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

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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, South Africa

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

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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,[1] 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

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

population working in the informal sector,[2] 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, although it is costly.

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[3] inequality in South Africa (Orthofer, 2016). The top 10 percent of South Africa's population receives 56 to 58 percent of

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

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[4] 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.[5]

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,[6] geographical type, province,[7] and household head education. Second, I conduct a policy simulation by applying an additional progressive tax rate to finance UBI or TCT, to examine how additional revenue generated from progressive tax can be

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

used to fund UBI or TCT separately, and the extent to which this can reduce income inequality. Actually, I implemented two methods to estimate the second part, the impact of UBI and TCT on income inequality. The first method considers a UBI that requires a 50 percent increase in marginal tax rates to fully finance its total budget; then distribute the same total budget in a TCT that provides higher transfers only to those targeted by the TCT. Next, the second method consider a smaller total budget for TCT that needs a 22 percent increase in marginal tax rate to fully finance those targeted by TCT; after, a smaller transfer is given to all South Africans to fund UBI, set such that the total budget for UBI equals the TCT total budget.

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 more when a UBI or a TCT is combined with progressive taxation. The size of this large decrease in income inequality is more than 50 percent for the UBI or TCT financed at the UBI total budget and more than 38 percent for UBI or TCT financed at the TCT total budget. In all the group decompositions, the within-group inequality contributes more than 72% to the overall income inequality, while between-group inequality contributes less than 27%.

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[8] 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.

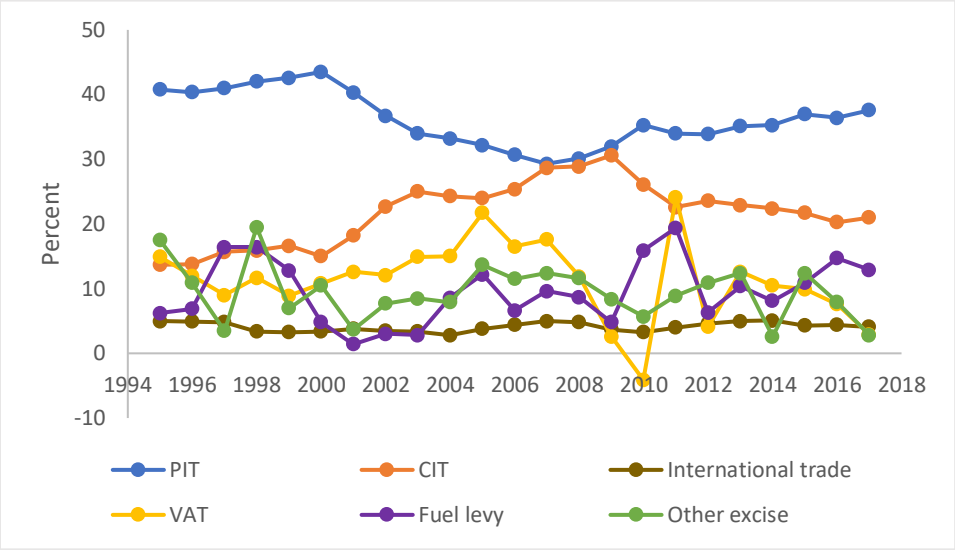
Inchuaste et al. (2015) find that direct taxes in South Africa are progressive, while indirect taxes are slightly regressive for the population at the bottom half of the income distribution. This is because the personal income tax in South Africa is more progressive than indirect or consumption taxes. 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

[8] 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.

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



Source: South Africa Reserve Bank (SARB, 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.[9] 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[10] 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 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.

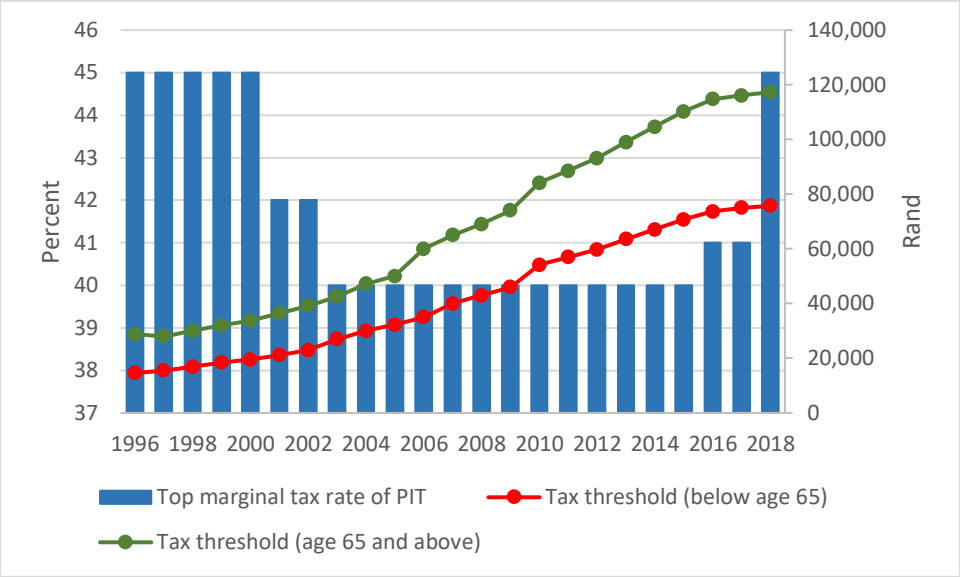
[9] It is officially known as the Commission of Inquiry into Certain Aspects of South African Tax Structure.
[10] Tax rebate is a refund or a payment to the taxpayer when the taxpayer pays more tax than they owe.

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.

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



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

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[11] 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.

[11] 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 5 (2017) data, which was collected from February 2017 to December 2017. It

focuses on the income and expenditure data. The total number of individuals and households interviewed are 30,110 and 13,719.

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, creating new variables, and other data management of the raw survey data, a total sample of 15,169 individuals and 6,389 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 large discrepancies in the sample size of the raw data and the analysis data is due to missing income in the raw data.

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 2018 tax code from the annual budget review report (National Treasury of South Africa, 2018) is 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 2018 tax year 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):

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

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

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

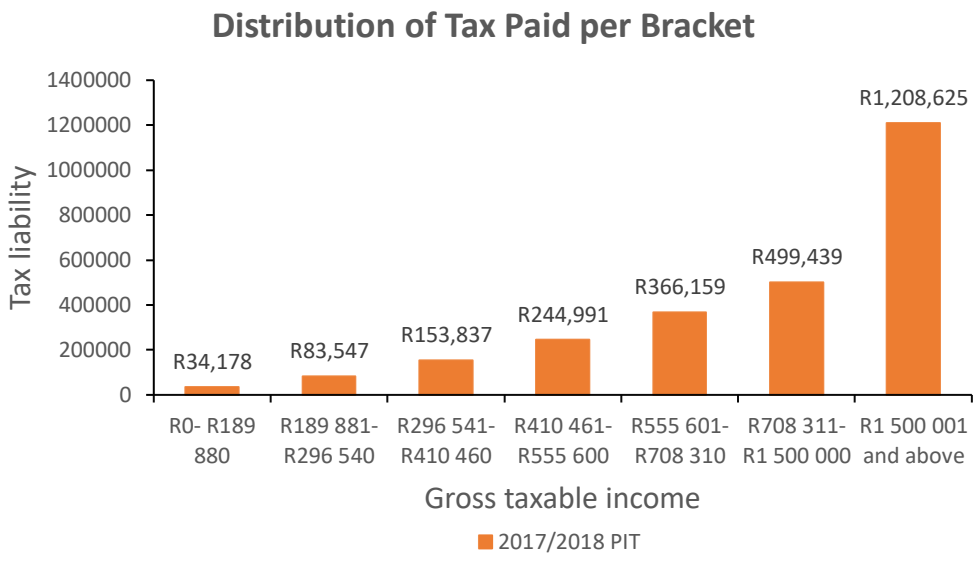
where, y^g is the gross taxable income and y^n is the net taxable income from the NIDS data; r is the tax rebate which is dependent on age group as shown in the tax codes; F_i is the fixed tax amount that varies by tax bracket for individual *i*; $t_i$is the marginal tax rate for each bracket; L_i is 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 2018 personal income tax rates for South Africa is reported in Table 2, showing the seven 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. The marginal tax rate is nonlinear spanning 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.

Table 2: Personal Income Tax Rates and Brackets Adjustments

Taxable income (R)	2017/2018 Rates of Tax
R0 - R189 880	18% of each R1
R189 881 - R296 540	R34 178 + 26% of the amount above R189 880
R296 541 - R410 460	R61 910 + 31% of the amount above R296 540
R410 461 - R555 600	R97 225 + 36% of the amount above R410 460
R555 601 - R708 310	R149 475 + 39% of the amount above R555 600
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 R1 500 000
Rebates	
Primary	R13 635
Secondary	R7 479
Tertiary	R2 493
Tax Threshold	
Below age 65	R75 750
Age 65 and over	R117 300
Age 75 and over	R131 150
Medical Tax Credit	
Taxpayer and first dependent	R303/month
Each additional dependent	R204/month

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



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

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):

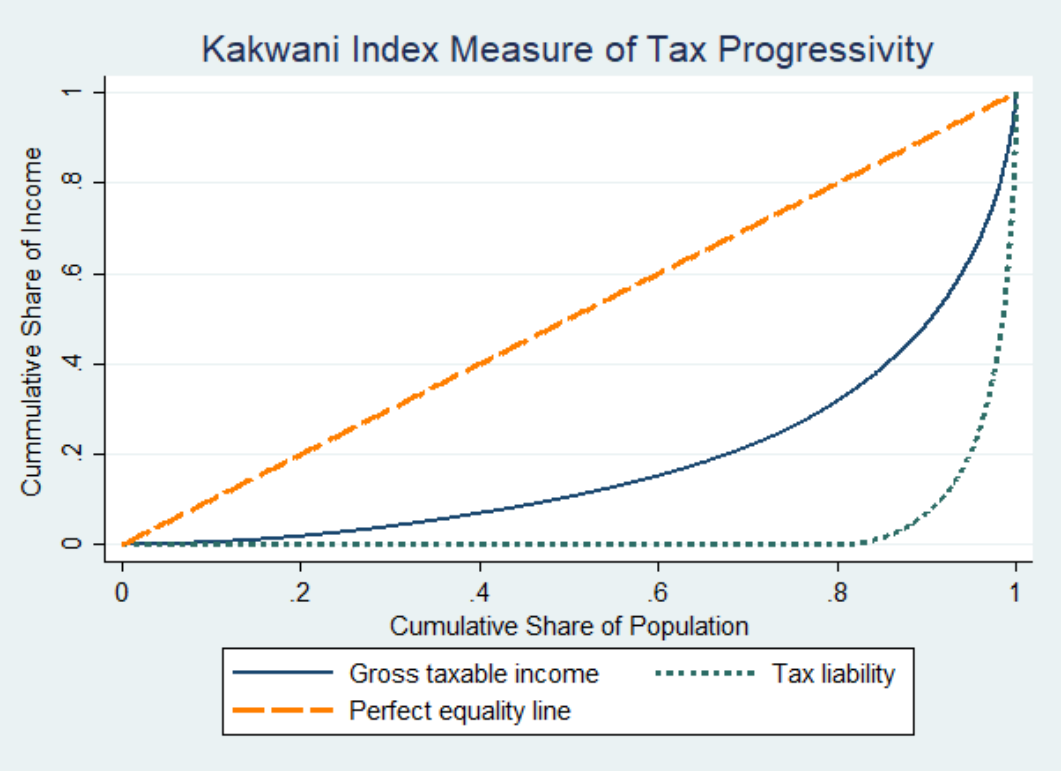
$$K = C_t - G_y \qquad (4)$$

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. 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.

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



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

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 gross 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 progressive tax measures

Progressivity Measure	Index
Musgrave-Thin redistributive effect	1.130
Kakwani progressivity index	0.286
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).[12] These inequality measures are defined as:

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

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

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.

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

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,[13] and the DA[14] are proponents of this grant in one way or another. In contrast, the ANC[15] 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

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

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 2017 South African national poverty lines to set two possible amounts for a UBI and a TCT scheme, one based on the food poverty line and the other based on the upper-bound general poverty line (Stats SA, 2018). The upper general poverty line includes 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 R531 (2017) per individual per month. It is also called the extreme poverty line.

There is also a lower-bound general poverty line as part of the South African national poverty lines, which 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 R758 (2017) per individual per month, and the upper poverty line is R1,138 (2017) per individual per month (Stats SA, 2018). 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

15,169 household members and then multiplied by the household weight to expand the sample size to South Africa's population size.

Table 4: Inflation-adjusted poverty lines and total budget required to fund UBI and TCT

	Food-bound (Rand)	Upper-bound (Rand)
2017		
Poverty line (Rand/person/month)	531	1,138
Poverty line (Rand/person/year)	6,372	13,656
Total budget required		
Method 1: Fund both program at UBI Budget	155.9 billion	334.1 billion
Method 2: Fund both program at TCT budget	66.68 billion	49.3 billion

NB: Method 1, the total budget required to fund UBI equals total budget at which TCT is funded. Method 2, the total budget required to fund those targeted equals total budget at which UBI is funded. All values are weighted.

I use two methods in generating the total budget required. For method 1, I calculate how much total budget is needed to fund a UBI that transfers to all South Africans an amount that is equal to the food poverty line and the upper poverty line. Then for method 2, I calculate the total budget required to fund a TCT that transfers to household members targeted at the food and upper poverty line an amount that is equal to the food poverty line and the upper poverty line. These derived total budgets equal the total revenues the government needs to finance the different amounts of UBI (for all households), and TCT (for targeted households only). I restricted the analysis of this study to total budgets calculated at the food poverty lines for both UBI (155.9 billion) and TCT (66.68 billion).

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.

3.5.1. Income Prediction with Proxy Measures

This paper employs a regression based PMT to identify poor households that should 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

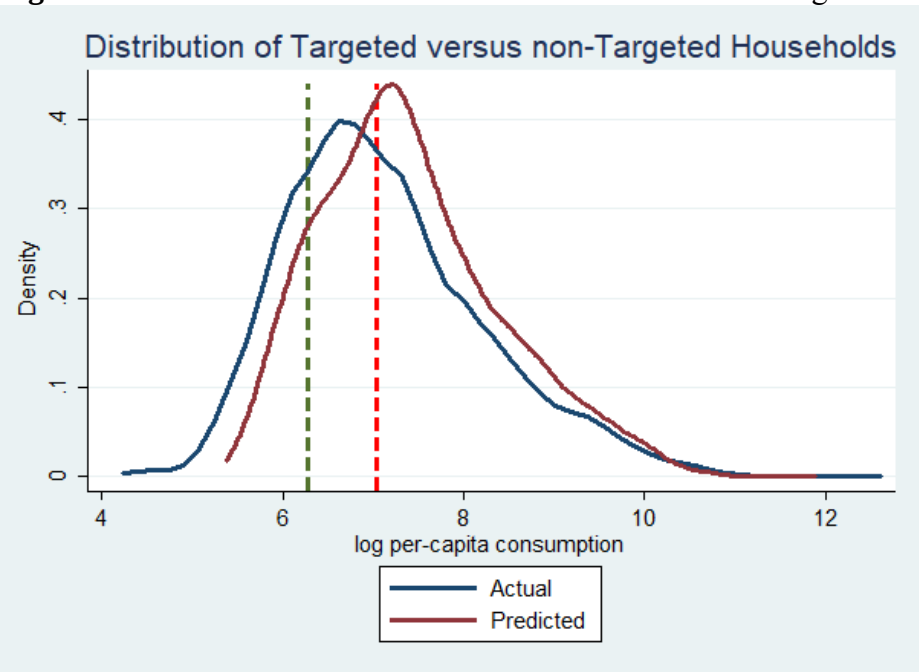
validation (test) samples. The calibration sample is to regress monthly household per-capita consumption on 56 indicator variables. The indicator variables chosen for this estimation are based on their verifiability and on their correlation with household per-capita consumption. Monthly per-capita consumption 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 full-data sample, for targeting purposes. The actual per-capita consumption used in the regression is logged, so the exponential of the log predicted per-capita consumption is taken to create the PMT score for a household. The OLS model has an R-squared of 0.776, 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. In modeling the TCT program for this study, households are targeted using the food and upper poverty lines as thresholds. 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. This is explained further in method 2 below. 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. The upper poverty line is only use as a threshold and not as a transfer amount in this study.

Figure 5: Distribution of Households' Actual and Predicted Log Incomes



NB: The forest green line is for the food poverty line (2017) and the orange red line is for the upper poverty line. The households with predicted consumption less than the poverty lines are targeted 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.

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

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 29.

Figure 5 shows the distribution of households' actual and predicted log incomes, as well as the food poverty line (in forest green) and the upper poverty line (in red). These lines depict the households targeted against the non-targeted households. By comparison, more households were targeted at the food poverty line than at the upper poverty line. Out of 13,995 households targeted, 8,164 (58.34%) were targeted at the food poverty line and 2,246 (16.05%) were targeted at the upper poverty line. The coverage rate for those at the food poverty line is 99.7 percent and that for the upper poverty line is 77.2 percent. The inclusion and exclusion error rates for the targeting at the food poverty line threshold are 33. 6 and 0.27 percent; and that for those targeted at upper poverty line are 5.5 and 22.8 percent.

3.5.2. Tradeoffs between Inclusion and Exclusion Error

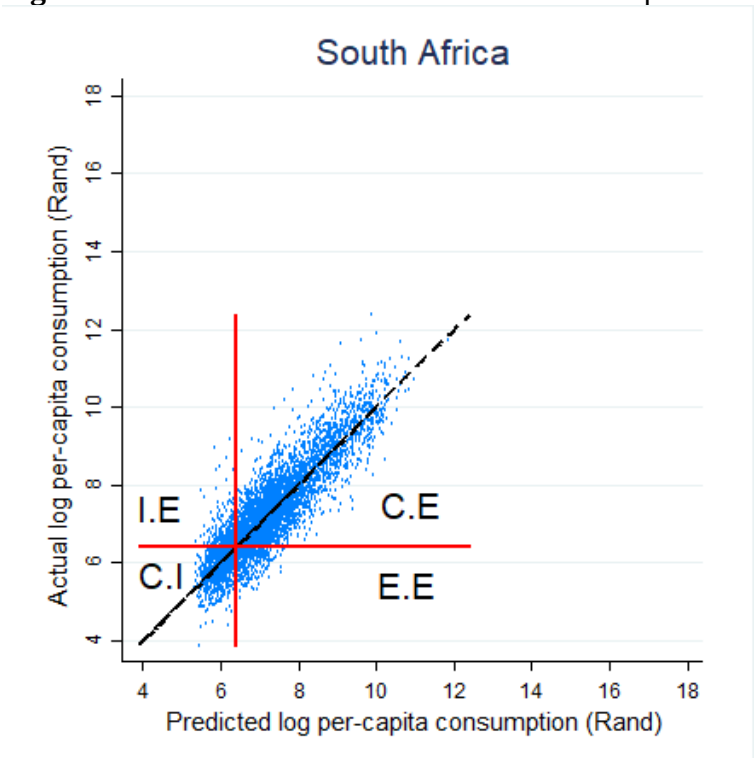
The accuracy of the PMT for targeting purposes is displayed graphically in Figure 6, which plots actual per-capita consumption against predicted per-capita consumption. Four quadrants are in the figure, correct inclusion (CI), correct exclusion (CE), inclusion error (IE), and exclusion error (EE). This graph explores the tradeoffs in the errors of inclusion and exclusion. The targeting problem a government may face is that by setting different cutoffs a for program eligibility, the government may choose the balance between the inclusion and exclusion errors that it makes. This figure plots the results with one cutoff a, at 35 percent of the log predicted values. So clearly, shifting the red vertical line to the left or to the right would change the balance of inclusion and exclusion error.[16]

For instance, if the aim of the government is to assist those who are actually poor, then by not giving the assistance to anyone (setting $a = 0$) means no transfers and this leads to extremely high

[16] The horizontal line in Figure 5 is fixed because inclusion and exclusion errors are established with respect to a household's true poverty status where actual per-capita consumption is either above or below the poverty line; and not with respect to the PMT design that shows the vertical line with eligibility cutoff choice a.

exclusion error, since everyone below the poverty line is being excluded. However, this may also result in no inclusion error, because people with higher-income status who should not be receiving the program are not getting it. On the other hand, a UBI (setting $a = \infty$) may suggest there is no exclusion error because all poor people will get the transfer. Yet, this leads to very high inclusion error, since all people with high-income status will also receive the transfer. So, varying the cutoff value between the limits $a = 0$ and $a = \infty$, allows us to trace out the tradeoffs between inclusion error and exclusion error that the government may encounter.

Figure 6: 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 approximately 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. For readability, the points plotted depict a random sample of 50 percent of the full data for this study (out-of-sample test).

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 R66,000

and R55,590 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 (6.97) 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 study 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 (79.6%), followed by Colored (10.2%), white (7.9%), and Asian/Indian (2.3%). The geographical type variable classifies almost two thirds (72.2%) of the households as living in urban settings, and slightly more than one-third (27.8%) 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 (31%), KwaZulu-Natal (18.4%), and Western Cape (13.4%). 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.

Figure 7 shows the graphical representation of the distribution of logged gross and net taxable income. This income distribution is displayed by decile group decomposition in Table 7, with the richest 10 percent of individuals (decile 10) having the highest gross (51.67%) and net (45.29%) income share.

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

Variable	Mean (Rand)	SD (Rand)	CV
Variables from data:			
Aggregate net income (labor)	58,288	119,791	2.06
Food expenditure	7,886	34,725	4.40
Nonfood expenditure	25,580	66,900	2.62
Rent expenditure	10,600	18,517	1.75
Total expenditure	44,361	95,811	2.16
Net worth	3,962,446	27,600,000	6.97
Labor income	49,517	90,104	1.82
Household size	4.37	3.17	0.73
Created variables:			
Gross taxable income	66,000	173,846	2.63
Net taxable income	55,590	119,860	2.16

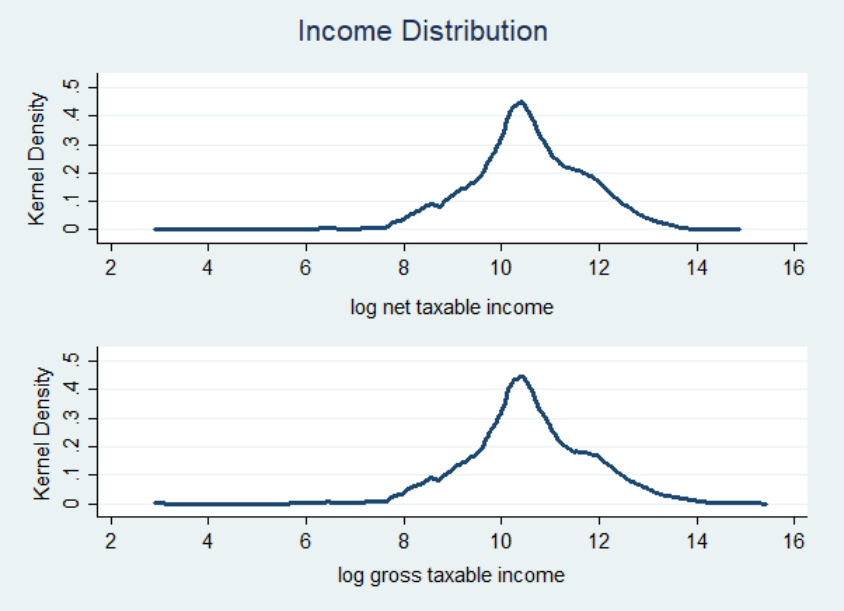
Statistics is done at the individual level. Number of observations: 15,168.
CV is coefficient of variation, ratio of SD to mean, all values are weighted

Table 6: Distribution of population by race, province, geography, and household head education (weighted)

Variable	Frequency	Percent
Race		
African	19,480,709	79.6
Colored	2,496,254	10.2
Asian/Indian	559,628	2.3
White	1,927,390	7.9
Province		
Western Cape	3,285,584	13.4
Eastern Cape	2,070,880	8.5
Northern Cape	623,639	2.6
Free State	1,138,909	4.7
KwaZulu-Natal	4,489,971	18.4
North West	1,261,847	5.2
Gauteng	7,581,555	31.0
Mpumalanga	2,074,299	8.5
Limpopo	1,937,295	7.9
Geographical type		
Rural	6,810,630	27.8
Urban	17,653,350	72.2

Household head education		
primary	1,073,517	9.1
lower secondary	1,770,829	15.0
upper secondary	3,874,605	32.7
tertiary (non-university)	1,299,989	11.0
tertiary (university)	3,336,824	28.2
no education	488,781	4.1

Figure 7: Distribution of Log Gross and Net Taxable Income



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

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	5,711	0.69	5,711	0.58
2	14,443	1.56	14,443	1.32
3	23,633	2.98	23,633	2.52
4	31,148	3.21	31,148	2.71
5	38,396	4.19	38,396	3.54
6	50,249	6.02	50,249	5.08
7	69,703	7.47	69,977	6.36
8	100,924	10.95	106,903	9.88
9	163,784	19.39	184,468	18.19
10	408,751	43.55	552,448	49.83

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 Wave 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 using two methods. First method I simulate a 10% and a 50% increase in the marginal tax rate of all tax brackets in the South African tax codes for the UBI program. For second method I simulated 10% and 22% increase in the marginal tax rate for the TCT program. I used the revenue generated in each method for a specific program to also fund the other program under the same total budget.

Method 1: Simulation Based on UBI Total Budget to Fund Both UBI and TCT

These simulations aim to generate the adequate tax revenue to finance UBI at the food poverty line level, for all individuals in the household. The required total budget needed to finance the food poverty line for UBI amounts to R155.9 billion. Because there is no data on labor hours for this study, I first 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. Then 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 then 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 or 50 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 old 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.

Next, under the same total budget of 155.9 billion for UBI, the additional revenue generated from this simulation is also used separately to fund the TCT program. Simply put, the TCT transfer amount is set so that the total budget of the TCT will equal the total budget for UBI. This additional revenue distributes a transfer amount (larger than the UBI transfer) to only those targeted by the TCT. The transfer amount for the TCT program is estimate as the total budget for UBI divided by the number of those targeted at the food poverty line or at the upper poverty line. Thereafter, the new income distribution with the added TCT transfer amount for those targeted is used to calculate new estimates of the Theil inequality, T and L, using equations (5) and (6). Finally, the change in the distribution of income under UBI and TCT are compared.

Method 2: Simulation Based on TCT Total Budget to Fund Both UBI and TCT

Here, the simulation aims to generate an adequate tax revenue to fund those households targeted by TCT at the food poverty line. The required total budget needed to fund TCT at the food

poverty line is R66.68 billion. The same approach as in method one is followed to simulate a percent increase in marginal tax rate, and to calculate new total and additional revenue for the simulation based on the TCT budget at the food poverty line. To estimate the impact of TCT finance by a percent increase in marginal tax rate on the income distribution, the TCT transfer amount at the food poverty line is added to the new income y_k^n using the equation:

$$Y_{TCT}^n = y_k^n + TCT$$

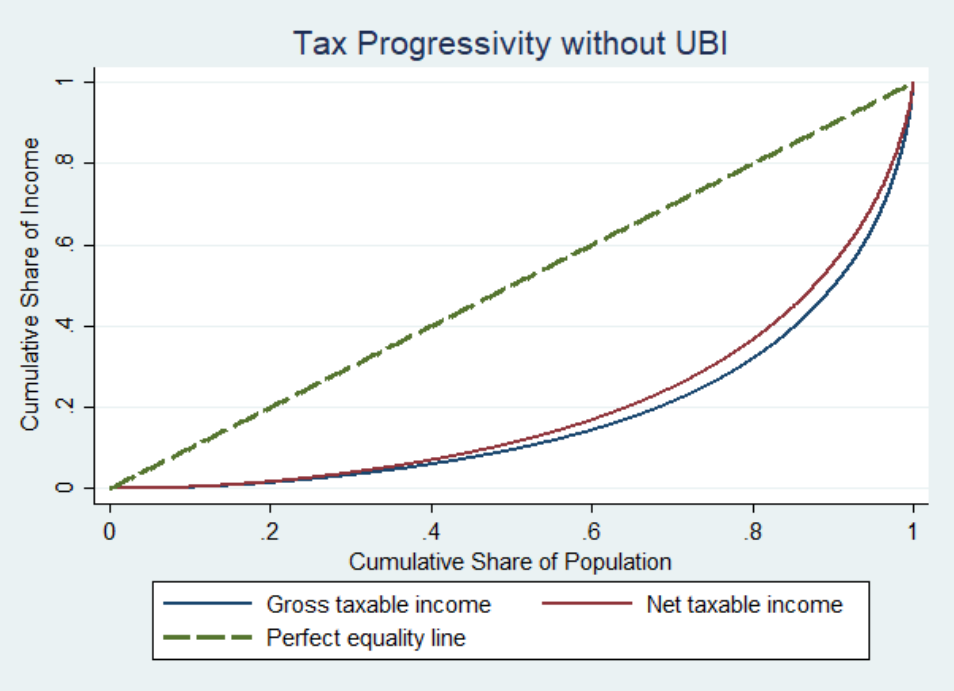
Now, I consider a UBI for all South Africans that gives a smaller transfer amount, set so that the total budget of the UBI is equal to this TCT total budget of R66.68 billion. Lastly, this new distribution of net income with the added UBI transfer amount for all households is used to calculate new estimates of the Theil inequality, T and L, using equations (5) and (6). Then, the change in the distribution of income under UBI and TCT are compared for this method.

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: 0.599) is slightly above the Lorenz curve of the gross taxable income (Gini: 0.641). 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).

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



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

Tables 9, 10, 11, and 112 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 African (0.72; 0.59)[17] group is very large, followed by those of Colored, Asian/Indian, and White groups respectively. However, inequality at the national (country) level (0.80; 0.67) is more pronounced than the African group inequality. In addition, the White (0.49; 0.39) and the Asian/Indian subgroup (0.57; 0.57) 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 (13%; 19%) compared to the share of inequality within the racial groups, the within-group component (87%; 81%).

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 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.

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

The inequality decomposition by geographical type is reported in Table 10. The two measures indicate that rural inequality (0.80; 0.666) is greater than urban inequality (0.76; 0.64) and almost equal to the country level inequality (0.797; 0.671). 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 11 shows that inequality is very high in all nine provinces, but it is particularly high in Limpopo, Eastern Cape, Mpumalanga, Gauteng, and KwaZulu-Natal provinces. Western Cape, Free-State, 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 95 percent. This reflects the large inequity within each of the nine provinces.

Finally, the decomposition by the household head's education in Table 12 shows that households headed by someone with no education have high inequality (0.69; 0.60) 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 (0.54; 0.47) of all the other education levels. Compared to the decomposition by race, geographical type, and province, the between-group inequality (23%; 28%) contributes a substantial amount to overall inequality, yet the within-group inequality (77%; 72%) still remains far larger than the between group inequality in this case.

5.2. 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 is presented in Table 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 additional 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 and TCT at the food poverty line. It can fund less than a quarter of the total budget required to finance the food poverty line UBI; and it can fund almost half of the TCT total budget at the food poverty line.

The total expenditure required by the South African government to fully fund the food poverty line UBI would necessitate a 50 percent increase in marginal tax rate, which generates additional revenue of R161 billion (total budget: 155.9 billion). For TCT, the cost required to fully fund the food poverty line TCT is R70.86 billion (total budget: R66.68 billion), which implies a 22 percent increase in the marginal tax rate. The analysis of this study is restricted to total budgets calculated at the food poverty lines for both UBI and TCT.

5.2.1. Method 1: Funding UBI and TCT under UBI Budget

The additional revenue generated from the 50 percent increase in tax rate for the food poverty line UBI total budget, distribute to all South Africans a lumpsum amount of R6,372. Then, at this same UBI total budget, an approximate amount of R11,839 is distributed to only those targeted at the food poverty line by the TCT program; and those targeted at the upper poverty line receive an approximate amount of R43,035. The transfer amount for those targeted at the food poverty line is larger than the food poverty line amount but less than the upper poverty line (R13,656) amount. Whereas, the amount for those targeted at the upper poverty line is larger than

the upper poverty line amount. The latter is that because just a few people are targeted at the upper poverty line, hence the larger transfer amount.[18]

At the UBI total budget, Figures 9 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 9 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. Figure 11 indicates that giving transfers to households targeted at the food poverty line reduces income inequality more than distributing transfers to those targeted at the upper poverty line. This is so because fewer households are targeted at the upper poverty line. All the same, the decrease in overall income inequality under the UBI total budget is slightly more for the UBI scheme than for the 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 13, 14, 15, and 16. Then, the estimates on the magnitude by which income inequality is reduced under TCT funded by progressive tax are shown in Tables 17, 18, 19, and 20.

Table 13, shows a large decrease in income inequality for the African (0.37, 0.37), Colored (0.39; 0.38), Asian/Indian (0.37; 0.38), and White (0.35; 0.30) populations, and for the country (0.43; 0.43), as a whole; with a 50 percent increase in marginal tax rate to fund UBI. Income inequality decompositions by geographical type, province, and household head education show a similar pattern of results of the fall in income inequality. For geographical type, as shown in Table

[18] 8,164 (58.34%) households were targeted at the food poverty line and 2,246 (16.05%) were targeted at the upper poverty line.

14, there is a significant decrease in income inequality for rural (0.37, 0.38) and urban (0.43, 0.43), and at the national level (0.43, 0.43); for UBI financed scheme. Table 15, indicates a substantial decrease in income inequality for provinces, Western Cape (0.37, 0.39), Eastern Cape (0.43, 0.42), Northern Cape (0.37, 0.36), Free-State (0.32, 0.31), KwaZulu-Natal (0.36, 0.36), North-West (0.35, 0.35), Gauteng (0.48, 0.46), Mpumalanga (0.47, 0.50), and Limpopo (0.46, 0.43); and the overall (0.43, 0.43) income inequality, under UBI. Similarly, for decomposition by household head education under UBI funding, as display in Table 16, there is large reduction in income inequality for primary (0.3, 0.3), lower secondary (0.34, 0.34), upper secondary (0.35, 0.37), university tertiary (0.38, 0.36), non-university tertiary (0.37, 0.36), and no education (0.33, 0.34); and at the national level (0.47, 0.48).

The results for a 50 percent increase in tax to fund TCT (targeted at food and upper poverty line) at same total budget for UBI is as follows. Table 17, indicates a reduction in income inequality for Africans (food: 0.45, 0.39; upper: 0.65, 0.51), Colored (food: 0.46, 0.39; upper: 0.65, 0.50), Asians/Indians (food: 0.47, 0.48; upper: 0.58, 0.50), and White (food: 0.46, 0.38, upper: 0.45; 0.37); and for the whole country (food: 0.52, 0.48; upper: 0.72, 0.58). For geographical type, as shown in Table 18, there is a decrease in income inequality for rural (food: 0.42, 0.36; upper: 0.74, 0.58) and urban (food: 0.55, 0.50; upper: 0.67, 0.55), and for the country (food: 0.52, 0.48; upper: 0.72, 0.58) as a whole. As displayed in Table 19, there is a fall in income inequality for provinces, Western Cape (food: 0.47, 0.44; upper: 0.61, 0.52), Eastern Cape (food: 0.50, 0.42; upper: 0.81, 0.60), Northern Cape (food: 0.46, 0.40; upper: 0.67, 0.51), Free-State (food: 0.38, 0.34; upper: 0.60, 0.41), KwaZulu-Natal (food: 0.40, 0.35; upper: 0.68, 0.53), North-West (food: 0.42, 0.39; upper: 0.65, 0.51), Gauteng (food: 0.61, 0.55; upper: 0.69, 0.58), Mpumalanga (food: 0.55, 0.54;

upper: 0.69, 0.65), and Limpopo (food: 0.54, 0.43; upper: 0.89, 0.63); and the overall (food: 0.52, 0.48; upper: 0.72, 0.58) income inequality.

Finally, for household head education under TCT funding, as display in Table 20, there is a decrease in income inequality for primary (food: 0.46, 0.35; upper: 0.61, 0.45), lower secondary (food: 0.49, 0.39; upper: 0.54, 0.43), upper secondary (food: 0.51, 0.48; upper: 0.57, 0.49), university tertiary (food: 0.51, 0.45; upper: 0.49, 0.42), non-university tertiary (food: 0.54, 0.47; upper: 0.57, 0.46), and no education (food: 0.39, 0.33; upper: 0.63, 0.51); and for the overall income inequality (food: 0.62, 0.57; upper: 0.69, 0.59) at the national level. In comparison, it is clear that the TCT funding for those targeted at the food poverty line reduces income inequality far more than for those targeted at the upper poverty line. The fall in income inequality for a 50 percent increase in tax is relative to the findings in Table 9, 10, 11, and 12 which does not take into account UBI or TCT.

5.2.2. Method 2: Funding UBI and TCT under TCT Budget

For this method, I consider a TCT that provides a transfer amount equal to the food poverty line, but only to those targeted by the TCT (using a PMT that identifies people below the food poverty line as poor) under a smaller total budget. To fully fund this smaller total budget, an additional revenue is generated from a 22 percent increase in tax rate, after which a lumpsum amount of R6,372 is distributed to all those targeted at the food poverty line. Next, I consider a UBI for all South Africans that gives a smaller transfer, set so that the total budget of the UBI is equal to this TCT budget. At same TCT budget, an approximate lumpsum amount of R3,429 (less than the food poverty line amount) is distributed to all the South Africans.

Figures 10 and 12 depicts a graphical representation of how much overall income inequality is reduced by UBI and TCT that are funded via tax progressivity at the TCT budget.

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 TCT, Figure 12 reveals that the decline in overall income inequality is larger for the net taxable incomes with TCT, compared to the net taxable income without a TCT. Then for UBI, Figure 10 indicates that giving transfers to all South Africans reduces income inequality more than the income distribution without a UBI. However, under this TCT total budget, the reduction in overall income inequality is a little greater for the UBI than for the TCT.

Following, 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 21, 22, 23, and 24. Then, the estimates on the magnitude by which income inequality is reduced under TCT funded by progressive tax are shown in Tables 25, 26, 27, and 28. All estimations are based on the food poverty line TCT total budget.

Table 21, indicates a fall in income inequality for the Africans (0.47, 0.46), Colored (0.49, 0.47), Asians/Indians (0.45, 0.47), and White (0.42, 0.35) populations, and for the country (0.55, 0.54), as a whole; with a 22 percent increase in marginal tax rate to fund UBI under TCT budget. For geographical type, as shown in Table 22, there is a decrease in income inequality for rural (0.49, 0.49) and urban (0.54, 0.53), and at the national level (0.55, 0.54); for UBI financed scheme under TCT budget. Table 23, indicates a reduction in income inequality for provinces, Western Cape (0.48, 0.49), Eastern Cape (0.56, 0.52), Northern Cape (0.47, 0.45), Free-State (0.41, 0.4), KwaZulu-Natal (0.46, 0.45), North-West (0.46, 0.44), Gauteng (0.59, 0.56), Mpumalanga (0.59, 0.62), and Limpopo (0.59, 0.53); and the overall (0.55, 0.54) income inequality, to fund UBI under TCT budget. As shown in Table 24, there is a decrease in income inequality for primary (0.38, 0.37), lower secondary (0.42, 0.41), upper secondary (0.43, 0.46), university tertiary (0.46, 0.41),

non-university tertiary (0.45, 0.43), and no education (0.42, 0.44); and at the national level (0.58, 0.58) for decomposition by household head education for UBI funding under TCT budget.

Next, the results for a 22 percent increase in tax rate to fund TCT at its' own total budget is as follows. Table 25 presents a decline in income inequality for African (0.50, 0.45), Colored (0.52; 0.46), Asian/Indian (0.50; 0.51), and White (0.46; 0.38); and for the whole country (0.58; 0.55). As illustrated in Table 26 for geographical type, there is a reduction in income inequality for rural (0.47, 0.44) and urban (0.60, 0.56), and for the country (0.58, 0.55) as a whole. Table 27 reveals a decrease in income inequality for provinces, Western Cape (0.52, 0.50), Eastern Cape (0.56, 0.50), Northern Cape (0.50, 0.45), Free-State (0.43, 0.39), KwaZulu-Natal (0.45, 0.41), North-West (0.47, 0.45), Gauteng (0.66, 0.60), Mpumalanga (0.60, 0.62), and Limpopo (0.62, 0.50); and the overall (0.58, 0.55) income inequality. Then, for household head education, as shown in Table 28, there is show is a fall in income inequality for primary (0.46, 0.38), lower secondary (0.50, 0.42), upper secondary (0.53, 0.51), university tertiary (0.52, 0.45), non-university tertiary (0.55, 0.47), and no education (0.66, 0.61); and for the overall income inequality (0.58, 0.58). The fall in income inequality for a 22 percent increase in tax is relative to the findings in Table 9, 10, 11, and 12 which does not take into account UBI or TCT.

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

5.3. Comparing UBI to TCT

From the general results, it is obvious the first method, where a 50 percent hike in tax rate is used to fund UBI at its own total budget, reduces income inequality more than the second method

with a 22 percent increase in tax rate that finances UBI at the TCT total budget. The TCT funding for only those targeted at the food poverty line under the UBI total budget in the first method, slightly reduces income inequality more than the TCT that finances its own total budget in method two. However, within each method, the magnitude of income inequality reduced by UBI is much greater than that of the TCT targeted at the upper poverty line, and slightly higher for those targeted at the food poverty line.

In comparison, from the first method, we can see that income inequality for most of the race decomposition declines by more than 48 percent for a UBI, 37 percent for a TCT at the food poverty line and 9 percent at the upper poverty line; relative to the income distribution without a UBI or TCT. But, for the second method, the reduction in income inequality reduces by more than 34 percent for UBI and 31 percent for a TCT. At the country level, income inequality falls by more than 34 percent for method one and by more than 27 percent for the second method. The remaining group decompositions, geographical type, province, and household head education all follow a similar pattern of reduction in income inequality for a UBI or a TCT.

In short, both methods, and both UBI and TCT reduces income inequality, but, the decline in income inequality under the UBI total budget (50% increase in tax) is greater than the income inequality at the TCT total budget (22% percent increase in tax). However, this excludes the TCT for only those targeted at the upper poverty line under the UBI total budget, that reduces income inequality slightly relative to the fall in income inequality without a UBI or a TCT. Therefore, both approaches can be implemented for a UBI or a TCT, but there are two main trade-offs between UBI and TCT; that is, costs of the program and the poor methods of targeting households.

5.4. Effects of High Marginal Tax Rate and Tax Efficiency Effects

High increases in marginal tax rates can encourage taxpayers to change their behavior in different ways that affect taxable income, tax revenue base, and tax efficiency. These behavioral changes include changes in labor supply and high non-compliances in the form of tax evasion and tax avoidance. Tax evasion (failure to pay taxes) is illegal cheating on taxes whereas tax avoidance (minimizing of taxes) is where individuals think of ways to move their money around legally, so that they can avoid high taxes. Tax efficiency is measured as the deadweight loss due to high tax rates resulting from behavioral changes of taxpayers. This implies if marginal tax rate is increased to raise revenue, the level of deadweight loss is also impacted.

Due to data limitation, this study does not estimate the parameters that explains the effect of high tax rate on elasticity of taxable income, revenue base, and tax efficiency. Moreover, the focus of this study is on raising marginal tax rate to finance UBI and TCT, thereby reducing income inequality; and not to find the effect of high tax rates on revenue and tax efficiency. In spite of that, a high tax rate unavoidably affects the revenue base and tax efficiency, since tax obligations are functions of individual behavior. Therefore, I use other parameter estimates in the literature that can explain a possible case for South Africa on how higher tax rates affects economic efficiency.

Yolande and Schoeman (2015) find that tax efficiency decreases with an increase in taxable income due to high marginal taxes in South Africa. This loss in efficiency is more evident in the case of the richest income group with a 54.5 percent increase in deadweight loss at the then current marginal tax rate of 40 percent. Increasing this rate from 40 to 45 percent raises revenue from R132.8 billion to R153.7 billion (16% rise) but with a higher rise in deadweight loss from R37.5 billion to R56.2 billion (by 50 percent increase). Overall, the increase in deadweight loss ranges

from 2.75 to 54.5 percent with respect to the income groups and the pattern of increase is the same for all income groups but they are affected differently. The wide gap is because the top richest people in South Africa receive more than 50 percent of overall income (Orthofer, 2016), justifying the depth of high-income inequality in South Africa. Thomas (2007) estimate that elasticity of taxable income due to taxes is 0.52 with a deadweight loss of 15 percent of the revenue, but this is at a flatter tax rate system for New Zealand. The United States with a more progressive tax schedule like South Africa, shows a deadweight loss ranging from 18 to 37 percent (Robson, 2007).

This study increases marginal tax rate by 22 and 50 percent to generate adequate revenue that funds UBI or TCT fully as shown in Table 30. So, obviously it does not comply with the standard of 10-20 percent for the low marginal tax rate and 30 to 50 percent for the top tax rate. Finally, the high-income gap in South Africa suggests that even at a 22 percent increase in marginal tax rate, there may be disincentive to work, tax evasion, tax avoidance, and higher deadweight loss, that will lead to loss in economic efficiency. Therefore, aside the two main tradeoffs (cost of program and poor targeting methods) between UBI and the TCT, both programs will generate high revenue but it comes at a loss in economic efficiency. This may be due to high deadweight loss as a result of behavioral changes of the taxpayers.

6. 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 22 and 50 percent increase in marginal tax rates. I then estimated the impact of this simulation on overall income inequality and inequality by group decomposition. Basically, I implemented two methods in estimating the impact of UBI and TCT on income inequality. I first considered a UBI whose total budget at the food poverty line funds UBI. Then, I distribute the same total budget in a TCT scheme that provides larger transfers, but only to those "targeted" by the TCT (using a PMT that identifies people below the food and upper poverty line). Secondly, I considered a smaller total budget for TCT at the food poverty line that funds TCT and then distribute smaller transfers to all South Africans to fund UBI, set so that the total budget of the UBI is equal to this TCT budget.

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 UBI or TCT fully funded by the additional revenue generated from the different tax increases (22%, 50%), reduces income inequality 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 50 percent for the UBI or TCT funded at UBI total budget and more than 38 percent for UBI or TCT funded at the TCT total budget. But this precludes the TCT for only those targeted at the upper poverty line under the UBI total budget, that reduces income inequality slightly compared to the decrease in income inequality by progressive taxation without UBI or TCT. In all estimations, the within-group inequality contributes larger proportions to overall inequality than the between-group inequality.

Funding UBI and TCT programs at the TCT total budget may require less budget to fully finance them than financing UBI and TCT programs at the total budget for UBI, however, TCT may lead to imperfect targeting with a poor coverage rate. I think, the South African government may consider implementing UBI and TCT at either total budget, because income inequality is reduced in both cases, all reduction is greater under the UBI total budget. 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, at either total budgets. 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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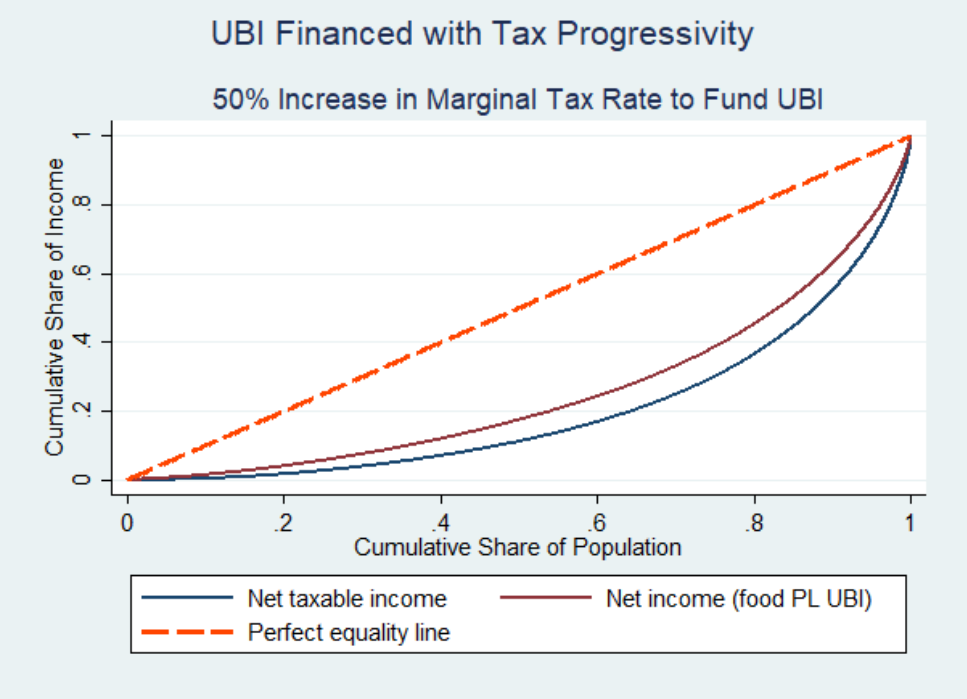
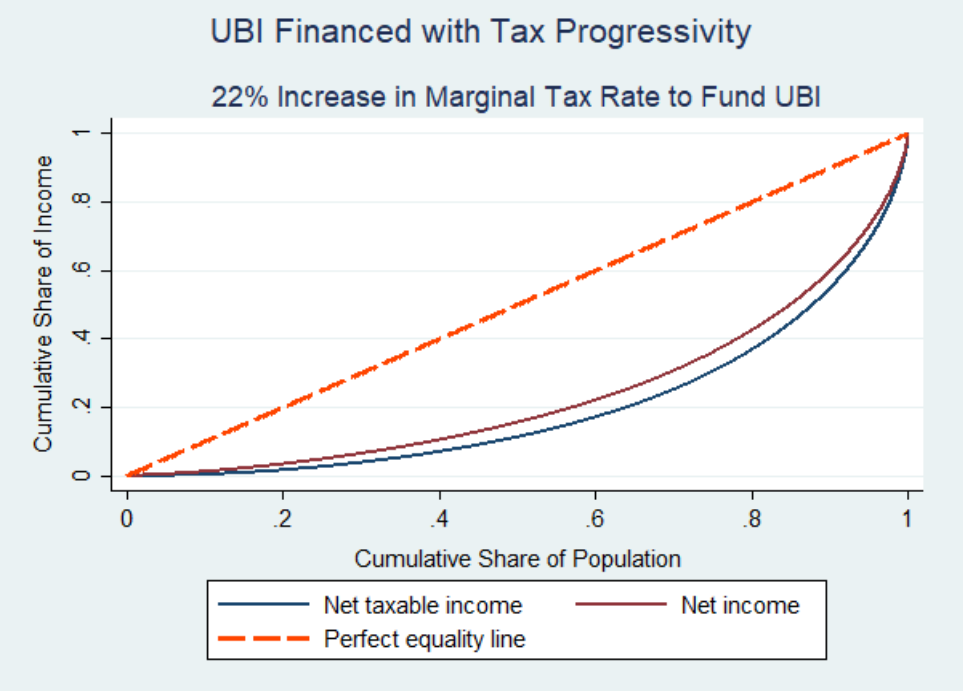
Appendix A

Figure 9: Reduction in income inequality through UBI at UBI Total Budget



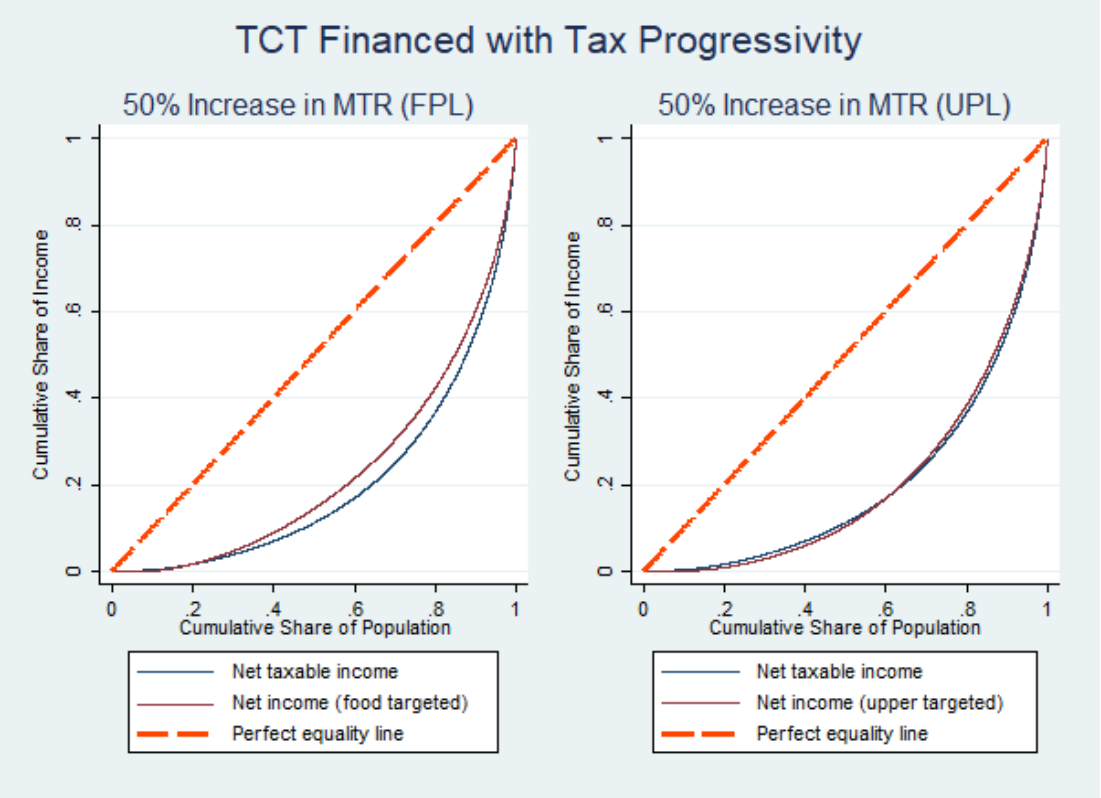
Source: Author's calculations based on data from the wave 5 NIDS survey.

Figure 10: Reduction in income inequality through UBI at TCT Total Budget



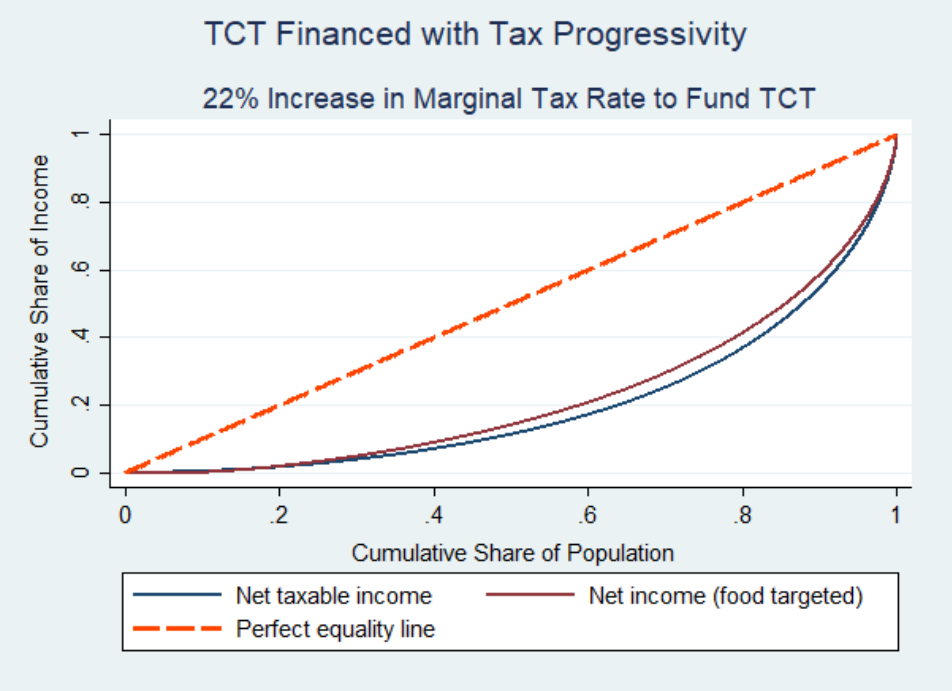
Source: Author's calculations based on data from the wave 5 NIDS survey

Figure 11: Reduction in income inequality through TCT at UBI Total Budget



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

Figure 12: Reduction in income inequality through TCT at TCT Total Budget



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

Appendix B

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

	Total tax revenue (Rand)	Additional tax revenue (Rand)
UBI (Fund both scheme)		
Initial value	254.7 billion	0
10% increase in MTR	286.9 billion	32.21 billion
50% increase in MTR	415.7 billion	161 billion
TCT (Fund both scheme)		
Initial value	254.7 billion	0
10% increase in MTR	286.9 billion	32.21 billion
22% increase in MTR	325.5 billion	70.86 billion

Additional revenue is used in funding UBI and TCT at equal total budget for both program in each approach. All values are weighted.

Income Inequality without UBI or TCT

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

Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
GE (0) = L	0.719	0.710	0.574	0.489	0.797	0.697	0.100	12.56	87.44
GE (1) = T	0.589	0.580	0.567	0.392	0.671	0.540	0.131	19.48	80.52
Mean Income	91,320	124,116	197,324	356,815					

Table 10: Income Inequality Decomposition by Geography across Households (tax progressivity without UBI/TCT)

Theil measure	Rural	Urban	National	Within	Between	% of Between	% of Within
GE (0) = L	0.804	0.757	0.797	0.770	0.027	3.45	96.66
GE (1) = T	0.666	0.642	0.671	0.647	0.024	3.60	96.40
Mean Income	77,979	133,449					

Table 11: Income Inequality Decomposition by Province across Households (tax progressivity without UBI/TCT)

Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	(%) Between	(%) Within
GE (0) = L	0.689	0.880	0.694	0.684	0.797	0.774	0.022	2.80	97.20
GE (1) = T	0.618	0.671	0.574	0.506	0.671	0.649	0.022	3.30	96.70
Mean Income	115,044	93,307	91,091	91,362					

	KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
GE (0) = L	0.735	0.691	0.788	0.796	0.954
GE (1) = T	0.593	0.568	0.671	0.755	0.666
Mean Income	88,833	101,827	149,482	136,766	108,651

Table 12: Income Inequality Decomposition by Household head education across Households (tax progressivity without UBI/TCT)

Theil measure	Primary	Secondary (L)	Secondary (Up)	Tertiary (NU)	Tertiary (U)	No education	National
GE (0) = L	0.672	0.653	0.605	0.610	0.544	0.692	0.790
GE (1) = T	0.519	0.520	0.558	0.510	0.465	0.602	0.687
Mean Income	43,255	57,308	76,409	77,197	226,641	52,177	

	Within	Between	% Between	% Within
GE (0) = L	0.605	0.185	23.40	76.60
GE (1) = T	0.498	0.190	27.58	72.42

Method 1 Results: Income Inequality through UBI Scheme under UBI Total Budget

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

UBI		Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.367	0.388	0.367	0.350	0.431	0.368	0.063	14.52	85.48
		GE (1) = T	0.367	0.379	0.381	0.300	0.434	0.356	0.078	18.05	81.95
		Mean Income	101,751	133,029	192,216	307,744					

NB: Using UBI Total Budget

Table 14: 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	0.374	0.434	0.431	0.417	0.013	3.17	96.93
		GE (1) = T	0.381	0.432	0.434	0.422	0.012	2.86	97.14
		Mean Income	92,888	134,951					

Using UBI Total Budget

Table 15: 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	0.372	0.431	0.365	0.317	0.431	0.419	0.012	2.80	97.20
		GE (1) = T	0.389	0.418	0.358	0.313	0.434	0.422	0.012	2.77	97.23
		Mean Income	122,837	101,506	100,884	98,797					
			KwaZulu-Natal	**North-West**	**Gauteng**	**Mpumalanga**	**Limpopo**				
		GE (0) = L	0.361	0.352	0.475	0.473	0.459				
		GE (1) = T	0.356	0.347	0.464	0.503	0.428				
		Mean Income	103,364	107,120	147,037	138,315	116,034				

NB: Using UBI Total Budget

Table 16: 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	0.300	0.338	0.350	0.365	0.388	0.332	0.468
		GE (1) = T	0.300	0.337	0.374	0.360	0.357	0.344	0.475
		Mean Income	58,067	70,244	82,043	83,191	201,832	69,674	
			Within	**Between**	**% Between**	**% Within**			
		GE (0) = L	0.355	0.113	24.08	75.93			
		GE (1) = T	0.357	0.119	24.96	75.04			

Using UBI Total Budget

Method 1 Results: Income Inequality through TCT Scheme under UBI Total Budget

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

	TCT	Theil measure	African	Colored	Asian/India	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.450	0.464	0.470	0.456	0.522	0.452	0.070	13.38	86.62
		GE (1) = T	0.393	0.394	0.478	0.380	0.482	0.393	0.088	18.34	81.66
		Mean income	115,048	150,167	212,814	365,890					
	Upper	GE (0) = L	0.653	0.645	0.557	0.446	0.717	0.633	0.084	11.75	88.25
		GE (1) = T	0.510	0.503	0.501	0.366	0.584	0.477	0.108	18.41	81.59
		Mean income	107,391	144,329	228,755	373,996					

Using UBI Total Budget

Table 18: 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	Food	GE (0) = L	0.415	0.549	0.522	0.512	0.010	1.99	98.01
		GE (1) = T	0.355	0.504	0.482	0.472	0.010	2.04	97.96
		Mean income	110,177	153,296					
	Upper	GE (0) = L	0.739	0.671	0.717	0.690	0.028	3.85	96.15
		GE (1) = T	0.582	0.554	0.584	0.559	0.025	4.28	95.72
		Mean income	88,819	153,710					

Using UBI Total Budget

Table 19: 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	Food	GE (0) = L	0.472	0.496	0.457	0.381	0.522	0.510	0.012	2.28	97.72
		GE (1) = T	0.440	0.421	0.398	0.340	0.482	0.470	0.012	2.46	97.54
		Mean income	139,689	116,722	115,412	110,154					
			KwaZulu-Natal	**North-West**	**Gauteng**	**Mpumalanga**	**Limpopo**				
		GE (0) = L	0.404	0.421	0.614	0.552	0.533				
		GE (1) = T	0.349	0.391	0.554	0.554	0.425				
		Mean income	120,146	120,873	168,237	159,400	134,051				
	TCT	Theil measure	W. Cape	E. Cape	N. Cape	Free-State	National	Within	Between	% Between	% Within
50% Increase in MTR	Upper	GE (0) = L	0.605	0.806	0.666	0.598	0.717	0.697	0.021	2.87	97.13
		GE (1) = T	0.515	0.599	0.507	0.413	0.584	0.564	0.020	3.47	96.53
		Mean income	137,936	106,679	111,081	105,953					
			KwaZulu-Natal	**North-West**	**Gauteng**	**Mpumalanga**	**Limpopo**				
		GE (0) = L	0.681	0.651	0.694	0.692	0.887				
		GE (1) = T	0.525	0.507	0.579	0.652	0.629				
		Mean income	101,395	124,342	170,026	150,619	124,022				

Using UBI Total Budget

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	Food	GE (0) = L	0.457	0.493	0.512	0.537	0.509	0.387	0.623
		GE (1) = T	0.345	0.389	0.477	0.446	0.450	0.331	0.571
		Mean income	67,143	78,387	85,758	85,136	228,508	88,355	
			Within	**Between**	**% Between**	**% Within**			
		GE (0) = L	0.501	0.122	19.602	80.400			
		GE (1) = T	0.441	0.130	22.694	77.306			
	TCT	**Theil measure**	**Primary**	**Secondary (L)**	**Secondary (Up)**	**Tertiary (NU)**	**Tertiary (U)**	**No education**	**National**
50% Increase in MTR	Upper	GE (0) = L	0.609	0.543	0.568	0.568	0.489	0.630	0.688
		GE (1) = T	0.445	0.426	0.486	0.463	0.424	0.505	0.589
		Mean income	56,360	70,705	94,205	93,161	237,085	60,355	
			Within	**Between**	**% Between**	**% Within**			
		GE (0) = L	0.548	0.140	20.39	79.61			
		GE (1) = T	0.445	0.144	24.45	75.55			

Using UBI Total Budget

Method 2 Results: Income Inequality through UBI Scheme under TCT Total Budget

Table 21: Income Inequality Decomposition by Race across Households (UBI Financed with Tax Progressivity)

	UBI	Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.468	0.491	0.454	0.415	0.546	0.466	0.080	14.68	85.32
		GE (1) = T	0.459	0.466	0.472	0.349	0.539	0.436	0.103	19.06	80.94
		Mean Income	97,730	130,047	197,072	336,677					

Using TCT Total Budget

Table 22: 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	0.488	0.542	0.546	0.527	0.019	3.58	96.54
		GE (1) = T	0.491	0.529	0.539	0.522	0.017	3.24	96.76
		Mean Income	86,654	135,810					

Using TCT Total Budget

Table 23: 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	0.479	0.557	0.466	0.411	0.546	0.530	0.017	3.03	96.97
		GE (1) = T	0.489	0.523	0.448	0.395	0.539	0.523	0.016	3.06	96.94
		Mean Income	120,357	98,659	97,186	96,169					

	KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
GE (0) = L	0.461	0.460	0.588	0.587	0.593
GE (1) = T	0.449	0.442	0.562	0.621	0.528
Mean Income	97,356	105,797	150,074	139,329	113,743

Using TCT Total Budget

Table 24: 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	0.381	0.416	0.434	0.445	0.457	0.422	0.579
		GE (1) = T	0.372	0.405	0.456	0.425	0.414	0.435	0.575
		Mean Income	51,391	64,552	80,038	81,003	216,764	61,834	

	Within	Between	% Between	% Within
GE (0) = L	0.434	0.146	25.17	74.83
GE (1) = T	0.423	0.152	26.45	73.55

Method 2 Results: Income Inequality through TCT Scheme under TCT Total Budget

Table 25: Income Inequality Decomposition by Race across Households (TCT Financed with Tax Progressivity)

	TCT	Theil measure	African	Colored	Asian/Indian	White	National	Within	Between	% of Between	% of Within
50% Increase in MTR	Food	GE (0) = L	0.495	0.519	0.503	0.462	0.579	0.495	0.083	14.40	85.60
		GE (1) = T	0.454	0.455	0.514	0.383	0.547	0.440	0.107	19.52	80.48
		Mean Income	104,718	139,441	205,193	365,326					

Using TCT Total Budget

Table 26: 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	Food	GE (0) = L	0.474	0.596	0.579	0.562	0.017	2.96	97.13
		GE (1) = T	0.435	0.556	0.547	0.532	0.015	2.82	97.18
		Mean Income	95,667	145,706					

Using TCT Total Budget

Table 27: 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	Food	GE (0) = L	0.524	0.564	0.503	0.429	0.579	0.563	0.016	2.75	97.25
		GE (1) = T	0.502	0.502	0.454	0.394	0.547	0.531	0.016	2.90	97.10
		Mean Income	129,894	107,396	106,179	102,207					

	KwaZulu-Natal	North-West	Gauteng	Mpumalanga	Limpopo
GE (0) = L	0.449	0.474	0.661	0.603	0.615
GE (1) = T	0.411	0.451	0.601	0.623	0.504
Mean Income	105,911	112,907	161,307	150,007	123,420

Using TCT Total Budget

Table 28: 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	Food	GE (0) = L	0.461	0.498	0.528	0.547	0.516	0.427	0.657
		GE (1) = T	0.379	0.422	0.507	0.466	0.454	0.398	0.611
		Mean Income	56,708	69,346	82,145	81,682	228,032	73,161	
			Within	**Between**	**% Between**	**% Within**			
		GE (0) = L	0.512	0.145	22.02	77.97			
		GE (1) = T	0.459	0.152	24.84	75.16			

Using TCT Total Budget

Table 29: Proxy-means test prediction of income using OLS

Variables	OLS (Log per-capita consumption
Dwelling rating**:** Need structural repairs	0.024
	(0.050)
Structurally sound, but needs maintenance	0.042
	(0.049)
Structurally sound	0.104**
	(0.049)
Good condition, recent maintenance/renovation	0.121**
	(0.054)
Roof type**:** Bricks/Mixture of mud and cement/Mud	0.147*
	(0.080)
Cement block/concrete/Stone and rock	0.031
	(0.058)
Tile	0.233***
	(0.026)
Asbestos/cement roof sheeting	0.022**
	(0.032)
Wall type**:** Mixture of mud and cement	-0.065*
	(0.037)
Floor type**:** Concrete	0.055*
	(0.032)
Carpet	0.036
	(0.036)
Tiles	0.174***
	(0.037)
Wood	0.338***
	(0.064)
Linoleum/Vinyl	0.099**
	(0.043)
House status**:** House rented	0.152***
	(0.025)
House owned	0.072***
	(0.023)
Water source & Electricity**:** Private tap water	0.066***
	(0.023)
Borehole	0.015
	(0.056)
Household has electricity	0.012
	(0.032)
Toilet type & shared**:** Flush toilet onsite	0.142**
	(0.066)
Flush toilet offsite	0.130**
	(0.066)

Chemical toilet	-0.118
	(0.088)
Pit latrine with ventilation pipe	-0.066
	(0.064)
Shared toilet facility	0.089***
	(0.024)
Cooking energy source**:** Gas	0.185
	(0.034)
Electricity (mains or generator)/Solar energy	0.096*
	(0.054)
Paraffin	0.033
	(0.059)
Heating energy source**:** Gas	0.027
	(0.021)
Electricity (mains or generator)/Solar energy	0.193***
	(0.068)
Paraffin	0.070*
	(0.038)
Telephone	0.315***
	(0.033)
Radio	-0.021
	(0.017)
TV	0.029
	(0.026)
Satellite	0.150***
	(0.021)
Computer	0.347***
	(0.027)
Cellphone	0.126***
	(0.028)
Electric stove	0.010
	(0.031)
Gas stove	0.105***
	(0.026)
Microwave	0.033
	(0.023)
Fridge/Freezer	0.051*
	(0.026)
Washing machine	0.083***
	(0.024)
Lounge suite	0.075***
	(0.021)
Vehicle	0.459***
	(0.028)
Bicycle	0.188***
	(0.033)
Motorcycle	0.036

	(0.071)
Household size: 1-2 people	0.990***
	(0.028)
Household size: 3-4 people	0.402***
	(0.022)
Per-capita room	0.122***
	(0.008)
Household head gender	0.130***
	(0.018)
Household head age**:** 0 - 30 years	-0.057**
	(0.029)
31 - 50 years	0.006
	(0.022)
Household head education**:** primary	0.023
	(0.033)
lower secondary	0.091***
	(0.033)
upper secondary	0.285***
	(0.035)
tertiary (non-university)	0.067**
	(0.033)
tertiary (university)	0.315***
	(0.027)
Observations	4,866
R-squared	0.776

Table 30: Marginal tax rates

Base Rate	22% increase	50% increase
18	21.96	27
26	31.72	39
31	37.82	46.5
36	43.92	54
39	47.58	58.5
41	50.02	61.5
45	54.9	67.5