keywords: Universal basic income, targeted cash transfers, progressive taxation, income inequality, Theil entropy measures of inequality

JEL Classification: E62, H21, H24, H53, O55

[1] Working Paper: This is a draft with preliminary results and not the final version.

1. Introduction

South Africa has one of the highest recorded levels of inequality in the world (World Bank, 2014). The country inherited a very high level of inequality during the apartheid period, and this high inequality has risen in the first two decades of the post-apartheid era. In those decades, South Africa has implemented a wide range of initiatives to address the issues of inequality and poverty, including the use of redistributional fiscal policies. (World Bank, STATS SA, 2018).

Despite this, there has been no significant reduction in inequality in post-apartheid South Africa. This paper considers the impact of the adoption and implementation of new and robust approaches, in addition to or in place of the approaches adopted thus far. The IMF's October 2017 Fiscal Monitor on "Tackling Inequality" states that fiscal policy can be a powerful redistributional tool for addressing rising inequality, with the caveat that both tax and transfers should be simultaneously considered in designing redistributive fiscal policies. These fiscal policies include progressive taxation, universal basic income (UBI), and public spending on education and health (IMF, 2017; pages 15-20). UBI is an unconditional lump sum payment given to everyone in a country irrespective of their socio-economic status.

South Africa has one of the world's most progressive tax systems, yet the country still has the most unequal distributions of income and wealth in the world (OXFAM, 2017). UBI is appealing because it avoids the problems of targeting,[2] yet there is limited evidence on the effects of UBI in developing countries. UBI together with existing progressive taxation can be a new approach to address the limited strength of fiscal and other policies in reducing income inequality in South Africa. This is because they can produce substantial redistribution to the poor. But in developing countries, there is a no direct observation of income for the vast majority of the

[2] Such as inclusion and exclusion errors, direct administrative costs, and other inefficiencies

population working in the informal sector,[3] mostly the poor; and their inclusion in the formal tax system is very limited. Perhaps, this can lead to poor redistribution through the tax system; which in turn can make targeted cash transfer (TCT) along with progressive tax framework more complex in a developing country setting (Hanna and Olken, 2019). Given that most governments in developing countries target poor and vulnerable people to receive cash transfers using various targeting methods (del Ninno, Carlo, and Mills 2015).

In this paper, I explore the potential of a UBI to reduce income inequality in South Africa, comparing it to a targeted cash transfer (TCT), in both cases using additional revenue generated from progressive taxation as the source of funding. More specifically, the paper compares the magnitude by which UBI versus TCT, both funded by progressive taxation can reduce income inequality. The TCT is implemented by using a proxy means test (PMT), which uses observable household characteristics such as assets (consumer durable goods), demographic variables, and household head attributes to predict households' income or consumption when other income data are inaccessible or questionable. However, a PMT generally leads to imperfect targeting, resulting in errors of inclusion (delivering transfers to non-poor households) and exclusion (failure to deliver transfers to poor households). If TCT were perfectly targeted, with neither type of error, it could reduce inequality (and poverty) more effectively than UBI. But since both errors exist it is possible that UBI could be more effective.

There is relatively little research on income inequality in South Africa (Leibbrandt et al. 2010; Van der Berg, 2009; Alvaredo and Atkinson, 2010; Woolard et al., 2015; Inchauste et al., 2015) and very little research has examined the extent and dynamics of wealth[4] inequality in South Africa (Orthofer, 2016). The top 10 percent of South Africa's population receives 56 to 58 percent

[3] Informal labor is about 86% in Africa (ILO, 2018).
[4] Looks at the distribution of assets (wealth)

of total income and own almost 95 percent of all wealth (Orthofer, 2016). Other studies (Inchauste et al. 2015; Woolard et al. 2015) that have evaluated the redistribution of major fiscal policy tools – how government spending and progressive taxation redistribute income to groups at different income levels – show that income inequality is significantly reduced by these policies, yet it remains persistently high. This suggests that the country needs increased fiscal redistribution to tackle the issue of stubbornly high-income inequality. These studies evaluate how inequality can be reduced through redistribution using tax progressivity and other social programs. However, none of these studies has examined redistribution through the lens of a UBI or a TCT[5] to reduce income inequality, which is the focus of this.

This paper contributes to the literature by addressing income inequality using a UBI or a TCT coupled with progressive taxation. It focuses on income inequality at the household level – the inequality between households. Global income inequality has declined over the past decade due to reduced between-country inequality, yet this reduction has been counteracted by rising inequality within many countries, including South Africa.[6]

Empirically, the analysis is in two main parts. First, I use household survey data to calculate income inequality as measured by the Theil entropy measure without considering a UBI or TCT. The Theil index is very useful for understanding the nature of inequality, as it can be used to divide the population into subgroups, including race,[7] geographical type, province,[8] and household head education. Second, I conduct a policy simulation by applying an additional progressive tax rate to

[5] Duflo (2003) examined the impact of a cash transfer program in South Africa, but not on income inequality instead on nutritional status and gender.
[6] Zia Qureshi, Trend in Income Inequality: Global, Inter-country, and Within-Countries (https://www.brookings.edu/wp-content/uploads/2017/12/global-inequality.pdf).
[7] Race consists of African, Colored, Asian/Indian, and White. Geographical type is divided into rural and urban.
[8] There are nine provinces including Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North-West, Gauteng, Mpumalanga, and Limpopo.

finance UBI or TCT, to examine how additional revenue generated from progressive tax can be used to fund UBI or TCT separately, and the extent to which this can reduce income inequality.

The findings show that a UBI or a TCT implemented simultaneously with progressive taxation reduces income inequality more than a progressive tax policy without a UBI or a TCT. With progressive taxation only, income inequality continues to be very large in all the subgroup populations, but inequality is reduced when a UBI or a TCT is combined with progressive taxation. In all the group decompositions, the within-group inequality contributes more than 70% to the overall income inequality, while between-group inequality contributes less than 30%.

The rest of this paper is organized as follows. Section 2 describes the policy background of UBI and progressive taxation, and provides a brief introduction on inequality. In section 3, I describe the data, the measures of UBI and TCT, progressive taxation, and the descriptive statistics. In section 4, I explain the empirical methodology. In section 5, I present and discuss the results. Finally, I conclude in section 6.

2. Policy Background and Inequality

This section provides background information on inequality in South Africa, describes the progressive nature of the South African tax system, and explains universal basic income (UB1) and targeted cash transfer (TCT) policies.

2.1. Inequality in South Africa

South Africa is an upper middle-income developing country, with a set of labor-markets and welfare institutions that mimic those of advanced capitalist countries (e.g. the United States of America) in many respects (Seekings and Nattrass, 2005). The country inherited very high inequality from the apartheid period, which despite policies to reduce inequality has stubbornly risen for more than two decades. South Africa has relied on redistributive fiscal policy tools to reduce inequality and poverty over the past decades. Several programs have been implemented since the end of apartheid in 1994 to help reduce high levels of inequality and poverty. These include the 1994 Reconstruction and Development Program, the 1996 Growth, Employment, and Redistribution, the 2006 Accelerated and Shared Growth Initiative, and the 2012 National Development Plan for South Africa.

Various initiatives were undertaken under these programs, including the use of different fiscal policies to achieve effective redistribution, such as government investments in education, health and social development, social assistance to vulnerable households and individuals, contributory social security, and investments in public transport, housing, and local amenities. These policies account for almost 60 percent of government spending and have played a role in reducing inequality and poverty to some extent (World Bank, STATS SA, 2018). Yet, there has been no meaningful reduction in income inequality in South Africa. The levels of inequality in South Africa are even larger than those of Brazil, another highly unequal country. The richest 20

percent of South Africans' account for 61.3 percent to aggregate consumption expenditure, compared to 55.7 percent in Brazil (Stats SA 2014).

Table 1 shows that there is a substantial reduction in income inequality in South Africa via highly progressive systems of social spending and taxation as revealed by comparing the decile shares of market income and with the shares for disposable income. It is obvious from the table that the wealthiest deciles of the population bear much of the tax burden. The government then rechannels these funds from the rich to the poorest so as to increase their disposable incomes. Despite this progress, inequality of disposable income continues to be persistently high.

Table 1: Distribution of Market Income, Personal Income Tax PIT, and Disposable Income

Decile	Share of market income (%)	Share of personal income tax (%)	Share of disposable income (%)
1	0.10	0.00	0.50
2	0.20	0.00	1.00
3	0.50	0.00	1.40
4	0.80	0.00	1.90
5	1.50	0.00	2.50
6	2.70	0.10	3.60
7	4.50	0.40	5.50
8	8.30	2.00	9.10
9	17.70	10.60	17.90
10	63.70	86.90	56.70

Source: Inchauste et al. (2015). This table reports the share of total market income, PIT, and disposable income received by each 10% of the population from the poorest 10% (decile 1) to the richest 10% (decile 10)

This suggests that the country needs more fiscal redistribution to further reduce South Africa's severe income inequality. As presented in Figure 2, from 1996 to 2018, the top marginal tax rates have remained at 40 to 45 percent. This raises the question of whether to increase marginal tax rates for all taxpayers or only for the rich (the wealthiest 10% of the population), since the top wealthy people in South Africa receive more than 50 percent of overall income (Orthofer, 2016). In effect, increasing marginal tax rates either for all taxpayers or just for the rich will impose a

higher tax burden on wealthy people than on poor people. However, the rich (the wealthiest 10% of the population) own approximately 95 percent of all assets in South Africa (Orthofer, 2016). Therefore, the rich may be able to bear an additional burden without great difficulty.

2.2. Tax Progressivity in South Africa

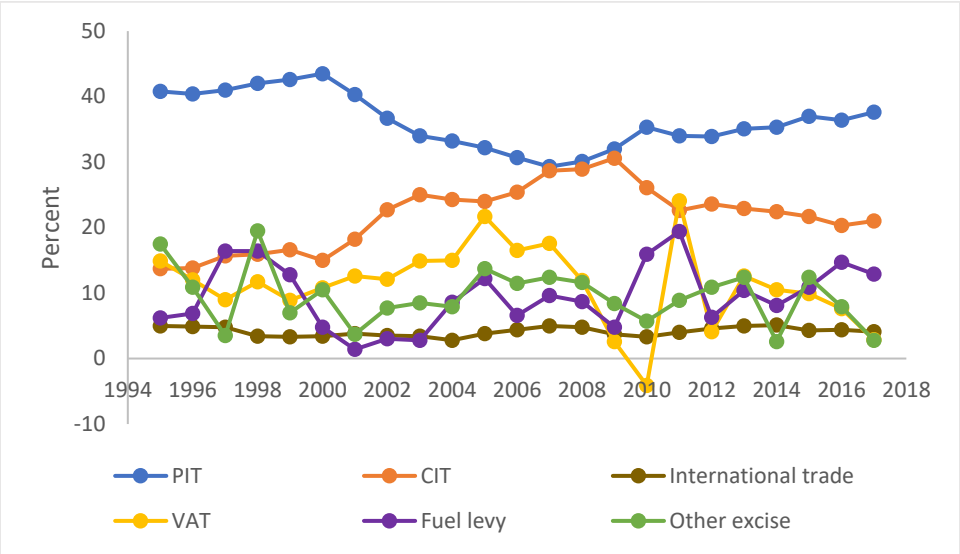
Tax progressivity is a valuable fiscal policy tool that can produce a more equitable income distribution, higher revenues, and possibly improve economic performance and growth (Weller, 2007). South Africa has one of the most progressive tax systems in the world, yet it continues to be the most unequal country in the world in terms of net (post-tax) income (DFI & OXFAM, 2017). More than 90 percent of the country's tax revenue is generated from direct and indirect taxes (Stats SA 2012a; National Treasury 2013). The direct taxes that generate the most revenue are the personal income tax (PIT), the corporate income tax (CIT), and the skills development levy[9] tax. The indirect taxes that generate the most revenue are the value added tax (VAT), specific excise duties, the general fuel levy, and international trade taxes.

Inchuaste et al. (2015) find that direct taxes in South Africa are progressive, while indirect taxes are slightly regressive for the population at the bottom half of the income distribution. This is because the personal income tax in South Africa is more progressive than indirect or consumption taxes. South Africa generates more revenue from the personal income tax than from indirect or consumption taxes. The ultimate goal of progressivity in the PIT is to generate tax revenue in an equitable manner.

As shown in Figure 1, the PIT generates the largest share of South Africa's tax revenue, followed by the corporate income tax (CIT). The graph provides a useful perspective on the structure of the main sources of tax revenue and how they varied between 1995 and 2017. There

[9] It is a levy imposed to promote learning and development of employees in South Africa and is driven by an employer's salary bill.

was a steady decline in the PIT as a percentage of total tax revenue from 2001 to 2007, after which there was a slow increase in the share of the PIT. In contrast, the CIT exhibits the opposite pattern, increasing from 1995 to 2009 and then falling gradually to 2017.



Source: South Africa Reserve Bank (SARB, 2017)

Figure 1: Major Sources of Tax Revenue as a Proportion of Total Tax Revenue (1995 -2017)

The personal income tax structure has been revised in many aspects since 1994 (Manuel, 2002), in accordance to the recommendations made by the Katz Commission.[10] These include a reduction in the number of tax bracket from ten to six, scrapping the child rebate, assigning the individual as the unit of taxation, and increasing the rebate[11] annually to compensate for inflation and to maintain progressivity.

This study measures progressive taxation using the personal income tax (PIT) structure, for two main reasons. First, the PIT contributes the largest share to revenues of all the taxes in South Africa and, second, data are easily accessible for the PIT. Various approaches have been

[10] It is officially known as the Commission of Inquiry into Certain Aspects of South African Tax Structure.
[11] Tax rebate is a refund or a payment to the taxpayer when the taxpayer pays more tax than they owe.

adopted to measure progressivity, and there is no straightforward answer as to which measure of tax progressivity is the best; it often depends on the context.

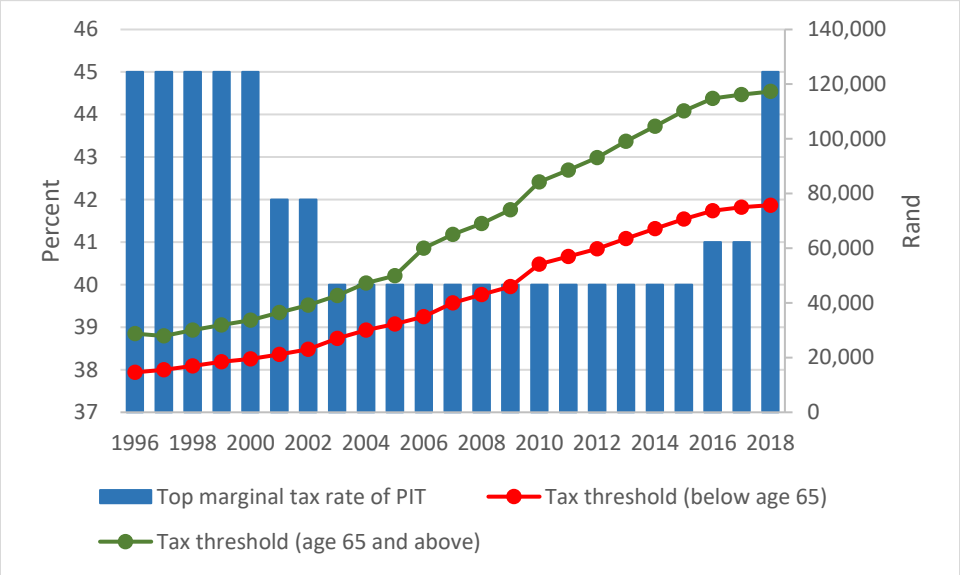
A few studies (Nyamongo and Schoeman, 2007; Vander Berg, 2009; Van Heerden and Schoeman, 2010; Steenekamp, 2012; Inchauste et al., 2015) have examined the progressivity of taxes and transfers in South Africa using different measures. Nyamongo and Schoeman (2007) presented empirical evidence for South Africa using the Musgrave and Thin (1948) and Kakwani (1977) measures of progressivity. The Musgrave and Thin method indicates that progressivity declined between 1994 and 2004, whiles the Kakwani index shows that progressivity increased between 1989 and 2000. It then decreased between 2000 and 2004, in response to tax reforms.

Inchauste et al. (2015) measure the progressivity of the personal income tax and the payroll tax by comparing South Africa to Brazil and Mexico. They find that the Kakwani index for South Africa (0.13) is much smaller than those for Brazil (0.27) and Mexico (0.30). This large difference is due to South Africa's higher income inequality combined with a lower tax progressivity at the bottom end of the income distribution. Steenekamp (2012b) used three measures to examine how adjustment to the PIT rate and tax threshold affects progressivity – findings show that the PIT system is progressive, however, there is a declining trend in tax progressivity between 1994 and 2009.

The personal income tax rates in South Africa have occasionally decreased, in spite of the overall progressive nature of the country's tax structure. The top marginal tax rate of the personal income tax reduced from 45% to 42% in 2001, and then to 40% in 2003. It remained at 40% until 2016, when it increased to 41%, and further to 45% in 2018. This is displayed in Figure 2. The tax threshold - the level of income or money earned, above which people or companies must pay tax

- increased steadily from 1996 to 2018. This implies that the rich - those at the upper end of the income distribution – bear much more of the tax burden than the poor.

In the case of South Africa, this burden may not be much of an issue for the wealthy. Therefore, increasing the marginal tax rate, either for all taxpayers or only for the rich, may increase efficiency and reduce inequality in South Africa. This is because a larger proportion of the population at the bottom of the income distribution does not pay taxes due to the fact that their gross income is less than the tax threshold.



Source: The National Treasury of South Africa: Budget review report from 1996 to 2018

Figure 2: Variation in Top Marginal Tax Rate, and the Tax Threshold

2.3. Universal Basic Income and Targeted Cash Transfers

The idea of a universal basic income is attracting greater attention, and has become widely discussed in public economic policy debates. It has generated discussions among a growing number of economists, politicians, entrepreneurs, and financiers. Some governments – Canada, India, Finland, Kenya, Netherlands, and California - around the globe are evaluating its use and are embarking on pilot studies. Businesses are collaborating with non-profit organizations to carry out research that appraises its costs and benefits.

Proponents of the idea include distinguished intellectuals beginning from radical thinkers, liberals, and utopian socialists in the eighteenth and nineteenth century, including Thomas Paine, Thomas Spence, Charles Fourier, Joseph Charlier, John Stuart Mill and John Kenneth Galbraith (Van Parijs and Vanderborght, 2017). Currently, the IMF has joined the campaign, and in its latest Fiscal Monitor, it says that UBI could reduce income inequality (IMF, 2017; pages 15-20). Universal basic income is an income redistribution scheme that is defined by three main features: 1) it is a cash transfer scheme, as opposed to an in-kind transfer such as food or fuel; 2) It is unconditional, which means it is not contingent on the recipient to satisfy any compliance criteria to receive the grant; 3) It is universal, which suggests that it is not targeted to any specific group of people based on their socio-economic or demographic status.

It is surprising that UBI is being debated in both developed and developing countries, considering the different economic environments of these countries. The leading economic argument behind a UBI adoption in the context of developed countries is the imminent threat of unemployment due to globalization and automation, whereas in developing countries it is recommended as an effective policy measure to combat poverty. UBI is also advocated as an effective policy to address rising inequality and wage stagnation in both developed and developing countries, which is the main focus of this study, which focuses on a developing country.

Skeptics and opponents of UBI frequently raise two major criticisms. First, a UBI can reduce incentives to work and thus reduce the labor supply. Second, the tax rates needed to generate revenue to fund UBI can be extremely high. Other concerns are that it may crowd out funding for other existing social grant programs that generally target the poor or the vulnerable – widows, low-income parents, the elderly, and so on. On the other hand, UBI is attractive since it avoids the problems of targeting, which complicate targeted cash transfers (TCT); those problems

consist of inclusion and exclusion errors, direct administrative costs, and inefficiencies of various types. It may also avoid ineffectiveness and inequity in the current social safety net programs – programs that provide benefits to individuals and families.

There is limited evidence on the effects of UBI in developing countries, and only three developing countries had had a UBI, and only for a short time frame. These include a basic income grant in two villages in Namibia, and nationwide cash transfer programs in Iran and Mongolia (Salehi-Isfahani and Mostafavi-Dehzooei, 2017; World Bank, 2020). However, none of these pilot studies has been experimentally examined. Many studies have experimentally evaluated existing TCT schemes in developing countries, which are different from UBI. Evidence from such studies shows that, on average, cash transfers to the targeted poor do not lead to either disincentives to work or spending wastefully on inessential consumption (Banerjee et al. 2017; Bastagli et al. 2016; and Evans and Popova, 2017). Other findings from experimental evaluations of targeted cash transfer programs include increase in total expenditure, test scores, school attendance, cognitive development, use of health facilities, dietary diversity, labor force participation, women's empowerment, marriage, fertility, and use of contraceptives; and decrease in child labor migration, borrowing, and domestic violence(Banerjee, Niehaus, and Suri, 2019). Hanna and Olken (2019) examine how transfers are targeted in developing countries and present empirical evidence on the tradeoff between UBI and TCT in Indonesia and Peru.

There are various alternatives for funding UBI and TCT, which include raising revenue from many incremental taxes via progressive taxation, cutting government expenditure or canceling existing social grants programs, running larger budget deficits, and from other nontax revenue – largely the revenue expenditure of the government. Yet, there is no straightforward answer on the actual cost of a UBI and TCT policy, nor on the method for funding it. This paper

explores the potential outcomes of implementing a UBI in the context of South Africa, its feasibility, and how it affects income inequality; using revenue generated from an increase in progressive taxation. UBI is then compared to a TCT program, which is the mechanism used for most of the existing cash transfer programs in South Africa.

UBI is similar to a Negative Income Tax (NIT) in terms of its outcome, but they move in different paths to get to that point. The NIT, promoted by Milton Friedman (Friedman, 1962), is an extension of a progressive tax system. In the same manner as the wealthy pay increasingly higher rates of taxes on their income (progressive tax), those below the poverty threshold pay increasingly negative[12] tax rates on their income or receive benefits (the latter of which can be seen as an NIT). In contrast, UBI transfers a lump sum amount unconditionally to all but then deducts it for the wealthy, and NIT transfers money only to the poor, not the wealthy (Tondani, 2009). So, due to the taxes to fund UBI, the wealthy end up with less income than before the program even though they do get a lump sum transfer. NIT proposals have been examined in the United States in previous decades (Brown, 1988; Moffit, 2003)

In summary, comparing UBI to TCT, both can be funded by an increase in marginal tax rates through progressive taxation, which could be useful for constructing a new approach to reduce income inequality in South Africa. I use data from South Africa to compare UBI and TCT, empirically. In theory, TCT could reduce income inequality more efficiently and equitably than UBI, except that the imperfect targeting may make it less effective. Therefore, it is not clear which of these two policies is most effective for reducing income inequality.

[12] A negative tax provides positive income transfers to the poor.

3. Data, Measures, and Descriptive Statistics

This section first describes the data, and then explains the detailed approach used to measure inequality, progressive taxation, universal basic income (UBI), and targeted cash transfer (TCT). The last sub-section provides descriptive statistics to present a detailed picture of all the variables used in this study.

3.1. Data

The data used are from the National Income Dynamics Study (NIDS) - which is the first national household panel data study in South Africa. The mode of interview is face-to-face, with individual household members. The Southern Africa Labor and Development Research Unit (SALDRU) located at the School of Economics in University of Cape Town conducts the NIDS project. NIDS collects data on the livelihoods of individuals and households over time. It specifically collects data on: positive and negative income shocks, changes in poverty and wellbeing, household composition and structure, fertility and mortality, migration, employment, labor market participation and economic activity, health and education, and vulnerability and social capital.

To date, five waves of nationally represented panel data have been collected, in 2008, 2010/2011, 2012, 2014/2015, and 2017. The study started with Wave 1, a nationally representative sample of over 28,000 individuals in 7,300 households across the country in 2008. Waves 2 through 5 were collected from the same households, and the same household members, every two years. The initial (Wave 1) household members are called Continuing Sample Members (CSMs). Any additional members to the households added in later waves are interviewed but are not tracked in the subsequent waves; these members are called Temporary Sample Members (TSMs).

This study uses the wave 4 (2015) and wave 5 (2017) data, which were collected from September 2014 to August 2015 and from February 2017 to December 2017, respectively. It focuses on the income and expenditure data. The total number of individuals and households interviewed are 26,804 and 11,889 for Wave 4, and 30,110 and 13,719 for Wave 5.

Eligible individuals interviewed for the NIDS survey were adults aged 15 and older, including those not in the labor force due to being in school, having disability, being retired, or doing housework. After merging wave 4 and wave 5, creating new variables, and other data management of the raw survey data, a total sample of 47,703 individuals and 12,303 households were utilized for the analysis of this study. The sample for analysis is restricted to households for whom there exist income data for at least one individual.

The NIDS data do not provide information on annual gross taxable income and tax liability, it provides only net income from all sources. To calculate tax liability, the 2016 and 2018 tax codes from the annual budget review report (National Treasury of South Africa, 2016; 2018) are applied to the NIDS data to calculate the gross taxable income and tax liability variables. I consider only income sources that are currently taxed through the personal income tax system, labor income.

This consists of all employment earnings, profit shares, and bonuses in the NIDS data. I first applied the PIT tax rates to the aggregate net income in the data, to calculate gross taxable income. Then, I applied the South African medical tax credit scheme to back out each households' gross taxable income, to ensure that the gross taxable income somewhat corresponds to the gross income from which tax lability is calculated. The medical tax credit is a rebate that applies to the fees paid by a taxpayer to a registered medical scheme on behalf of the taxpayer and their dependents. From Table 2, the monthly medical tax credit for the 2016 tax year is R270 for the taxpayer and the first dependent, and R181 for additional dependents. For the 2018 year, it is R303

for the taxpayer and the first dependent, and R204 for additional dependents. Due to lack of data, medical aid contributions, deductions, exemptions (pension fund contribution), and government transfers are not use to calculate the gross taxable income. These deductions, exemptions, transfers etc., are assumed to be already accounted for in the net income from the data, due to limitation of data on these variables. Therefore, this study focuses on effective tax, and not statutory tax. Equations (1) and (2) show how gross taxable income can be calculated from the net taxable income, the tax rebate, the fixed amount, and other details of the income tax (SARS, 2015; Rasmussen, 2017):

$$y^n = y^g - (y^g - L_i)t_i - F_i + r$$

$$y^n = y^g(1 - t_i) + t_i L_i - F_i + r \qquad (1)$$

$$y^g = \frac{(y^n - r + F_i - t_i * L_i)}{1 - t_i} \qquad (2)$$

where, y^g is the gross taxable income and y^n is the net taxable income from the NIDS data; r is the tax rebate which is dependent on age group as shown in the tax codes; F_i is the fixed tax amount that varies by tax bracket for individual i; $t_i$is the marginal tax rate for each bracket; L_i is the lower bound tax base for each tax bracket. The gross taxable income is the base income variable to which different hypothetical tax codes can be applied.

The 2016 and 2018 personal income tax rates for South Africa are reported in Table 2, showing the six (2016) and seven (2018) structured tax brackets and their respective tax rates and fixed amounts. The first tax bracket reported in Table 2 has a zero fixed amount ($F_i = 0$), and $L_i = 0$ for this bracket. If the gross taxable income is below the tax threshold as presented in Table 2, then, $y^n = y^g$, that is there is no tax. The tax rebates are categorized into primary (below age 65),

secondary (age 65 and above), and tertiary (age 75 and above); and the same category applies to the tax threshold.

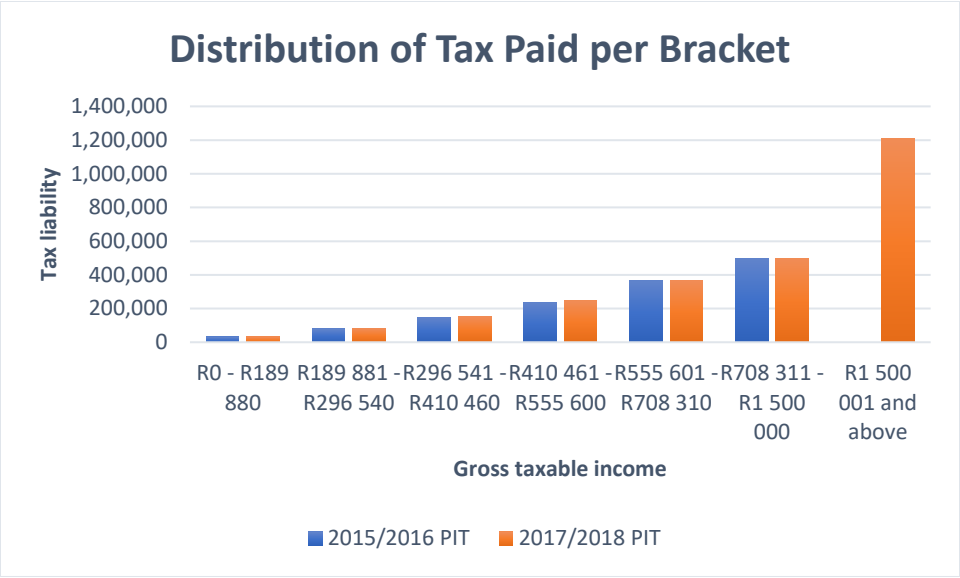
Table 2: Personal Income Tax Rates and Brackets Adjustments

Taxable income (R)	**2015/2016 Rates of Tax**	**Taxable income (R)**	**2017/2018 Rates of Tax**
R0 - R181 900	18% of each R1	R0 - R189 880	18% of each R1
R181 901 - R284 100	R32 742 + 26% of the amount above R181 900	R189 881 - R296 540	R34 178 + 26% of the amount above R189 880
R284 101 - R393 200	R59 314 + 31% of the amount above R284 100	R296 541 - R410 460	R61 910 + 31% of the amount above R296 540
R393 201 - R550 100	R93 135 + 36% of the amount above R393 200	R410 461 - R555 600	R97 225 + 36% of the amount above R410 460
R550 101 - R701 300	R149 619 + 39% of the amount above R550 100	R555 601 - R708 310	R149 475 + 39% of the amount above R555 600
R701 301 and above	R208 587 + 41% of the amount above R701 300	R708 311 - R1 500 000	R209 032 + 41% of the amount above R708 310
		R1 500 001 and above	R533 625 + 45% of the amount above R1500 000
Rebates		**Rebates**	
Primary	R13 635	Primary	R13 635
Secondary	R7 479	Secondary	R7 479
Tertiary	R2 493	Tertiary	R2 493
Tax Threshold		**Tax Threshold**	
Below age 65	R75 750	Below age 65	R75 750
Age 65 and over	R117 300	Age 65 and over	R117 300
Age 75 and over	R131 150	Age 75 and over	R131 150
Medical Tax Credit		**Medical Tax Credit**	
Taxpayer and first dependent	R270/month	Taxpayer and first dependent	R303/month
Each additional dependent	R181/month	Each additional dependent	R204/month

Source: National Treasury of South Africa, 2016 & 2018 (Budget review), from March 1st, 2017 to February 28th, of 2016 & 2018.

The marginal tax rate is nonlinear spanning from 18 percent (lowest tax bracket; R0 – R181,900) to 41 percent (highest tax bracket; R701,301 and above) for 2016; and from18 percent (lowest tax bracket; R0 – R189,880) to 45 percent (highest tax bracket; R1,500,001 and above) for

2018. Table 2 is also graphically displayed in Figure 3, explaining the distribution of tax paid per tax bracket.



Source: National Treasury of South Africa, 2016 & 2018 (Budget review), from March 1st, 2017 to February 28th, of 2016 & 2018.

Figure 3: Distribution of Tax Liability for Each Tax Bracket.

3.2. Progressive Taxation Measure

There are several proposed methods to measure the progressivity of taxation. These methods fall into two groups, local measures and global measures. Local measures of progressivity focus only on the tax schedule, without accounting for the income distribution that is being applied to this tax schedule. Some of these measures include tax elasticity (average rate progression, marginal rate progression, and liability progression) and residual income elasticity (Jakobsson, 1976; Seidl, 2009; Govori, 2015). Local measures are limited in their information because they do not take into account the income distribution.

In contrast, global measures of progressivity account for both the distribution of tax liability and the distribution of income, and have several advantages relative to local measures. Examples of these measures include the Reynolds and Smolensky index, the Musgrave-Thin (MT) index, the

Suits index, and the Kakwani index (Musgrave and Thin, 1948; Reynolds and Smolensky, 1977; Kakwani, 1977; Suits 1977). To obtain a good progressive measure, information on pre- and post-tax income inequality and the distribution of the tax burden are largely required (Musgrave and Thin, 1948; and Kakwani, 1977; Suits 1977). This allows for the distribution of income using the pre- and post-tax income inequality information, and the distribution of tax liability using the tax information.

I measure the progressivity of South Africa's personal income tax (PIT) using individual-level data. The Musgrave and Thin (1948) index of tax progressivity is calculated using the inequality of before-tax (gross taxable) and after-tax (net taxable) income distributions. More specifically, the Musgrave and Thin (1948) index is defined as:

$$MT = \frac{1-G_{yg}}{1-G_{yn}} \qquad (3)$$

where G_{y^g} is the Gini coefficient for before-tax income and G_{y^n} is the Gini coefficient for after-tax income. The tax schedule is progressive if $MT > 1$, proportional if $MT = 1$, and regressive if $MT < 1$. While the MT measure appeals to intuition, a simple comparison between before-tax and after-tax income might not be an optimum measure of tax progressivity since this information does not give a suitable measure of progressivity. Thus, the Kakwani index incorporates the distribution of the tax burden in addition to the before-tax income.

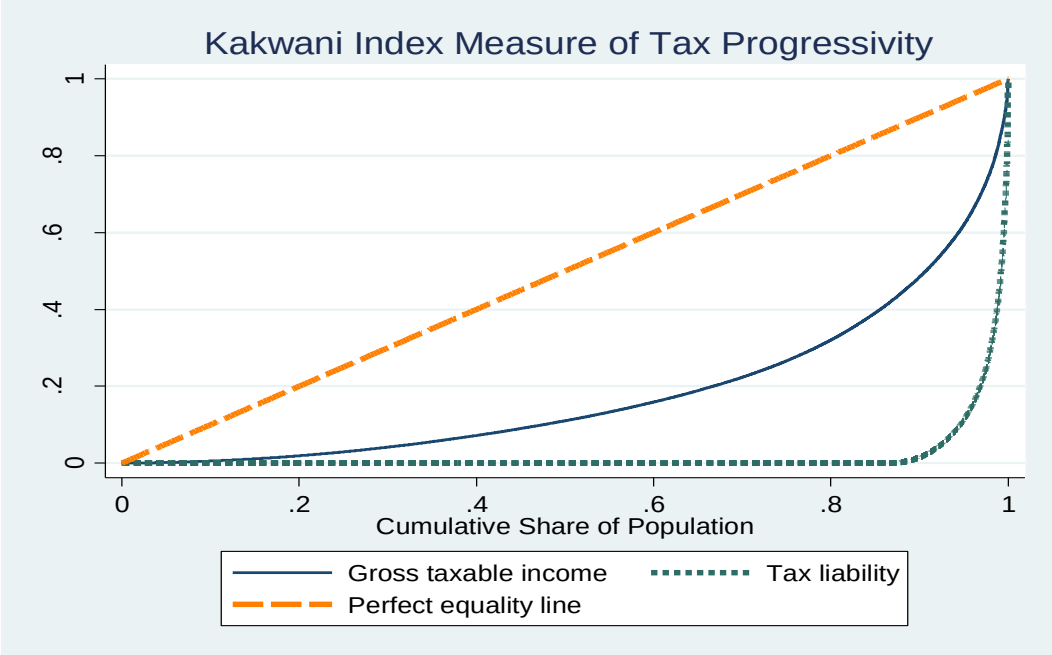
Kakwani (1977) builds on the MT measure by comparing the Lorenz curve of the before-tax income distribution and the concentration curve of taxes. Kakwani's index of tax progressivity t is defined as the difference between the concentration coefficient of taxes (C_t) and the convexity of the Lorenz curve of before-tax income which is represented as the Gini coefficient (G_y):

$$K = C_t - G_y \qquad (4)$$

Figure 4 illustrates this graphically, with Lorenz curve for tax liability is (C_t) and for gross taxable income is G_y. Mathematically, the concentration coefficient of taxes is given as:

$$C_t = 2\sum_{k=1}^{n} \frac{1}{n}\left(\frac{k}{n} - \sum_{i=1}^{k} \gamma_i\right)$$

where $i = 1, \ldots\ldots, k$ denotes individual i, n is the total number of individuals in a country, γ_i is the share of total taxes paid by individual i. The conditions required for a tax schedule to be progressive, proportional, or regressive are, $K > 0$, $K = 0$, and $K < 0$, respectively. The graphical depiction of the Kakwani index in Figure 4, shows a situation where the concentration coefficient of taxes (tax liability curve) is far greater than the Lorenz curve of the gross taxable income, which means that the tax schedule is progressive.



Source: Author's calculations based on data from the wave 4 and 5 NIDS survey.

Figure 4: Graphical Depiction of the Kakwani Measure of Tax Progressivity

This paper also proposes a new measurement of the progressivity of taxation called the Income Elasticity of Tax Revenue (ETR), which is a less orthodox measure of tax progressivity. For the elasticity of tax revenue, assume a small amount x of a percent increase in the gross taxable

income of every individual, and then estimate the proportion by which tax revenue increases at this percent. The higher this latter percentage change, the higher the progressivity. This is defined as:

$$ETR = \frac{\partial TR}{\partial y^g} * \frac{y^g}{TR}$$

So, say, $TR = y^g - y^n$ and y^g increases by five percent. This leads to $TR_x = y_x^g - y_x^n$, where y_x^g and y_x^n are the gross and net taxable income for the x percent increment; and TR and TR_x are the tax revenue generated from the initial income distribution and from the new income distribution with the x percent increase in income. If the percentage change between TR and TR_x is greater than x percent, then the tax schedule is progressive, if it is equal to x percent it is proportional, and if it is less than x percent it is regressive.

Table 3 reports the summary statistics of the three-tax progressivity measures used for this study, using the NIDS dataset. All the three measures verify that the tax schedule for South Africa is indeed progressive. The results of the third measure show that the percentage change due to the five percent increase in gross taxable income for every household is approximately 8.1 percent, which is greater than 5 percent, therefore the tax system is progressive.

Table 3: Summary Statistics of Tax Progressive Measures

Progressivity Measure	Index
Musgrave-Thin redistributive effect	1.121
Kakwani progressivity index	0.304
Income elasticity of tax revenue	0.081

3.3. Measurement of Inequality

The distribution of income can be defined in terms of households, giving each household equal weight, or in terms of individuals, giving each individual equal weight. Since giving each household equal weight gives smaller weights to individuals in large households, it is best to give

each individual equal weight, and assume that income is shared equally among individuals in each household. While it is not clear that income is shared equally within households, there are no data on this, so there is little choice but to assume that such sharing takes place, which is standard in the income distribution literature. Therefore, in this study the individual is chosen as the main unit of analysis, and household income is assumed to be distributed equally among household members. There are many possible inequality measures, but any measure should satisfy five key axioms; mean independence, population size independence, symmetry, Pigou-Dalton transfer sensitivity, and decomposability (Foster, 1982).

The mean independence condition holds if a change in all incomes by a given proportion *k* does not change the measure of inequality. Population size independence holds if the inequality measure remains unchanged in the presence of an equal increase or decrease in the population size at all income levels. Pigou-Dalton transfer sensitivity holds when an income transfer from a wealthier individual to a poorer individual that does not make the latter wealthier than the former brings about a decrease in the inequality measure. Symmetry is satisfied when two individuals switch their incomes: the measure of inequality should remain unchanged. There are two separate types of decomposability: group decomposability and income source decomposability, this paper focuses on group decomposability.

The Theil T and Theil L are the most commonly used inequality measures (World Bank, 2005), and they satisfy all axioms above. Therefore, the two inequality measures chosen for this study are the first Theil entropy measure (T) and the second Theil entropy measure (L).[13] These inequality measures are defined as:

[13] Also referred to as the mean log deviation measure.

$$T = T_{\alpha=1} = \frac{1}{N_g}\sum_{g=1}^{G}(\frac{y_g^n}{\mu}) \ln\left(\frac{y_g^n}{\mu}\right) = \sum_{g=1}^{G}(\frac{y_g^n}{Y})\, T_g + \sum_{g=1}^{G}(\frac{y_g^n}{Y}) \ln\,(\frac{y_g^n/Y}{N_g/G}) \quad (5)$$

$$L = T_{\alpha=0} = \frac{1}{N_g}\sum_{g=1}^{G} ln(\frac{\mu}{y_g^n}) = \sum_{g=1}^{G}(\frac{N_g}{G})\, L_g + \sum_{g=1}^{G}(\frac{N_g}{G}) \ln\,(\frac{N_g/G}{y_g^n/Y}) \quad (6)$$

Where $\mu = \frac{1}{N_g}\sum_{g=1}^{G} y_g^n$ is the mean income for the whole population; Y is the total income of the population; y_g^n is total income of group g; N_g is the population in group g; G is the total population; T_g and L_g are the respective inequality coefficient for group g.

The first term to the right of the second equal sign of the Theil measure equations (5) and (6) is the within-group inequality, and the second term is the between-group inequality measure. The difference between T and L is that T is more sensitive to the differences at the upper end of the income distribution whereas L is more sensitive to the differences at the lower end of the distribution.

3.4. Universal Basic Income Measure for South Africa

More than two decades after the first democratic elections in 1994, persistent poverty and inequality and a lack of wage employment remain as major problems in South Africa. This may threaten the country's political stability and commitment to social justice (Barchiesi, 2007). Reducing inequality and poverty will require a massive intervention by the South African government, possibly with support from the private sector, labor organization and civil society (BIG Financing Group, 2004). A universal basic income (UBI) is one intervention that should be considered in this regard, although it will not be a cure-all for South Africa's economic and social challenges. UBI could also be an alternative for strengthening some shortcomings in South Africa's current social protection system. This is because the current means-tested programs have

limited coverage and most poor households do not receive social assistance (BIG Financing Group, 2004).

The White Paper for Social Welfare – the basic framework proposed to increase social welfare in South Africa - which was adopted in 1997, proposed a social protection system for South Africa, and a universal basic income was a piece of its vision. This led to the formal proposal by the South African Basic Income Grant (BIG) Coalition, which has led to heated debate among stakeholders and policymakers for nearly two decades. The BIG Coalition, COSATU,[14] and the DA[15] are proponents of this grant in one way or another. In contrast, the ANC[16] and the current South African government oppose it, and the government has declined to implement it because it claims that UBI is very costly (BIG Financing Group, 2004; Lombard, 2008).

However, the BIG coalition is still advocating for a universal, non-means-tested grant of at least R100 per month; which could help reduce poverty, encourage local consumption, and establish sustainable livelihoods. Possibly, this is because the current means-tested programs have failed the poor. Also, the coalition has conducted non-experimental studies which it claims show that BIG is the most efficient policy option for alleviating extreme poverty and inequality. Despite this dialogue, there is no pilot study or empirical evidence on UBI in South Africa.

The World Bank report "Taking on Inequality" shows that poverty reduction generally leads to inequality reduction. For example, in Brazil, Cambodia, and Peru, substantial declines in poverty led to meaningful reduction in inequality (World Bank, 2016). To provide empirical evidence on the likely effect of implementing UBI in South Africa, this paper uses the 2015 and 2017 South African national poverty lines to set three possible amounts for a UBI scheme, one

[14] Congress of South African Trade Unions
[15] Democratic Alliance
[16] African National Congress

based on the food poverty line, the second based on the lower-bound general (food plus nonfood) poverty line, and the third based on the upper-bound general poverty line (Stats SA, 2018). The lower and upper general poverty lines include both food and non-food components of minimal levels of household consumption expenditure. The food poverty line – the amount an individual requires to afford the necessary daily minimum energy intake - is R441 (2015) and R531 (2017) per individual per month. It is also called the extreme poverty line.

The lower-bound general poverty line is defined as the sum of the food poverty line and the average amount spent on non-food items of households whose total expenditure is equal to the food poverty line. The upper-bound general poverty line is defined as the food poverty line plus the average amount spent on non-food items by households whose food expenditure is equal to the food poverty line. The lower poverty line is R647 (2015) and R758 (2017) per individual per month, and the upper poverty line is R992 (2015) and R1,138 (2017) per individual per month (Stats SA, 2018).

Table 4: Inflation-adjusted Poverty Lines and Total Budget Required to Fund UBI and TCT

	Food (Rand)	**Upper-bound (Rand)**
2015		
Poverty line (Rand/person/month)	441	992
Poverty line (Rand/person/year)	5,292	11,904
2017		
Poverty line (Rand/person/month)	531	1,138
Poverty line (Rand/person/year)	6,372	13,656
Total budget required		
UBI	285.1 billion	624.8 billion
TCT	0.000	132 billion

NB: The poverty lines multiplied by the total population in South Africa equals the total budget require to fund UBI, and for TCT only for those targeted to receive the transfer.

In this study, I utilize the food and the upper-bound poverty lines, which are reported in Table 4. These poverty lines are applied to the sample of 12,303 households and then multiplied by the household weight to expand the sample size to South Africa's population size. In so doing, I

generate the total budget required to fund a UBI or a TCT for South Africa's population (equal to the cost of a UBI or a TCT set at the poverty lines). This derived total budget equals the total revenue the government needs to finance the different amounts of UBI (for all households), and TCT (for targeted households only).

3.5. Targeted Cash Transfer: Methods and Measures of Targeting

Unlike developed countries, where income is readily observable for most of the population, developing countries have a large fraction of the labor force working in the informal sector, whose incomes are not easily observed. This may lead to an inequitable redistribution through the tax system, which could make implementation of a TCT alongside a progressive taxation more complicated in a developing country (Hanna and Olken, 2019). Most governments in developing countries target poor and vulnerable people to receive social grants through various methods of targeting, including, proxy means-testing, community-based targeting, geographic targeting, and self-targeting (del Ninno, Carlo, and Mills 2015).

An alternative to UBI is a targeted cash transfer, but how can these transfers be targeted if households' incomes are not observed? This paper explores the use of proxy-means tests (PMT) to target poor households to receive a targeted cash transfer. The PMT method is used in many developing countries, such as Indonesia, Pakistan, Nigeria, Mexico, the Philippines, Burkina Faso, Ecuador, and Jamaica (Fiszbein and Schady, 2009). Basically, a PMT is used to predict income or per capita consumption expenditure using observable household characteristics such as ownership of consumer durables or assets, demographic variables, and attributes of the household head. The predicted income or per capita consumption is then used for means-testing, that is to determine whether a household, or an individual, is eligible for benefits. If the predicted income or expenditure is below a certain chosen threshold, then a household or an individual is considered

eligible for benefits; and if the predicted income or expenditure is above the chosen threshold then the household or individual is ineligible for benefits.

This paper employs a regression-based PMT to identify poor households that should then be eligible to receive a lump sum transfer, using ordinary least squares (OLS) regression to predict the household poverty status. This regression is applied to the NIDS survey data and then used to make out-of-sample predictions for the relevant population. In order to perform the out-of-sample tests, the initial sample is randomly split into equally sized calibration (training or estimating) and validation (test) samples. The calibration sample is to regress monthly household per-capita consumption on 56 indicator variables. The indicator variables chosen for this estimation are based on their verifiability and on their correlation with household per-capita consumption. Monthly per-capita consumption is then predicted for each household in the validation sample using the coefficients from the calibration regression, in order to check the fit of the model.

Afterwards, these coefficients are used to estimate proxy-mean test (PMT) scores for each household in the validation sample, for targeting purposes. The actual per-capita consumption used in the regression is logged, so the log predicted per-capita consumption is multiplied by 100 to create the PMT score for a household. The OLS model has an R-squared of 0.74, which implies that the regression has a good level of explanatory power.

Predictions of income and consumption using regression-based PMT inevitably lead to imperfect targeting and thus to inclusion (type II) and exclusion errors (type I). Inclusion errors wrongly include households predicted to have a per-capita consumption below the poverty line whereas their actual per-capita consumption is above the poverty line. Exclusion errors exclude households that are in the target population based on their actual per-capita consumption being below the poverty line, but are predicted to be above the poverty line. The accuracy of the PMT

for targeting purposes is displayed graphically in Figure 5, with plots actual per-capita consumption against predicted per-capita consumption. Four quadrants are in the figure, correct inclusion, correct exclusion, inclusion error, and exclusion error.

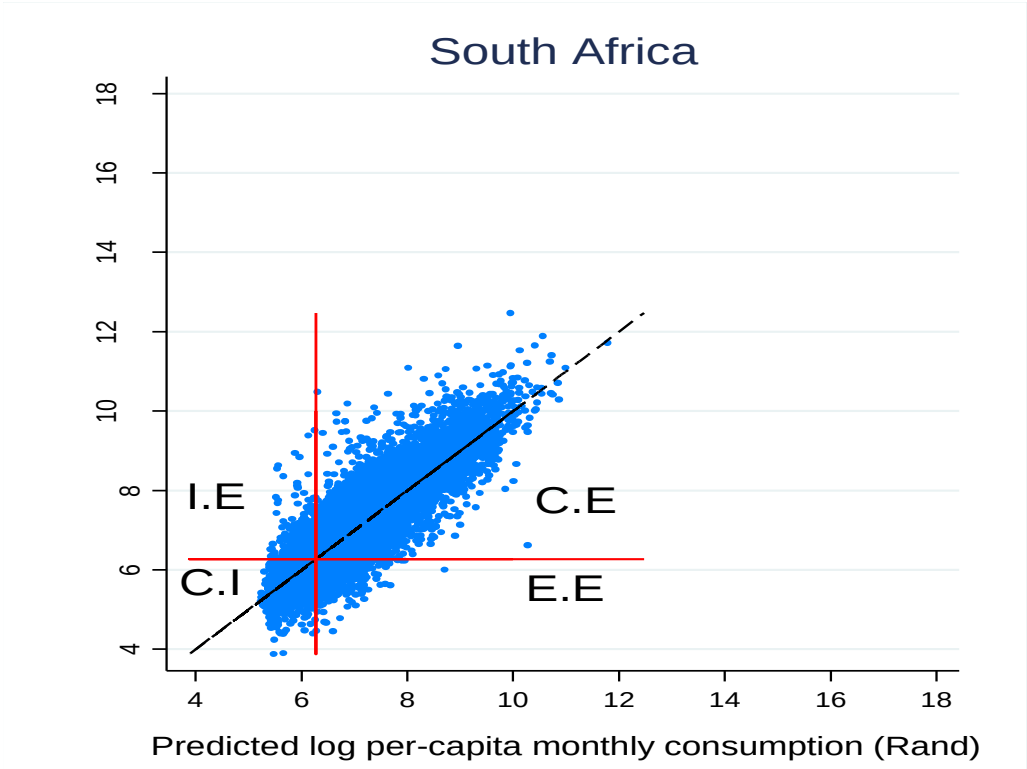


Figure 5: Actual and Predicted Household Per Capita Consumption (logged values)
Source: This is from the regression using basic PMT variables. The red lines represent the country's poverty line at the 35th percentile in logged values. Points in the top left quadrant are incorrectly predicted as poor (inclusion errors). Points in the bottom right quadrant are incorrectly predicted as non-poor (exclusion errors). Points in the bottom left and top right quadrants are correctly predicted as poor and non-poor respectively. The dashed line is a 45 degrees line.

In modeling the TCT program for this study, households are targeted using the food and upper poverty lines as thresholds, and also as the transfer amount. Households that are below the food poverty line are considered extremely poor and those below the upper poverty line are considered poor. The analysis based on the food poverty line classifies as poor any household whose predicted per capita consumption is less than that poverty line, and given all such households a transfer equal to the food poverty line. Whereas the analysis based on the upper

(general) poverty line classifies as poor any household whose predicted per capita consumption is less than that poverty line, and given all such households a transfer equal to the upper poverty line.

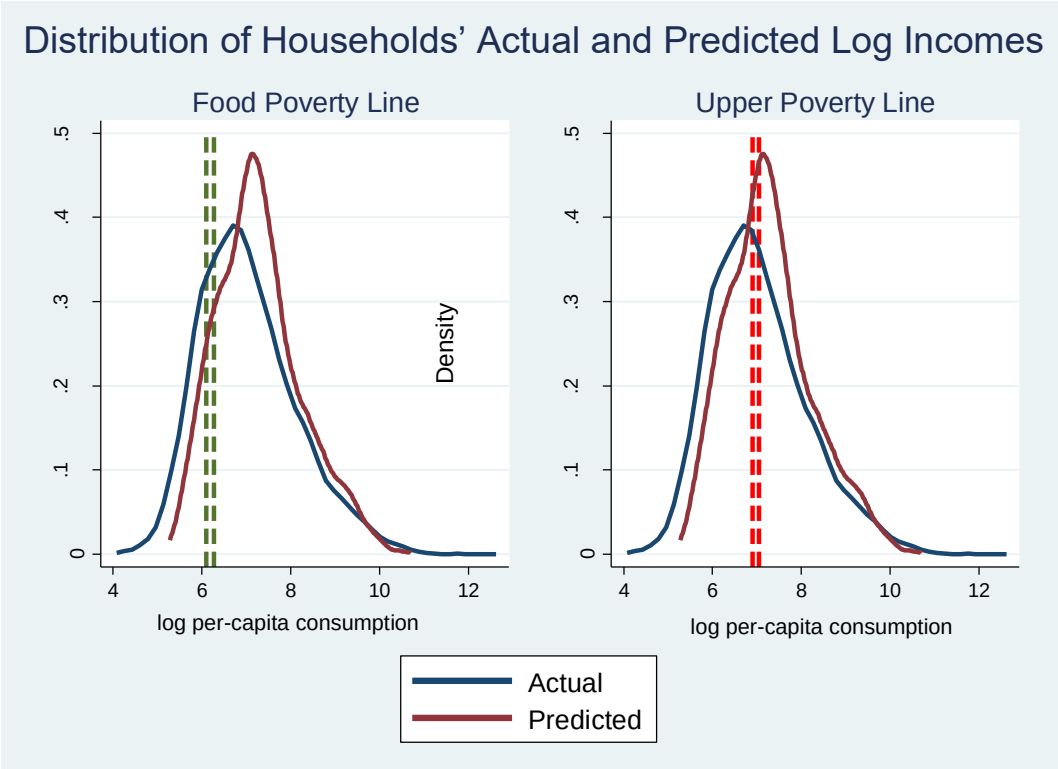


Figure 6: Distribution of Households' Actual and Predicted Log Incomes
NB: The green lines are for the food poverty line (2015 and 2017) and the orange red lines are for the upper poverty line. The households with predicted consumption less than the poverty lines are targeted and to receive transfers under the TCT policy.

Consumption is used for the PMT regressions instead of income, for three main reasons: 1) difficulties in ascertaining income in a survey or straightforward means test; 2) smoothing of consumption (likely to fluctuate over time less than income); 3) more likely to reduce the extent of inequality between wealthier and poorer households because the wealthy tend to spend a smaller proportion of their income. The method of estimating regression-based PMT models is used, as specified below.

$$y_{it} = \alpha_t + \beta_t \boldsymbol{X_{it}} + \varepsilon_{it}; \qquad (i = 1, \ldots \ldots N_{it}); \qquad \hat{y}_{it} = \hat{\alpha}_t + \hat{\beta}_t \boldsymbol{X_{it}}$$

where y_{it} is log consumption expenditure per capita of household *i* in year *t*, $\boldsymbol{X_{it}}$ is a vector of covariates (assets and others), N_{it} is the survey sample size, and $\hat{\alpha}_t$ and $\hat{\beta}_t$ are estimated coefficients from an OLS regression. The PMT results are reported in appendix Table 21. Figure 6 shows the distribution of households' actual and predicted log incomes, as well as the food poverty lines (in blue) and the upper poverty line (in red).

3.6. Descriptive Statistics

Table 5 provides summary statistics for income, expenditure types, net-worth, and household size, at the individual level of the data. The means of gross and net taxable income are R60,239 and R51,006, respectively. The net aggregate income is the income variable in the original data, and the net taxable income is the income variable derived from applying the tax codes to this net aggregate income in order to create gross taxable income and tax liability. The net taxable and the net aggregate income are different because of the lack of data on some taxes such as deductions, exemptions, and other credits.

Total expenditure is the sum of food, nonfood, and rent expenditure. The coefficient of variation of households' net-worth (9.45) is far larger than the coefficient of variation of the income variables. This suggests there is a substantial heterogeneity in the distribution of household wealth, which is consistent with the evidence that wealth is much more unequally distributed than income (Orthofer, 2016). Tax liability is the tax revenue generated by the government from the tax paid by individuals.

Descriptive statistics by race, province, geographical type, and household head education are provided in Table 6. The geographical type variable has three categories - traditional, urban, and farms - but this uses only two categories, urban and rural, by combining traditional and farms

observations together as rural. The majority of the household sample population for this study are Africans (78%), followed by Colored (10%), white (8.6%), and Asian/Indian (2.8%).

Table 5: Summary Statistics of Variables (yearly and weighted)

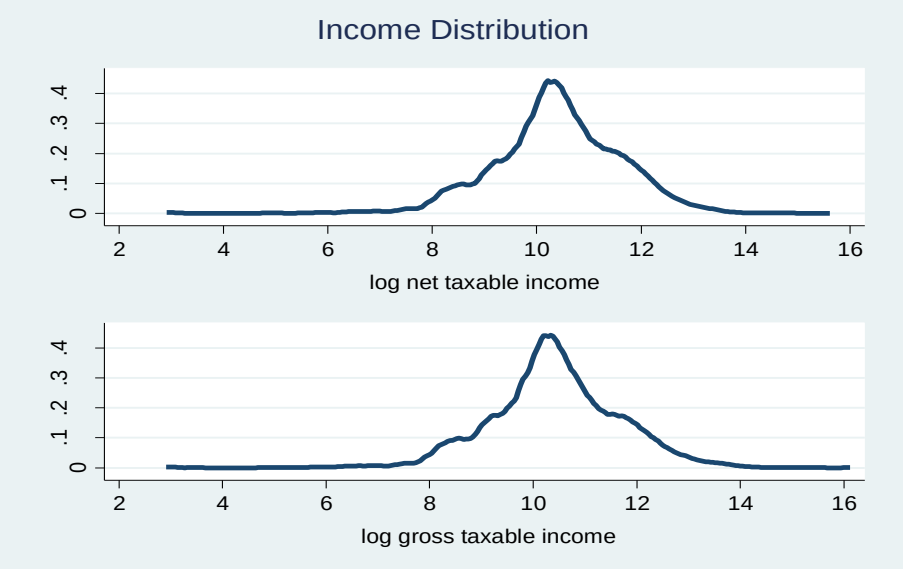
Variable	Mean (Rand)	SD (Rand)	CV
Variables from data:			
Aggregate net income (labor)	53,483	120,833	2.26
Food expenditure	7,054	25,223	3.58
Nonfood expenditure	22,561	55,466	2.46
Rent expenditure	9,753	16,546	1.70
Total expenditure	38,951	79,321	2.04
Net worth	4,084,624	38,600,000	9.45
Labor income	45,405	86,590	1.91
Household size	4.46	3.20	0.72
Created variables:			
Gross taxable income	60,239	178,355	2.96
Net taxable income	51,006	120,878	2.37

Statistics is done at the individual level. Number of observations: 29,703. CV is coefficient of variation, ratio of SD to mean, all values are weighted

The geographical type variable classifies almost two thirds (65%) of the households as living in urban settings, and slightly more than one-third (35%) in rural areas. South Africa has nine provinces, including Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, and Limpopo. A highest proportion of households are located in Gauteng (29.9%), KwaZulu-Natal (18%), and Western Cape (13.6%). The education level of the household head is categorized into primary, lower secondary, upper secondary, tertiary (non-university and university), and those with no education.

Table 6: Distribution of Population by Race, Province, Geography, and Household Head Education (weighted)

Variable	Frequency	Percent
Race		
African	38,134,779	78.0
Colored	5,183,643	10.6
Asian/Indian	1,349,665	2.8
White	4,206,363	8.6
Province		
Western Cape	6,665,421	13.6
Eastern Cape	4,388,273	9.0
Northern Cape	1,200,789	2.5
Free State	2,430,266	5.0
KwaZulu-Natal	8,810,592	18.0
North West	2,827,586	5.8
Gauteng	14,610,533	29.9
Mpumalanga	3,954,262	8.1
Limpopo	3,986,727	8.2
Geographical type		
Rural	13,994,040	28.6
Urban	34,880,409	71.4
Household head education		
no education	1,013,616	4.4
lower secondary	3,693,425	16.1
upper secondary	7,666,734	33.4
tertiary (non-university)	2,211,557	9.6
tertiary (university)	6,154,145	26.8



Source: Author's calculations based on data from the wave 4 & 5 NIDS survey.

Figure 7: Distribution of Log Gross and Net Taxable Income

Table 7: Distribution of Taxable Income (Decile group)

Decile	Mean gross income levels (Rand)	Gross taxable income (%)	Mean net income levels (Rand)	Net taxable income (%)
1	5,122	0.58	5,122	0.68
2	12,607	1.20	12,607	1.41
3	20,296	2.11	20,296	2.49
4	27,739	2.86	27,739	3.37
5	35,294	3.74	35,294	4.41
6	46,266	4.70	46,266	5.53
7	63,644	6.64	63,639	7.84
8	97,121	10.01	93,116	11.30
9	158,713	16.49	143,791	17.69
10	498,906	51.67	373,347	45.29

Table describes the share of gross and net taxable income from decile 1 (poorest 10% of individuals) to decile 10 (richest 10% of individuals)

4. Empirical Methodology

This section explains the main concepts and the methodology used to evaluate the degree to which UBI and TCT, funded by a progressive income tax, can reduce income inequality in South Africa. This is done using the data from Waves 4 and 5 of the National Income Dynamics Study (NIDS). This section consists of two parts. First, it estimates income inequality using the two Theil inequality measures and the current distribution of income, that is, without adjusting for UBI or TCT. Second, it presents a policy simulation that uses increase in progressive income tax rates to finance either UBI or TCT, in order to examine how the extra revenue generated from a progressive tax schedule can be used to finance UBI or TCT, and the degree to which this can reduce income inequality.

4.1. Estimation of Income Inequality under Tax Progressivity without UBI or TCT

This subsection uses the net taxable income variable and equations (5) and (6) to estimate the two Theil inequality measures, applying the group decomposition property of those measures to different groups in the population. The sample is divided into subgroups by race, geographical type, province, and household head education. The two Theil measures, T and L, are estimated using the net (post-tax) distribution of income under the existing progressive South African tax structure, without taking into account UBI or TCT.

The two Theil measures of income inequality can be used to decompose overall inequality into the sum of the (weighted average of) inequality within each group and the inequality between the groups, which can be written as:

$$I_{Total} = I_{Within} + I_{Between} \qquad (7)$$

This decomposition can be used to calculate the contribution of income inequality within the subgroups to overall income inequality. The between-group component calculates the contribution to overall inequality of the variation in mean income across subgroups.

4.2. Policy Simulation of Marginal Tax Rate: Progressive Taxation

I conducted policy simulations to examine how the distribution of net taxable income would change under different tax schedule scenarios, simulating a 10%, 50%, and 110% increase in the marginal tax rate of all tax brackets in the South African tax codes for the UBI program. I simulated 10% and 50% for TCT.

These simulations aim to generate the adequate tax revenue to finance UBI or TCT at the food poverty line and upper poverty line levels, for all individuals in the household. The required total budget needed to finance the food poverty line and upper poverty line for UBI amounts to R285.1 billion and R624.8billion and the amount required to fund TCT amounts to R0 and R132 billion respectively. No household was targeted at the food poverty line, so there is zero budget for that. Initially, assume that there is no change in the work hours of household members, which means that their gross taxable income remains unchanged, but their net taxable income will change according to the change in the marginal tax rate.

Equation (5) is used to increase the marginal tax rate from t to t_k, assuming that y^g remains the same since work hours are constant. This y^n reduces to y_k^n. An increase in the marginal tax rate increases the fixed tax amount from F to F_k. The new net (after-tax) income due to the increase in the marginal tax rate is calculated as follows:

$$y_k^n = y^g(1 - t_k) + t_k L - F_k + r \qquad (8)$$

where the subscript k refers to the percent by which the old tax rate increases (10, 50, or 110 percent). To calculate the total revenue generated, I first use the difference between the gross

taxable income y^g and the initial net taxable income y^n to obtain the initial tax revenue (R_{old}). I then calculate the difference between the old gross taxable income y^g and the new net taxable income y_k^n to obtain the new tax revenue (R_{new}). Lastly, I calculate the difference between the new tax revenue (R_{new}) and the initial tax revenue (R_{old}) to obtain the additional increase in revenue (R_{add}). To examine the impact of UBI funded by a k percent increase in taxes on the distribution of income, just add y_k^n and UBI to get Y_{UBI}^n, using the equation:

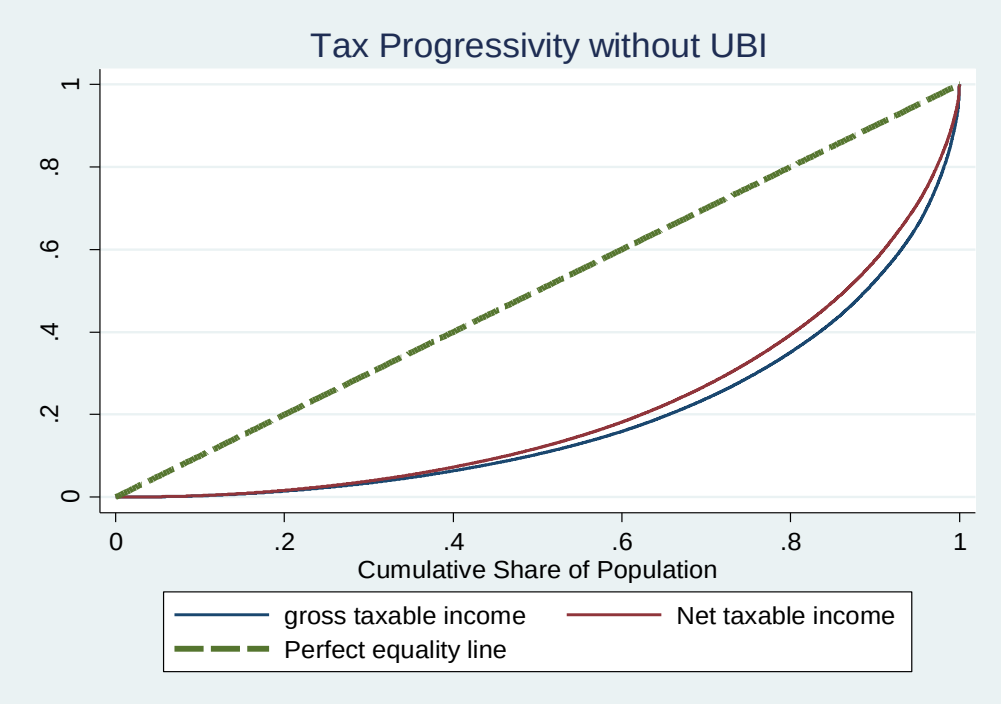
$$Y_{UBI}^n = y_k^n + UBI \qquad \text{where } y_k^n = y^n - R_{add}$$

Finally, this new distribution of net income is used to calculate new estimates of the Theil inequality, T and L, using equations (5) and (6), except that y^n is replaced by Y_{UBI}^n. The same simulation method above is used for the TCT program, to generate a different additional revenue that can fully fund the TCT budget. Finally, the change in the distribution of income under UBI and TCT are compared.

5. Results and Discussion

5.1. Effect of Tax Progressivity on Inequality and its Decomposition (without UBI or TCT)

Figure 8 depicts the effect of progressive taxation on overall income inequality by comparing the Lorenz curves for gross and net taxable income across individuals in a household. The Lorenz curve provides more information than the Gini coefficient, which expresses income inequality as a single number. This graph shows that income inequality is somewhat reduced by progressive taxation, because the Lorenz curve of the net taxable income (Gini: 0.59) is slightly above the Lorenz curve of the gross taxable income (Gini: 0.63). This is consistent with the literature that redistribution of taxes and transfers in South Africa reduces income inequality moderately (Inchauste et. al., 2015; Woolard et. al., 2015).



Source: Author's calculations based on data from the wave 4 & 5 NIDS survey.

Figure 8: Reduction in Income Inequality under Progressive Taxation without a UBI or TCT

Tables 9, 12, 15, and 18 present estimates of the Theil index T and L that describes the group decomposition of income inequality by race, geographical type, province, and household head

education. Before discussing these results, it should be recognized that the appropriate comparison to make is among the different groups for a particular inequality measure (say T or L); because nothing is earned by comparing different measures for a particular group. For example, one can point out that for both measures urban inequality is greater than rural inequality, but one cannot say that the T measure gives more inequality than the L measure.

Table 9 presents the inequality decomposition by race. Both Theil indices show that inequality among the Colored (0.73; 0.73)[17] group is very large, followed by those of Africa, Asian/Indian, and White groups respectively. However, inequality at the national (country) level (0.80; 0.70) is more pronounced than the Colored group inequality. In addition, the White (0.49; 0.43) and the Asian/Indian subgroup (0.50; 0.50) have the lowest levels of inequality, yet they still remain high. This gives a clear picture of the high inequality in South Africa, and which remains the most racially unequal country in the entire world (Seekings and Nattrass, 2005; World Bank, 2018).

One information use of these decompositions is to show that the share of the total income inequality due to differences in mean incomes of different racial groups, that is the between-group component, is quite small (14%; 20%) compared to the share of inequality within the racial groups, the within-group component (86%; 80%). Therefore, there is substantial inequity within all four races, and the contribution of the between race disparities to overall income inequality is relatively small. This is consistent with the World Bank (2005) report, which states that within-group inequality contributes at least three-quarters to overall income inequality in South Africa, and the between-group component contributes at most one quarter. But, if there is random measurement

[17] The first percent value is for L and the second is for T; the same is for all parentheses with two numbers.

error in incomes, which is quite likely, then the between-group component will be underestimated, and the within-group and overall inequality will be overestimated.

The inequality decomposition by geographical type is reported in Table 12. The two measures indicate that rural inequality (0.79; 0.64) is greater than urban inequality (0.76; 0.68) but less than the country level inequality (0.80; 0.70). It is clear that income inequality is extremely high in both rural and urban settings. Relative to the inequality by race decomposition, the between-group inequality in this case contributes very little to overall inequality, less than four percent of the total inequality in both measures. This means that differences between urban and rural sectors contribute very little to total inequality, but instead, there is a substantial disparity within each of these sectors that accounts for more than 95 percent of overall inequality.

Table 15 shows that inequality is very high in all nine provinces, but it is particularly high in Limpopo, Eastern Cape, Mpumalanga, KwaZulu-Natal, and Free-state provinces. Western Cape, Northern Cape, and North-West provinces have the lowest inequality of all the nine provinces. In the same manner as race and geographical type, between-group inequality contributes a very tiny proportion to overall inequality, with the within-group inequality contributing more than 94 percent. This reflects the large inequity within each of the nine provinces.

Finally, the decomposition by the household head's education in Table 18 shows that households headed by someone with no education have high inequality (0.74; 0.62) than all households with at least some form of education for its household heads. Households with a head that has a university degree have the lowest levels of inequality (0.56; 0.50) of all the other education levels. Compared to the decomposition by race, geographical type, and province, the between-group inequality (22%; 25%) contributes a substantial amount to overall inequality, yet

the within-group inequality (77%; 75%) still remains far larger than the between group inequality in this case.

6.2 UBI versus TCT Funded with Tax Progressivity, and its Effect on Inequality

The results of the policy simulation that evaluates how UBI and TCT, financed with progressive taxation are presented in Table 8 and Figure 8. Table 8 provides information on the total tax revenue and marginal tax revenue (relative to the initial revenue) generated from increases in marginal tax rate, separately for UBI and TCT. At the initial total tax revenue, the marginal revenue is 0 since there is no change in the tax rate. The additional tax revenue generated from 10 percent increment is very small and is insufficient to fund UBI at either poverty line and TCT at the upper poverty line. It can fund less than a quarter of the total budget required to finance the food poverty line and the upper-bound poverty line UBI, and for TCT upper-bound poverty line.

The total expenditure required by the South African government to fully fund the upper general poverty line UBI would necessitate a 110 percent increase in marginal tax rate, which generates additional revenue of R635.7 billion (total budget: 624.8 billion). For the food poverty line UBI, the government requires an expenditure of R288.8 billion (total budget: 285.1 billion), which necessitates a 50 percent increase in the marginal tax rate to fully fund it. For the TCT, no household was targeted at the food poverty line threshold. The cost required to fully fund the upper general poverty line TCT is R142.1 billion (total budget: 132 billion), which implies a 50 percent increase in the marginal tax rate. A graphical depiction of how UBI and TCT are fully financed through this policy simulation exercise is provided in Figure 9.

Figures 10 and 11 gives a graphical representation of how much overall income inequality is reduced by UBI and TCT that are funded via tax progressivity. These graphs are described by comparing the Lorenz curve of the initial net taxable income without UBI and TCT to the Lorenz

curves of the new net taxable incomes with UBI and TCT. In the case of UBI, Figure 10 reveals that the decline in overall income inequality is larger for the net taxable incomes with UBI, compared to the net taxable income without a UBI. This is the same for TCT in Figure 11. Further, it can be seen from the two figures that a reduction in overall income inequality increases with higher percent increment in marginal tax rate. This is true even in the case where the additional tax revenue generated are not enough to fully fund UBI or TCT.

The estimates of the Theil index T and L on how much overall income inequality and its decomposition is reduced under UBI financed with tax progressivity are presented in Tables 10, 11, 13, 14, 16, 17, 19, and 20. Table 10, shows a large decrease in income inequality for the African (food: 0.40, 0.41; upper: 0.30; 0.31), Colored (food: 0.46, 0.55; upper: 0.35; 0.43), Asian/Indian (food: 0.36, 0.40; upper: 0.30; 0.33), and White (food: 0.40, 0.38; upper: 0.35; 0.35) populations, and for the country (food: 0.49, 0.52; upper: 0.37; 0.41), as a whole; with a 10 percent increase in marginal tax rate. The fall in income inequality for a 50 and 110 percent increase in marginal tax rate, is slightly larger than the10 percent increment. This huge fall in income inequality for all tax scenarios is relative to the findings in Table 9, which does not take into account UBI.

Income inequality decompositions by geographical type, province, and household head education show a similar pattern of results of the drop in income inequality, even with a partial funding of UBI. In a nutshell, this suggests the government may focus on at least the food poverty line UBI, which can be partially (66% of the total budget) funded by a 10 percent increase in marginal tax rate and fully fund at 50 percent increase in marginal tax rate. Also, UBI can be partially financed with an additional revenue generated from progressive taxation and still have a large reduction in income inequality.

Finally, it can be verified from this results that tax progressivity alone reduces income inequality by less than tax progressivity implemented with a UBI. This is because income inequality reduction through the progressive taxation without UBI is far smaller than the reduction under UBI financed with progressive taxation.

6. 3 Compare UBI and TCT

The same results hold when a TCT program is financed through a progressive tax system, except that, at the food poverty line amount, income inequality is not reduced since there was no transfers to any household. This is because no household was targeted to receive food bound transfer unlike in case where about half of the population are targeted to receive upper bound transfer. Though, the TCT program can fully finance total upper budget at 50 percent increase in marginal tax rate unlike UBI at 110 percent, it does not reduce inequality that much compared to UBI even at 50 percent increment with partial funding. This because of the imperfect targeting from the TCT program which could lead to inclusion error rate (food: 0%; upper: 11%), exclusion error rate (food: 12%%; upper: 7%), and poor coverage rate (food: 87%; upper: 92%), So, though a smaller proportion of the population can be targeted with a fully funded budget required to finance it, inequality still remains very high, with a minute reduction or no change, in the case of TCT finance with total upper bound budget. Therefore, the two main trade-offs between UBI and TCT are costs of the program and the poor methods of targeting households.

In comparing, for instance the TCT and UBI funded at 50 percent increment for the upper poverty line and race population, we have, African (TCT: 0.43, 0.40; UBI: 0.27; 0.28), Colored (TCT: 0.66, 0.89; UBI: 0.31; 0.36), Asian/Indian (TCT: 0.53, 0.54; UBI: 0.25; 0.27), and White (TCT: 0.36, 0.30; UBI: 0.30; 0.29) populations, and for the country (TCT: 0.54, 0.55; UBI: 0.33;

0.35). So, even with a partially funded budget at 50 percent marginal tax rate for UBI, inequality is reduced more than TCT with a fully funded budget at 50 percent increase in marginal tax rate.

7. Conclusion

In this paper, I investigated the impact of a universal basic income (UBI) versus a targeted cash transfer (TCT) funded through progressive taxation on household level income inequality. I analyze the case of South Africa, which has one of the world's most progressive tax systems, yet it is bedeviled by the worlds' highest income inequality. Empirically, the results show that UBI or TCT implemented simultaneously with progressive taxation reduces income inequality more than a progressive taxation without UBI or TCT.

I made three major contributions to the literature. First, I estimate the impact of progressive taxation on overall income inequality and group decomposability inequality, without considering UBI/TCT. Second, I conducted a policy simulation to examine how UBI or TCT amount can be financed with additional revenue generated from tax progressivity through a 10, 50, and 80 percent increase in marginal tax rates. I then estimated the impact of this simulation on overall income inequality and inequality by group decomposition.

I find that the overall inequality at the national level is reduced by progressive taxation policy, but only to some extent; inequality still remains high. The results of the simulation show that even with a UBI or TCT not fully funded by the additional revenue generated from the different tax increases, reduction in inequality is more than that of the reduction via progressive taxation only. The magnitude of this reduction far exceeds the reduction by progressive taxation without UBI or TCT by more than 30 percent. In all estimations, the within-group inequality contributes larger proportions to overall inequality than the between-group inequality.

TCT programs may require less budget to fully finance them than the UBI programs, however, TCT may lead to imperfect targeting with a poor coverage rate. I think, the South African government may consider implementing UBI instead of TCT, because, even with the lowest

budget require to finance TCT, income inequality is not reduced at all or that much. Also, though South Africa is a developing setting with poor and inaccurate income data coverage, we expect TCT to perform better than UBI, but it is not the case.

The evidence from this study combined with similar effects in the literature, suggests that UBI or TCT implemented in synchrony with progressive taxation can reduce income inequality in an efficient and equitable manner. But a UBI reduces income inequality far better than a TCT, even at 10 percent increase in marginal tax rate that can partially fund the total budget. Future extension of this work should investigate how non-fiscal plus fiscal policy solution tools together or separately implemented could reduce inequality.

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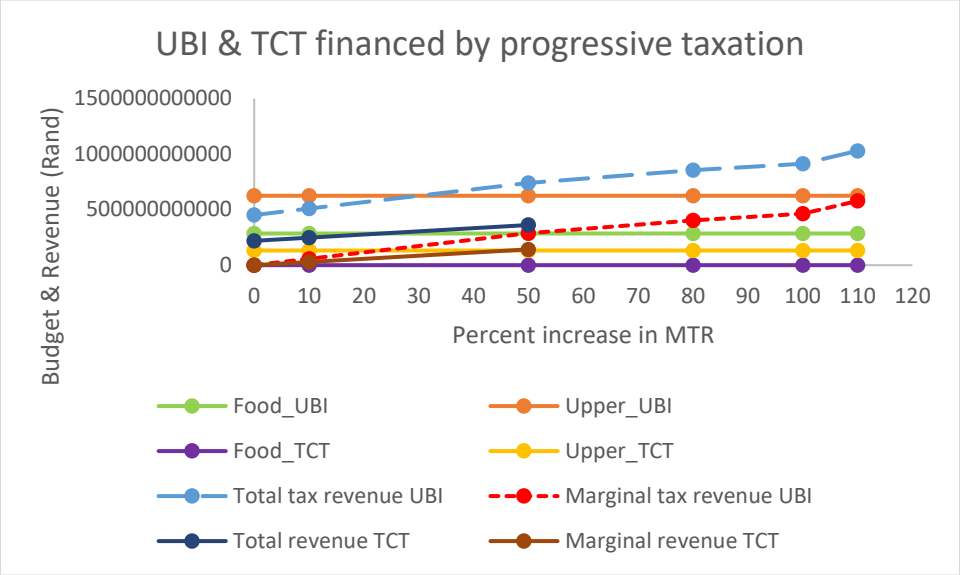
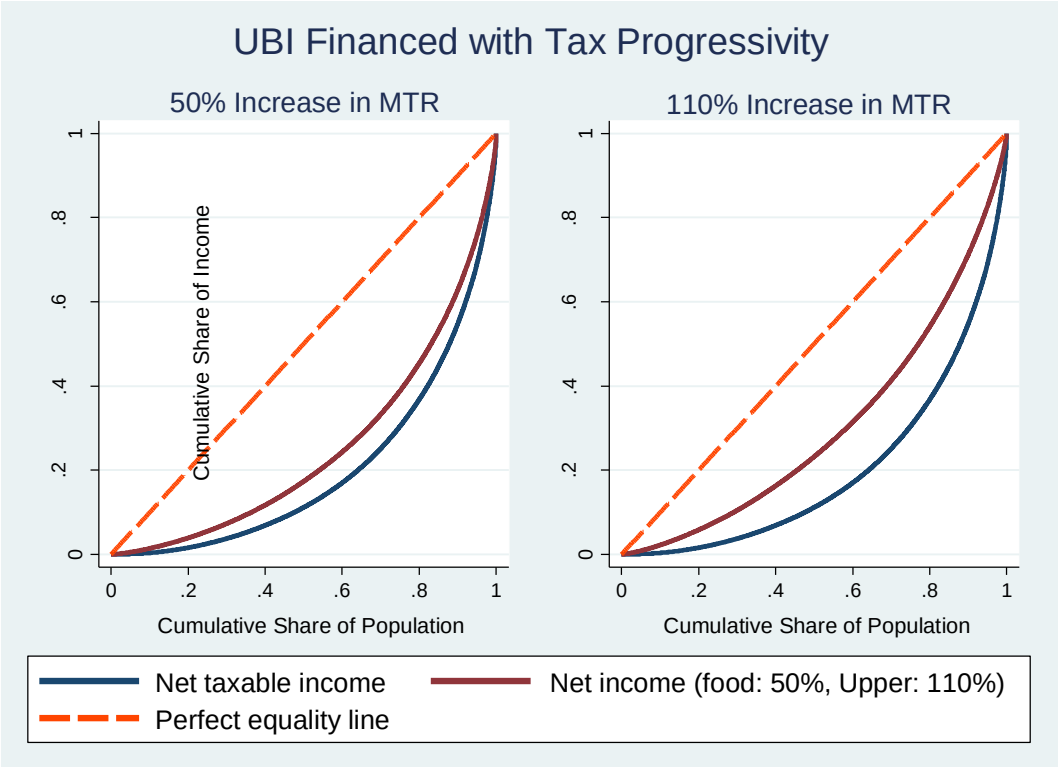
Appendix A



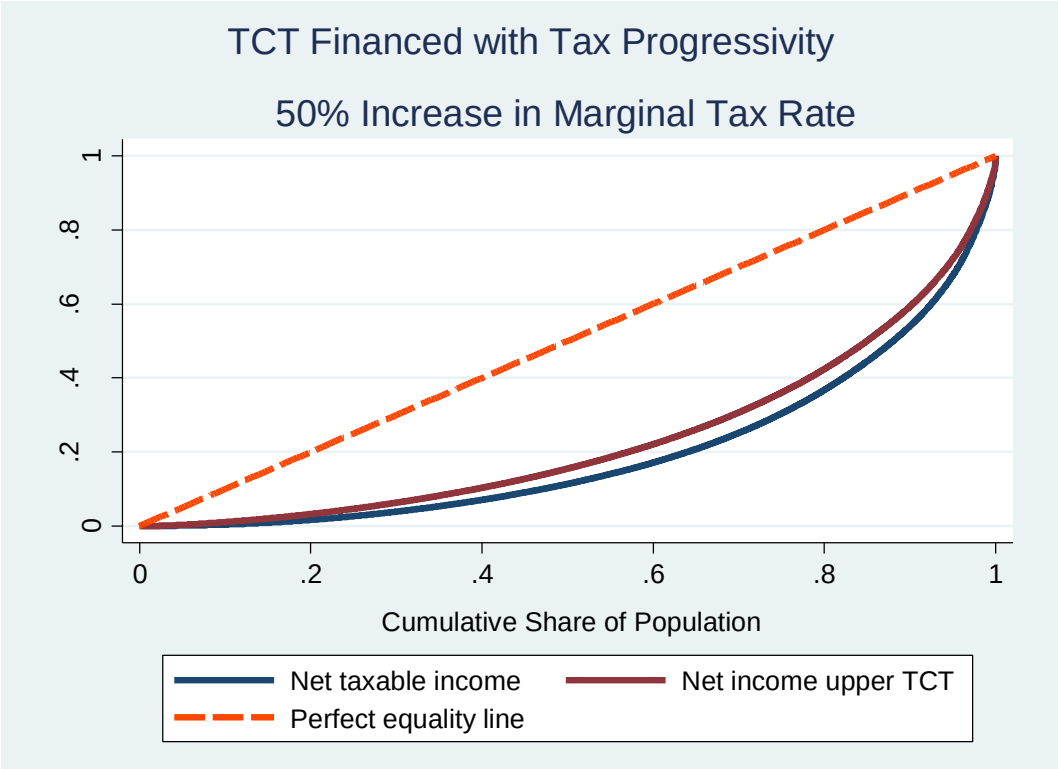
Source: Author's calculations based on data from the wave 4 & 5 NIDS survey.

Figure 9: Policy experimentation exercise on how UBI and TCT can be financed with revenue generated from progressive taxation.



Source: Author's calculations based on data from the wave 4 & 5 NIDS survey.

Figure 10: Reduction in income inequality through UBI and progressive taxation



Source: Author's calculations based on data from the wave 4 & 5 NIDS survey.

Figure 11: Reduction in income inequality through TCT and progressive taxation

Appendix B

Table 8: Total & marginal tax revenue generated from simulating % increase in MTR (weighted)

	Total tax revenue (Rand)	Additional tax revenue (Rand)
UBI		
Initial value	451.3 billion	0
10% increase in MTR	509.0 billion	57.7 billion
50% increase in MTR	740.1 billion	288.8 billion
80% increase in MTR	913.3 billion	462.1 billion
110% increase in MTR	1.087 trillion	635.7 billion
TCT		
Initial value	219.3 billion	0
10% increase in MTR	247.7 billion	28.4 billion
50% increase in MTR	361.4 billion	142.1 billion

Marginal revenue generated is used in funding UBI or TCT. I assume if marginal revenue is not enough to fully fund UBI/TCT, the rest of the amount will be sourced from total revenue and other sources.

Table 9: Income Inequality Decomposition by Race across Households (progressive taxation without UBI/TCT)

Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
GE (0) = L	0.708	0.727	0.495	0.485	0.797	0.685	0.112	14.06	85.94
GE (1) = T	0.583	0.729	0.502	0.426	0.698	0.556	0.142	20.29	79.71
Mean Income	83,236	122,610	221,526	325,444					

Table 10: Income Inequality Decomposition by Race across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	African	Colored	Asian/India	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.366	0.412	0.312	0.351	0.439	0.368	0.071	16.11	83.89
		GE (1) = T	0.365	0.466	0.332	0.324	0.453	0.366	0.087	19.11	80.89
		Mean income	93,682	128,788	208,735	284,129					
110% Increase in MTR	Upper	GE (0) = L	0.233	0.245	0.164	0.217	0.266	0.231	0.035	13.00	87.00
		GE (1) = T	0.228	0.252	0.165	0.194	0.263	0.223	0.040	15.28	84.72
		Mean income	106,066	136,093	193,461	234,515					

Table 11: Income Inequality Decomposition by Race across Households (TCT Financed with Tax Progressivity)

	UBI	Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Upper	GE (0) = L	0.432	0.664	0.529	0.358	0.539	0.452	0.086	16.04	83.96
		GE (1) = T	0.403	0.887	0.533	0.304	0.551	0.445	0.106	19.26	80.74
		Mean income	77,068	108,021	238,039	243,160					

Table 12: Income Inequality Decomposition by Geography across Households (progressive taxation without UBI/TCT)

Theil measure	Rural	Urban	National	Within	Between	% of Between	% of Within
GE (0) = L	0.790	0.757	0.797	0.767	0.030	3.90	96.25
GE (1) = T	0.636	0.679	0.698	0.671	0.027	3.87	96.13
Mean Income	72,672	127,885					

Table 13: Income Inequality Decomposition by Geography across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	Rural	Urban	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.37379	0.44385	0.43873	0.42379	0.01494	3.41	96.59
		GE (1) = T	0.36987	0.45771	0.45299	0.439	0.01398	3.09	96.91
		Mean income	86990.8	129002.35					
110% Increase in MTR	Upper	GE (0) = L	0.23769	0.26977	0.26555	0.26058	0.00497	1.87	98.13
		GE (1) = T	0.22883	0.26733	0.26278	0.25798	0.0048	1.83	98.17
		Mean income	104048	130209.97					

Table 14: Income Inequality Decomposition by Geography across Households (TCT Financed with Tax Progressivity)

	TCT	Theil measure	Rural	Urban	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Upper	GE (0) = L	0.48028	0.52046	0.5385	0.5097	0.0288	5.35	94.65
		GE (1) = T	0.43999	0.54311	0.55129	0.52541	0.02588	4.69	95.31
		Mean income	63542.9	112182.59					

Table 15: Income Inequality Decomposition by Province across Households (progressive taxation without UBI/TCT)

Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	% Between	% Within
GE (0) = L	0.674	0.918	0.671	0.728	0.797	0.782	0.014	1.81	98.19
GE (1) = T	0.690	0.683	0.560	0.560	0.698	0.684	0.014	2.00	98.00
Mean Income	120,919	85,977	86,478	79,919					

	KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
GE (0) = L	0.775	0.671	0.745	0.824	1.069
GE (1) = T	0.649	0.559	0.638	0.803	0.962
Mean Income	92,479	107,965	130,549	130,717	113,368

Table 16a: Income Inequality Decomposition by Province across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	% Between	% Within
50% Increase in MTR	Food	GE (0) = L	0.391	0.459	0.348	0.341	0.439	0.430	0.009	1.94	98.06
		GE (1) = T	0.440	0.431	0.350	0.341	0.453	0.445	0.008	1.82	98.17
		Mean income	126,582	94,259	95,295	88,359					

			KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
50% Increase in MTR	Food	GE (0) = L	0.392	0.370	0.448	0.490	0.54643
		GE (1) = T	0.389	0.360	0.444	0.531	0.6126
		Mean income	104,129	110,821	130,908	132,340	116,324

Table 16b: Income Inequality Decomposition by Province across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	% Between	% Within
110% Increase in MTR	Upper	GE (0) = L	0.233	0.280	0.214	0.199	0.266	0.261	0.004	1.63	98.37
		GE (1) = T	0.239	0.262	0.211	0.196	0.263	0.259	0.004	1.60	98.40
		Mean income	133,274	104,129	105,682	98,455					

			KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
110% Increase in MTR	Upper	GE (0) = L	0.247	0.214	0.278	0.297	0.307
		GE (1) = T	0.233	0.206	0.274	0.299	0.321
		Mean income	117,936	114,221	131,167	134,124	119,784

Table 17: Income Inequality Decomposition by Province across Households (TCT Financed with Tax Progressivity)

	TCT	Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	% Between	% Within
50% Increase in MTR	Upper	GE (0) = L	0.440	0.503	0.455	0.449	0.539	0.527	0.012	2.14	97.86
		GE (1) = T	0.428	0.450	0.480	0.401	0.551	0.540	0.011	2.04	97.96
		Mean income	94,195	71,919	81,166	82,366					

			KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
50% Increase in MTR	Upper	GE (0) = L	0.540	0.461	0.476	0.563	0.924
		GE (1) = T	0.590	0.422	0.471	0.587	0.974
		Mean income	88,028	91,876	112,250	108,027	122,074

Table 18: Income Inequality Decomposition by Household head education across Households (progressivity without UBI/TCT)

Theil measure	Primary	Secondary (L)	Secondary (Up)	Tertiary (NU)	Tertiary (U)	No education	National
GE (0) = L	0.650	0.627	0.634	0.594	0.541	0.738	0.789
GE (1) = T	0.519	0.496	0.599	0.532	0.500	0.618	0.710
Mean Income	41,202	53,814	77,348	84,291	213,849	41,670	

	Within	Between	% Between	% Within
GE (0) = L	0.610	0.179	22.65	77.35
GE (1) = T	0.529	0.181	25.49	74.50

Table 19a: Income Inequality Decomposition by Household head education across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	Primary	Secondary (L)	Secondary (Up)	Tertiary (NU)	Tertiary (U)	No education	National
50% Increase in MTR	Food	GE (0) = L	0.311	0.332	0.382	0.377	0.393	0.327	0.476
		GE (1) = T	0.308	0.322	0.407	0.381	0.384	0.340	0.492
		Mean income	54487.026	65624.914	81813.761	88977.079	190892.520	57718.738	

		Within	Between	% Between	% Within
Food	GE (0) = L	0.367	0.109	22.844	77.156
	GE (1) = T	0.379	0.114	23.089	76.911

Table 19b: Income Inequality Decomposition by Household head education across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	Primary	Secondary (L)	Secondary (Up)	Tertiary (NU)	Tertiary (U)	No education	National
110% Increase in MTR	Upper	GE (0) = L	0.223	0.235	0.247	0.257	0.252	0.225	0.295
		GE (1) = T	0.219	0.230	0.255	0.263	0.241	0.228	0.297
		Mean income	70,321	79,701	87,088	94,432	163,228	76,824	
			Within	**Between**	**% Between**	**% Within**			
	Upper	GE (0) = L	0.244	0.051	17.24	82.76			
		GE (1) = T	0.244	0.054	18.08	81.92			

Table 20: Income Inequality Decomposition by Household head education across Households (TCT Financed with Tax Progressivity)

	TCT	Theil measure	Primary	Secondary (L)	Secondary (Up)	Tertiary (NU)	Tertiary (U)	No education	National
50% Increase in MTR	Upper	GE (0) = L	0.261	0.278	0.334	0.340	0.359	0.333	0.451
		GE (1) = T	0.262	0.273	0.395	0.325	0.376	0.346	0.490
		Mean income	47,985	55,171	78,172	85,082	184,352	48,842	
			Within	**Between**	**% Between**	**% Within**			
	Upper	GE (0) = L	0.326	0.125	27.71	72.29			
		GE (1) = T	0.362	0.128	26.15	73.85			

Table 21a: Proxy-means test prediction of income using OLS regression

Variables	OLS (Log per-capita consumption)
Dwelling rating**:** Need structural repairs	0.106***
	(0.033)
Structurally sound, but needs maintenance	0.125***
	(0.032)
Structurally sound	0.162***
	(0.032)
Good condition, recent maintenance/renovation	0.208***
	(0.037)
Roof type**:** Bricks/Mixture of mud and cement/Mud	0.133***
	(0.051)
Cement block/concrete/Stone and rock	0.064
	(0.045)
Tile	0.244***
	(0.022)
Asbestos/cement roof sheeting	0.02
	(0.022)
Wall type**:** Mixture of mud and cement	-0.061**
	(0.027)
Floor type**:** Concrete	0.054**
	(0.022)
Carpet	0.054**
	(0.026)
Tiles	0.169***
	(0.026)
Wood	0.286***
	(0.049)
Linoleum/Vinyl	0.056*
	(0.032)
House status**:** House rented	0.155***
	(0.019)
House owned	0.036**
	(0.017)
Water source & Electricity**:** Private tap water	0.028
	(0.017)
Borehole	0.098**
	(0.05)
Household has electricity	-0.014
	(0.024)
Toilet type & shared**:** Flush toilet onsite	0.159***
	(0.043)
Flush toilet offsite	0.156***
	(0.042)
Chemical toilet	-0.066
	(0.057)
Pit latrine with ventilation pipe	-0.014
	(0.042)
Shared toilet facility	0.094***
	(0.018)
Observations	9,137
R-squared	0.741

Table 21b: Proxy-means test prediction of income using OLS regression

Variables	OLS (Log per-capita consumption)
Cooking energy source**:** Gas	0.18***
	(0.043)
Electricity (mains or generator)/Solar energy	0.103***
	(0.025)
Paraffin	0.068*
	(0.04)
Heating energy source**:** Gas	0.3***
	(0.06)
Electricity (mains or generator)/Solar energy	-0.008
	(0.016)
Paraffin	0.046
	(0.031)
Telephone	0.287***
	(0.027)
Radio	-0.017
	(0.0131)
TV	0.017
	(0.019)
Satellite	0.164***
	(0.016)
Computer	0.291***
	(0.021)
Cellphone	0.099***
	(0.021)
Electric stove	-0.023
	(0.023)
Gas stove	0.087***
	(0.019)
Microwave	0.069***
	(0.016)
Fridge/Freezer	0.076***
	(0.019)
Washing machine	0.131***
	(0.018)
Lounge suite	0.05***
	(0.015)
Vehicle	0.445***
	(0.022)
Bicycle	0.18***
	(0.027)
Motorcycle	0.07
	(0.055)
Household size: 1-2 people	0.962***
	(0.024)
Household size: 3-4 people	0.436***
	(0.016)
Per-capita room	0.122***
	(0.009)
Household head gender	0.131***
	(0.013)
Household head age**:** 0 - 30 years	-0.054**

	(0.023)
31 - 50 years	-0.018
	(0.016)
***Household head education*:** primary	-0.005
	(0.023)
lower secondary	0.08***
	(0.024)
upper secondary	0.247***
	(0.026)
tertiary (non-university)	0.102***
	(0.026)
tertiary (university)	0.336***
	(0.021)
Observations	9,137
R-squared	0.741