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 remains a significant 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) financed by progressive taxation can be a new way to reduce inequality in South Africa. In developing countries, however, data on income are limited for most of the population working in the informal sector. Additionally, inclusion in the formal tax system is low. This paper compares the magnitude by which UBI versus targeted cash transfers (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 additional progressive income taxes can be used to finance UBI and TCT, and the extent to which this can reduce income inequality. Results show that UBI and TCT reduce income inequality by more than 30% when these policies are accompanied and financed through progressive taxation; however, TCT reduces inequality more than does UBI.

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 globally (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, 2018b).

Despite these efforts, there has been no significant reduction in inequality in post-apartheid South Africa. This paper considers the impact of adopting and implementing new and robust approaches in addition to or in place of the methods 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 taxes 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 (Gonzales et al., 2017). 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 globally (Ehrenfreund, 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. With existing progressive taxation, UBI 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 UBI can produce a substantial redistribution of income to the poor. But in developing countries, there is no direct observation of income for most of the population working in the informal sector,[2] mostly the poor, and their inclusion in the formal tax system is minimal. Perhaps, this can lead to poor redistribution through the tax system, which can make targeted cash transfers (TCT) and a progressive tax framework more complex in a developing country setting (Hanna and Olken, 2018). Most governments in developing countries target poor and vulnerable people to receive cash transfers using various targeting methods (Del Ninno and Mills, 2015).

[1] Such as inclusion and exclusion errors, direct administrative costs, and other inefficiencies.
[2] About 86% of the labor force in Africa works in the informal sector. (Bonnet et al., 2019)

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), using additional revenue generated from progressive taxation as the source of funding. More specifically, the paper compares the magnitude by which UBI versus TCT, funded by progressive tax, can reduce income inequality. The TCT is implemented 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 provide 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. Whether UBI or TCT is more effective in reducing inequality is an empirical question, and this study provides an answer to this question.

There is relatively little research on income inequality in South Africa (Leibbrandt et al., 2010; Alvaredo and Atkinson, 1903; Inchauste et al., 2017; Van der Berg et al., 2009; Woolard 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 total income and owns almost 95 percent of all wealth (Orthofer, 2016). Other studies (Inchauste et al., 2017; 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 these policies significantly reduce income inequality, yet it remains persistently high. This suggests that South Africa needs increased fiscal redistribution to tackle the issue of stubbornly high income inequality. These studies evaluate how redistribution can reduce inequality 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 study.

[3] This study looks at the distribution of assets (wealth).

[4] Duflo (2003) examined the impact of a cash transfer program in South Africa, not on income inequality but on nutritional status and gender.

This paper contributes to the literature by addressing income inequality using a UBI or a TCT financed by 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 (Qureshi, 2018).

Empirically, the analysis is in two main parts. First, I use household survey data to calculate income inequality measured by the Theil entropy without considering a UBI or TCT. The Theil index is very useful for understanding the nature of inequality. It can be used to divide the population into subgroups, including race,[5] geographical type,[6] province,[7] and household head education. Second, I conduct a policy simulation by applying an additional progressive tax increase to finance UBI or TCT to examine the extent to which these programs can reduce income inequality. I implement three scenarios to estimate the second part, the impact of UBI and TCT on income inequality. The first scenario considers a UBI that requires an 80 percent increase in marginal tax rates to finance its total budget fully; then distributes the same total funding through a TCT that provides higher transfers only to those targeted by the TCT. Next, the second scenario considers a smaller total budget for a TCT that needs only a 13 percent increase in the marginal tax rate to finance fully[8] those targeted by TCT; after, a minor transfer is given to all South Africans to fund UBI, set such that the total budget for UBI equals the TCT total budget. In practice, an 80% increase in the tax rate to fund either a TCT or UBI maybe unrealistic since this can lead to tax evasion and avoidance, generating less revenue and greater deadweight loss. This leads to the third scenario, which considers a fixed UBI budget that requires a 26% increase in the tax rate to fund a UBI, and then at this fixed budget provides transfers to only those targeted by the TCT scheme. The administrative cost for UBI and TCT may differ for these two programs, but due to difficulty in calculating those costs, this study ignores the differences in the cost of these two policies.

The findings show that both a UBI or a TCT implemented simultaneously with pro-

[5] Race consists of African, Colored, Asian/Indian, and White.

[6] 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.

[8] To Fully finance the total budget means the additional revenue generated from the tax increase is either enough or more than enough to pay off the total funding under consideration.

gressive taxation greatly reduces income inequality. The size of this significant decrease in income inequality is more than 45% for the UBI or TCT financed at the higher total budget (80% tax increase) and between 17% to 22% for UBI or TCT financed at the TCT total budget (13% tax increase). For the UBI or TCT financed at a fixed UBI budget with a 26% increase in tax, the inequality reduction is between 25% to almost 30%. Overall, a TCT reduces inequality more than UBI.

The rest of this paper is organized as follows. Section 2 describes the policy background of UBI and progressive taxation and briefly introduces inequality. In section 3, I describe the data, the measures of UBI and TCT, progressive taxation, and 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 Motivation: Policy Background and Inequality in South Africa

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 (UBI) 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 has stubbornly risen despite policies to reduce inequality for over two decades. Over the past three decades, South Africa has relied on redistributive fiscal policy tools to reduce inequality and poverty. 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 program, 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 significantly reduced inequality and poverty (World Bank, 2018b). Yet, there has been no meaningful reduction in income inequality in South Africa. The levels of inequality in South Africa are even higher than those of Brazil, another highly unequal country. The wealthiest 20 percent of South Africans account for 61.3 percent of aggregate consumption expenditure, compared to 55.7 percent in Brazil (StatsSA, 2014; SEDLAC, 2014).

Table 1 shows that a highly progressive social spending and taxation system substantially reduces income inequality in South Africa, as revealed by comparing the decile shares of market income with the shares for disposable income. It is evident from the table that the wealthiest deciles of the population bear much of the tax burden. The government then

rechannels these funds from the wealthy to the poorest to increase the latter's disposable incomes. Despite this progress, inequality of disposable income continues to be persistently high.

This suggests that the country needs more fiscal redistribution to reduce South Africa's severe income inequality further. 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 wealthy (the wealthiest 10% of the population) since the wealthiest 10% of people in South Africa receive more than 50 percent of overall income (Orthofer, 2016). Increasing marginal tax rates for all taxpayers or just for the wealthy will impose a higher tax burden on wealthy people than on poor people. However, a rise in the marginal tax rate may lead to tax evasion and avoidance that could eventually generate less revenue and increased deadweight loss.

Table 1: Distribution of Market Income, Personal Income Tax, 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. (2017). 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 wealthiest 10% (decile 10).

2.2 Tax Progressivity in South Africa

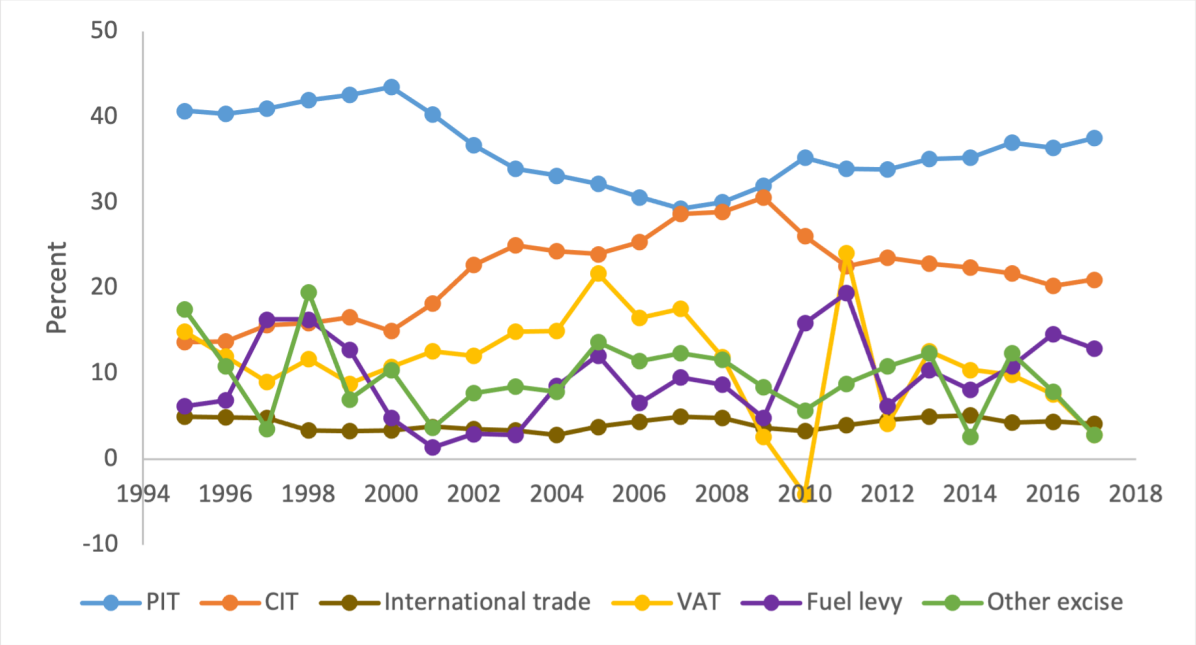
Tax progressivity is a valuable fiscal policy tool that can produce a more equitable income distribution, higher revenues, and possibly improve economic performance and growth (Weller, 2007). South Africa has one of the most progressive tax systems in the world, yet it continues to be an unequal country in terms of net (post-tax) income (Lawson and Martin, 2017). More than 90 percent of the country's tax revenue is generated from direct and indirect taxes (StatsSA,

2012; National Treasury, 2013). The direct taxes that generate the most revenue are the personal income tax (PIT), the corporate income tax (CIT), and the skills development levy[9] tax. The indirect taxes that generate the most revenue are the value-added tax (VAT), specific excise duties, the general fuel levy, and international trade taxes.

Inchauste et al. (2017) 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. South Africa generates more revenue from the personal income tax than from indirect or consumption taxes. The primary goal of progressivity in the PIT is to generate tax revenue in a manner that promotes equity.

As shown in Figure 1, the PIT generates the largest share of South Africa's tax revenue, followed by the corporate income tax (CIT).

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



Source: South Africa Reserve Bank (South African Reserve Bank, 2013).

The graph shows the structure of the primary sources of tax revenue and how they varied between 1995 and 2017. There 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 falling

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

gradually in 2017.

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

This study measures progressive taxation using the personal income tax (PIT) structure, for two main reasons. First, the PIT contributes the most significant 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.

A few studies (Nyamongo and Schoeman, 2007; Van der Berg et al., 2009; Van Heerden et al., 2010; Steenekamp, 2012b; Inchauste et al., 2017) 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.

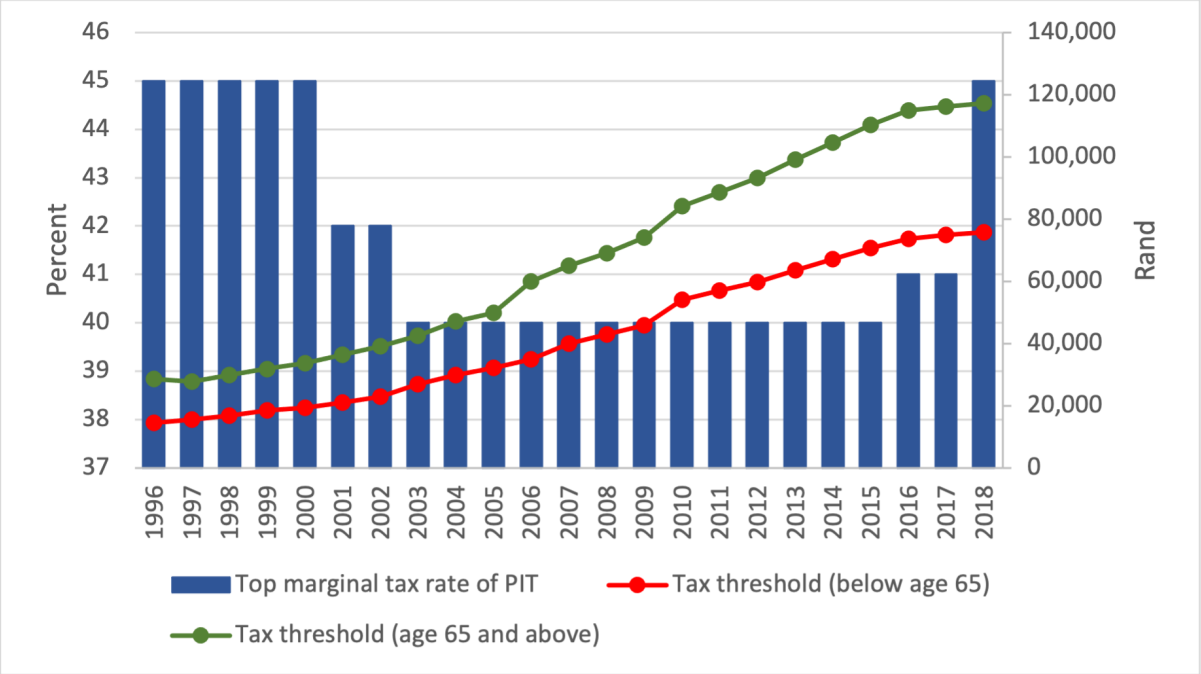
Inchauste et al. (2017) measure the progressivity of the personal income tax and the payroll tax by comparing South Africa to Brazil and Mexico. They find that the Kakwani index for South Africa (0.13) is much smaller than those for Brazil (0.27) and Mexico (0.30). This significant difference is due to South Africa's higher income inequality combined with lower tax progressivity at the bottom end of the income distribution. Steenekamp (2012a) used three measures to examine how the 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 despite the generally progressive nature of the country's tax structure. The top marginal tax rate of the

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

personal income tax was reduced from 45% to 42% in 2001 and to 40% in 2003. It remained at 40% until 2016, when it increased to 41%, and then it increased to 45% in 2018. These changes are displayed in Figure 2. The tax threshold - the level of income or money earned above which people must pay the income tax - increased steadily from 1996 to 2018. This implies that the wealthy - those at the upper end of the income distribution – bear a disproportionate share of the tax burden relative to 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 many economists, politicians, entrepreneurs, and financiers. Some governments – Canada, India, Finland, Kenya, Netherlands, California, and Minnesota - 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, from radical thinkers to liberals and utopian socialists, in the eighteenth and nineteenth centuries, including Thomas Paine, Thomas Spence, Charles Fourier, Joseph Charlier, John Stuart Mill, and John Kenneth

Galbraith (Van Parijs and Vanderborght, 2020) of the twentieth century. Currently, the IMF has joined the campaign, and its latest Fiscal Monitor says that UBI could reduce income inequality (Gonzales et al., 2017). 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 that it is not contingent on the recipient satisfying any compliance criteria to receive the grant; and 3) It is universal, so that it is not targeted to any specific group of people based on their socio-economic or demographic status.

UBI is being debated in both developed and developing countries, which is surprising considering the different economic environments. The leading economic argument behind UBI adoption in the context of developed countries is the imminent threat of unemployment due to globalization and automation. In contrast, it is recommended as an effective policy measure to combat poverty in developing countries. UBI can also be an effective policy to address rising inequality and wage stagnation in both developed and developing countries. This study focuses on a developing country, South Africa.

Skeptics and opponents of UBI frequently raise two significant 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, and direct administrative costs.

There is limited evidence on the effects of a UBI in developing countries, and only three developing countries have a UBI, which is 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, 2018; Gentilini et al., 2019). However, none of these pilot studies has been experimentally examined. Many studies have experimentally evaluated existing TCT schemes in developing countries. Evidence from such studies shows

that, on average, cash transfers to the targeted poor do not lead either to disincentives to work or to spending wastefully on unnecessary consumption (Banerjee et al., 2017; Bagstagli et al., 2016; Evans and Popova, 2017). Other findings from experimental evaluations of targeted cash transfer programs include an increase in total expenditure, test scores, school attendance, cognitive development, use of health facilities, dietary diversity, labor force participation, women's empowerment, marriage and use of contraceptives; and decrease in child labor migration, fertility, borrowing, and domestic violence (Banerjee et al., 2019). Hanna and Olken (2018) examine how transfers are targeted in developing countries and present empirical evidence on the tradeoff between UBI and TCT programs in Indonesia and Peru.

Various alternatives for funding UBI and TCT include raising revenue from incremental taxes via progressive taxation, cutting government expenditure or canceling existing social grants programs, running larger budget deficits, and other non-tax 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. A UBI is then compared to a TCT program, which is the mechanism used for most of the existing cash transfer programs in South Africa.

In its outcome, UBI is like a Negative Income Tax (NIT), but these policies move on 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 taxes on their income (progressive tax), those below the poverty threshold pay increasingly negative[12] tax rates on their income; or that is, they 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 rich (Tondani, 2009). So, due to the taxes to fund UBI, the wealthy end up with less income than before the program, even though they get a lump sum transfer. NIT proposals have been examined in the United States in previous decades Brown (1988); Moffitt (2003).

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

In summary, comparing UBI to TCT, both can be funded by an increase in marginal tax rates through progressive taxation, which could help construct a new approach to reducing 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 and administrative cost may make it less effective. Therefore, it is unclear which of these two policies is most effective for reducing income inequality.

3 Data, Measures, and Descriptive Statistics

This section describes the data and then explain in detail the approach used to measure inequality, progressive taxation, universal basic income (UBI), and a 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), the first national household panel data study in South Africa. The mode of the interview is face-to-face with individual household members. The Southern Africa Labor and Development Research Unit (SALDRU), located in the School of Economics at the University of Cape Town, conducts the NIDS project. NIDS collects data on the livelihoods of individuals and households over time. It collects detailed 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.

Five waves of nationally representative panel data were 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 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 collected from February 2017 to December 2017. It focuses on the income and expenditure data. The total number of individuals and households planned to be interviewed were 33,958 and 13,719, respectively. About 20% households refused to respond to the survey, which resulted in a smaller actual sample size.

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 a disability, being retired, or doing housework. After merging, creating new variables, and other data management of

the raw survey data, a total sample of 27,463 individuals and 10,842 households were utilized for the analysis of this study. As presented in Table 2, of the 27,463 household members, 8,947 were working for labor income in either the formal sector or the informal sector.[13] Of those working for labor income, 6,969 were working in formal sector jobs. The sample for analysis is restricted to all households that responded to the survey. There is a significant discrepancy in the sample size of the raw data and the analysis data due to the 20% of households that refused to respond to the survey.

Table 2: NIDS (Wave 5) Interview and Observations at the Household and Individual Level

	Number of Households	**Number of Individuals**
Total number plan to interview	13,719	33,958
Total number successfully interviewed	10,842	27,463
Households/Individuals working (labor)	6,709	8,947
Households/Individual with formal work	5,463	6,969

The NIDS data do not provide information on annual gross taxable income and tax liability; they provide only net income from all sources. To calculate gross taxable income, the 2018 tax code from the yearly budget review report (National Treasury, 2018) is applied to the NIDS data on net income, and then gross taxable income is used to calculate the tax liability variable. I consider only income sources currently taxed through the personal income tax system, which applies only to labor income and is by far the largest direct tax paid by individual households. After applying the tax codes to the labor income, I added the non-labor and capital income components from the NIDS data for all individuals to get the total income of each individual. I included capital income because it creates more income which can consequently widen the income inequality gap further (Chi, 2012).

This labor income consists of all employment earnings, profit shares, and bonuses in the NIDS data. To apply the tax codes to each individual,[14] I calculated each individual's aggregate net labor income, which is the sum of the various components of labor income that were collected from each working individual. These components include income from main

[13]The formal sector refers to where individuals work for a wage or salary, whereas the informal sector is where they work as self-employed, casual, and other informal jobs.

[14]Tax filing in South Africa is on an individual basis. But married couples can file jointly or separately depending on whether the pair married in a community of property or not. Marriage in a community of property refers to a marriage contract where couples marry without an antenuptial contract.

and second job, casual wages, self-employment income, 13th cheque, bonus payment, profit share, "help friend"[15] income, and extra piece-rate income. I applied the PIT tax rates to the aggregate net labor income to calculate gross taxable income.

Table 3: 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 (below age 65)	R13 635
Seconday (age 65 and over)	R7 479
Tertiary (age 75 and over)	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

From Table 3, the monthly medical tax credit for the 2018 tax year is R303 for the taxpayer, and the first dependent, and R204 for each additional dependent. 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 the taxpayer's dependents.[16] Due to a lack of data, deductions, exemptions (pension fund contributions), and government transfers are not used to calculate the individuals' gross taxable income.

Given the tax schedule in Table 3, equations (1) and (2) show how gross taxable income can be calculated from the net taxable income, the tax rebate, the fixed tax amount, and other

[15] Money offered by friends or family.

[16] I used the South African medical tax credit scheme to back out each gross taxable income to ensure that the gross taxable income corresponds to the gross income from which tax liability is calculated. This medical tax credit is for all households who pay taxes.

details of the income tax (South African Reserve Bank, 2015; Rasmussen, 2017):

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

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

$$y^g = \frac{y^n - r + F_i - t_i L_i}{1 - t_i} \tag{3}$$

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 (shown in Table 3, for example R34,178); t_i is the marginal tax rate for each bracket (shown in Table 3, for example 26%); L_i is the lower bound tax base for each tax bracket (shown in Table 3, for example R189,881). The gross taxable income is the base income variable to which different hypothetical tax codes can be applied.

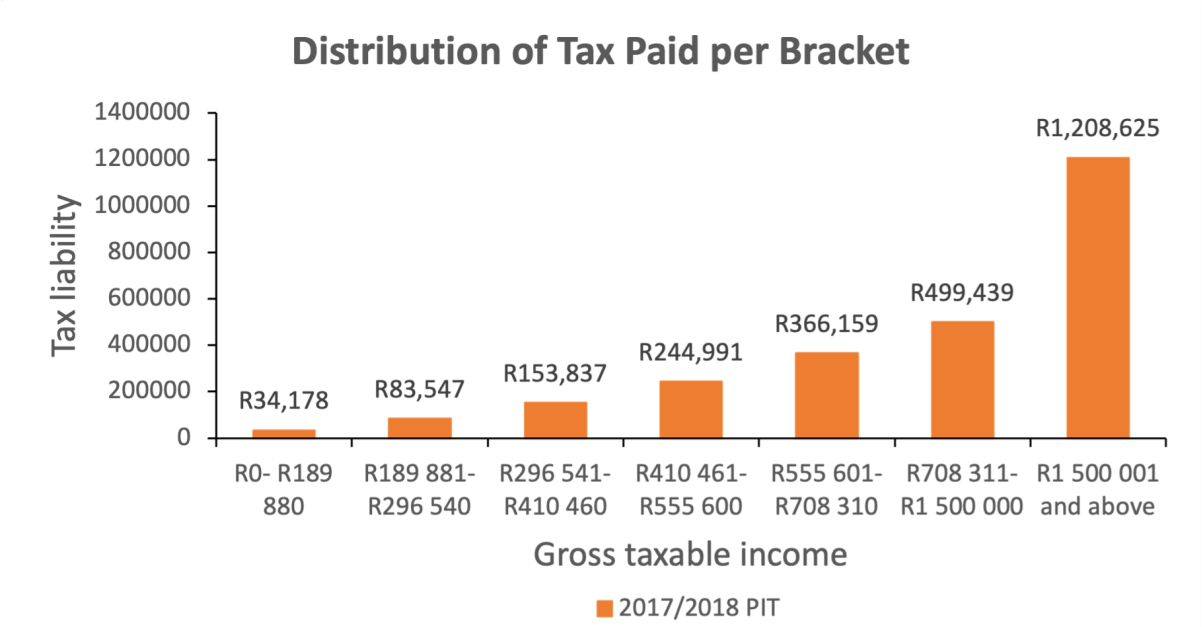
Given an individual's gross taxable income, the next step is to calculate his or her tax liability. The 2018 personal income tax rates for South Africa are reported in Table 3, showing the seven structured tax brackets and their respective tax rates and fixed amounts.[17] Tax liability is calculated in two steps. First, the seven structured tax brackets are used to calculate an individuals' "pre-rebate" tax liability. Second, that tax liability is reduced by deducting the "rebates" and "medical tax credits" shown in the bottom half of Table 3. If these deductions lead to a negative number for tax liability, then the individual pays no taxes. That means the individual's gross income is below the tax threshold presented in the lower half of Table 3. Therefore, such individuals are not taxed. The tax codes applied to equations 1, 2, and 3 are for individuals whose income is above the tax threshold. This is explained further in equation 4.

$$\begin{aligned} TL_i &= \max\left[y^g - (y^g - (y^g - L_i)t_i - F_i + r), 0\right], \\ &\text{so, if } y^g - (y^g - (y^g - L_i)t_i - F_i + r) \geq 0, \text{ use equation 3,} \\ &\text{else, if } y^g - (y^g - (y^g - L_i)t_i - F_i + r) < 0, \text{ then } y^n = y^g. \\ &\text{When this possibilty holds, then } y^n < \frac{-F_i + r}{t_i} + L_i. \end{aligned} \tag{4}$$

[17] These tax codes are applied to individuals.

where, TL is the tax liability for each tax bracket. The first tax bracket reported in Table 3 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 3, then $y^n = y^g$, that is, there is no tax. Tax rebates apply only to individuals who pay taxes, so if you are below the tax threshold and do not pay taxes, you also do not get a tax rebate. The marginal tax rate increases with income, ranging from 18 percent (lowest tax bracket; R0 – R189,880) to 45 percent (highest tax bracket; R1,500,001 and above) for 2018. Table 3 is also graphically displayed in Figure 3, explaining the distribution of tax paid per tax bracket.

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



Source: National Treasury of South Africa, 2016 & 2018 (National Treasury, 2018), from March 1st, 2017, to February 28th, 2016 & 2018. This figure shows the tax schedule in Table 3, where the tax liability is the fixed tax amount added to the marginal tax rate multiplied by the lower bound tax base for each of the seven brackets.

3.2 Measurement of Inequality

The income distribution can be defined in terms of households, giving each household equal weight, or in terms of individuals, giving each person equal weight. Since giving each household equal weight gives smaller weights to individuals in large households, it is best to give each person 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 central 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 fundamental axioms: mean independence, population size independence, symmetry, Pigou-Dalton transfer sensitivity, and group decomposability (Foster, 1983).

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 richer than the former brings about a decrease in the inequality measure. Symmetry is satisfied when two individuals switch their incomes: the measurement of inequality should remain unchanged. There are two 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 five axioms given above. Therefore, the two inequality measures chosen for this study are the first Theil entropy measure (T) and the second Theil entropy measure (L).[18] These inequality measures are defined as:

$$T = T_{\alpha=1} = \frac{1}{N_i}\sum_{i=1}^{N}(\frac{y_i}{\mu})\ln(\frac{y_i}{\mu}) = \sum_{g=1}^{G}(\frac{y_g}{Y})T_g + \sum_{g=1}^{G}(\frac{y_g}{Y})\ln(\frac{\frac{y_g}{Y}}{\frac{N_g}{N}}) \tag{5}$$

$$L = T_{\alpha=0} = \frac{1}{N_i}\sum_{i=1}^{N}\ln(\frac{\mu}{y_i}) = \sum_{g=1}^{G}(\frac{N_g}{N})L_g + \sum_{g=1}^{G}(\frac{N_g}{N})\ln(\frac{\frac{N_g}{N}}{\frac{y_g}{Y}}) \tag{6}$$

Where $\mu = \frac{\sum_{g=1}^{N} y_g}{N} = Y/N$ is the mean income for the whole population; Y is the total income of the population; y_i is the income of individual i; y_g is total income of group g; N_g is the population in group g; N is the total population; T_g and L_g are the respective inequality measures for group g; and α is the parameter of the generalized entropy family that regulates

[18] The second Theil entropy measure is also referred to as the mean log deviation measure.

the weight given to distances between cases in different parts of a distribution that captures the distributional sensitivity.[19]

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

3.3 Universal Basic Income Measure for South Africa

Over two decades after the first democratic elections in 1994, persistent poverty, inequality, and a lack of wage employment remain 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 organizations, and civil society (BIG Finance Reference 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 Finance Reference Group, 2004).

The White Paper for Social Welfare – the basic framework proposed to increase social welfare in South Africa - 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, Congress of South African Trade Unions (COSATU), and the Democratic Alliance are proponents of this grant in one way or another. In contrast, the African National Congress (ANC) 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 Finance Reference Group, 2004; Lombard, 2008). However,

[19] As α decreases, the T_α index becomes more sensitive to inequality at the lower end of the distribution.

the BIG coalition is still advocating for a universal, non-means-tested grant of at least R100 per month, which could help reduce poverty, encourage local consumption, and establish sustainable livelihoods. This is likely because the current means-tested programs have not helped reduce poverty. Also, the coalition has conducted non-experimental studies, claiming 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, substantial poverty declines in Brazil, Cambodia, and Peru led to meaningful inequality reduction (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 levels of funding for a UBI or for a TCT scheme, one based on the food poverty line and the other based on the general poverty line (Statistics South Africa, 2018). The 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.

The 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. This poverty line is R1,138 (2017) per individual per month (Statistics South Africa, 2018). These food and general poverty lines are reported in the first two lines of Table 4. These poverty lines are applied to the sample of 27,463 household members and then multiplied by the sampling weight to expand the sample size to South Africa's population.

I use three scenarios to generate the total budget required. For Scenario 1, I calculate how much total budget is needed to fund a UBI that transfers to all South Africans an amount equal to the food poverty line, and then I do the same for the general poverty line. For Scenario 2, I calculate the total budget required to fund a TCT that transfers an amount equal to the food poverty line only to individuals whose predicted per-capita consumption is below the food poverty line, and then I do the same for the general poverty line. These total derived budgets are the total revenues the government needs to finance the different amounts of UBI

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

	Food PL (Rand)	General PL (Rand)
2017		
Poverty line (Rand/person/month)	531	1,138
Poverty line (Rand/person/year)	6,372	13,656
Total budget required		
Scenario 1: Transfers an amount equal to the PL to all	258.4 billion	553.8 billion
Scenario 2: Transfers only to people below the PL	41.08 billion	233 billion
Scenario 3: Double the budget from Scenario 2	82.16 billion	466 billion

See the text for explanation of the three scenarios. All values are weighted. PL is Poverty Line.

(for all households) and TCT (for targeted households only). For brevity, I restrict the analysis of this study to total budgets calculated at the food poverty lines for both UBI and TCT. Note that the results using the general poverty line (available upon request) produce similar results for the general poverty line.

The total cost of a UBI that provides an amount equal to the food poverty line (R6,372) to all South Africans is 258.4 billion. The cost of a TCT that provides the same amount (R6,372) but only to people whose predicted consumption expenditure is below the food poverty line is 41.08 billion. Finally, I add a third scenario, which is a doubling of the Scenario 2 budget. This is used to double the transfer received per year for the UBI program.

3.4 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 and cannot be taxed. This could make the implementation of a TCT more complicated in a developing country (Hanna and Olken, 2018). Most governments in developing countries target poor and vulnerable people to receive social grants through various targeting methods, including proxy means-testing, community-based targeting, geographic targeting, and self-targeting (Del Ninno 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 uses 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). A PMT is used to predict per capita income or per capita consumption expenditure using observable household characteristics, such as ownership of consumer durables or assets, demographic variables, dwelling characteristics, and attributes of the household head. The predicted income or per capita consumption is then used for means-testing to determine whether a household or an individual is eligible for benefits. If the predicted per capita income or expenditure is below a certain chosen threshold, then a household or an individual is considered eligible for benefits. If the predicted income or expenditure is above the selected threshold, then the household or individual is ineligible for benefits.

3.4.1 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 households' poverty status. This regression is applied to the NIDS survey data and then is used to make out-of-sample predictions for the relevant population. 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 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 to check the model's fit.

Afterward, 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 used to create the PMT score for a household. The OLS model has an R-squared of 0.78, implying that the regression has strong explanatory power. Predictions of income and consumption using regression-based PMT inevitably lead to imperfect targeting and thus to inclusion (type II) and exclusion (type I) errors. 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 in the target population whose actual per-capita consumption is below the poverty line but is

predicted to be above the poverty line. In modeling the TCT program for this study, households are targeted using the food and general poverty lines as thresholds.[20] Households below the food poverty line are considered extremely poor, and those below the general poverty line are considered poor (which includes those who are extremely poor).

The analysis based on the food poverty line classifies as poor all households whose predicted per-capita consumption is less than the food poverty line, giving all such households a transfer equal to the food poverty line. This is explained further below. In contrast, the analysis based on the general poverty line classifies as poor any household whose predicted per-capita consumption is less than the general poverty line. The general poverty line is only used as a threshold and not as a transfer amount in this study because the budget becomes too high and will require a very high increase in the marginal tax rate to fund it, which is unrealizable.

Consumption is used for the PMT regressions instead of income for two main reasons: 1) difficulties in ascertaining income in a survey; 2) Consumption is smoother than income (likely to fluctuate over time less than income). The regression-based PMT models are specified below.

$$y_i = \alpha + \beta \boldsymbol{X_i} \tag{7}$$

$$\hat{y}_i = \hat{\alpha} + \hat{\beta} \boldsymbol{X_i} \tag{8}$$

Where $i = 1, ..., N$, y_i is log consumption expenditure per capita of household i, $\boldsymbol{X_i}$ is a vector of covariates (assets and others), N is the survey sample size, and $\hat{\alpha}$ and $\hat{\beta}$ are estimated coefficients from an OLS regression of equation 7. The PMT regression results are reported in Appendix Table 19.

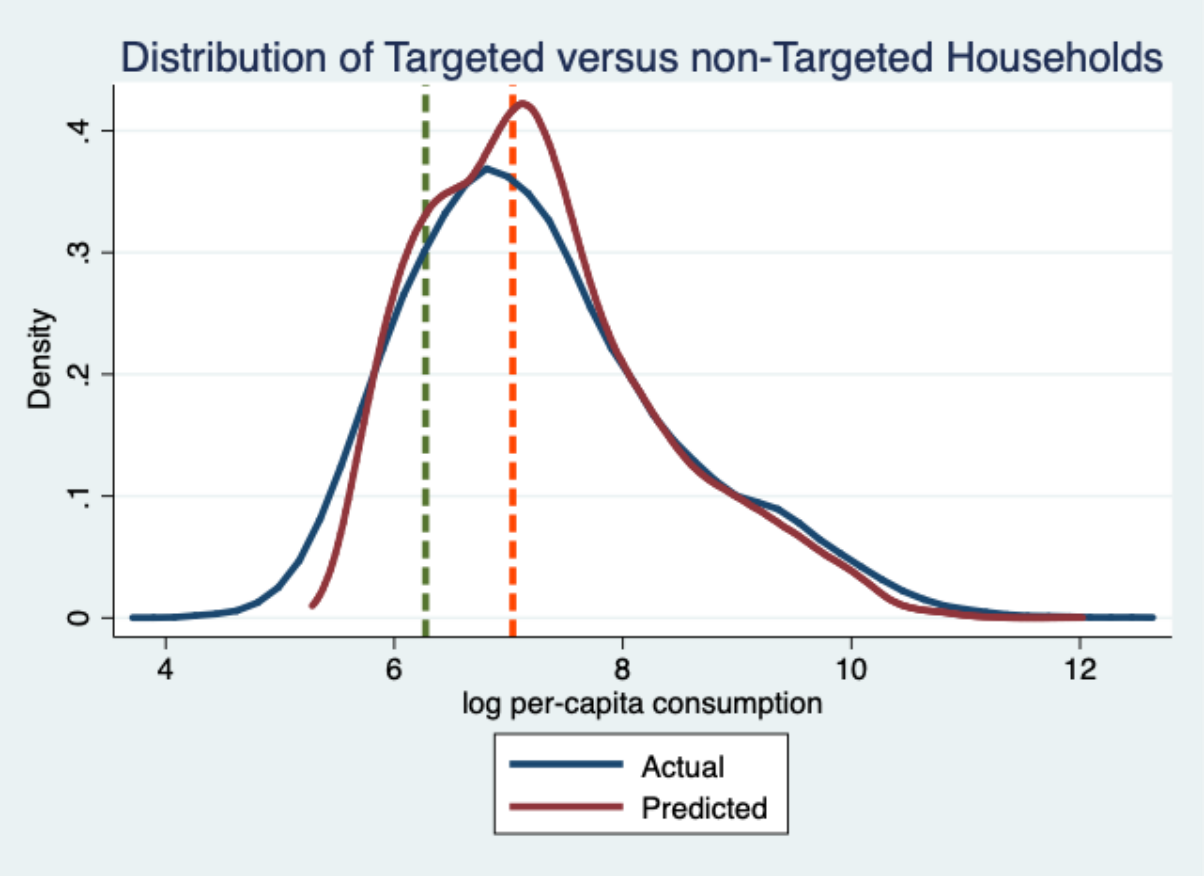
Figure 4 shows the distribution of households' actual and predicted log incomes, as well as the food poverty line (in forest green), and the general poverty line (in orange-red). These lines depict the households targeted (below the bars) against the non-targeted households (above the lines). Of 25,625 household members sample used for targeting,[21] 14,838 (57.9%)

[20] In targeting households, I use both poverty lines as the threshold for scenario 2. But, in estimating the total budget for the first two Scenarios in Table 4, I use the food poverty line as a transfer for this study, though I also estimated that for the general poverty line.

[21] The number of the household members (25,625) used for targeting is less than the total sample of people

were targeted at the general poverty line, and 6,637 (25.9%) were targeted at the food poverty line.

Figure 4: Distribution of Households' Actual and Predicted Log Incomes



Source: The forest green line is for the food poverty line (2017), and the orange-red line is for the general poverty line. The households with predicted consumption below the poverty line are targeted to receive transfers under the TCT policy.

Appendix Table 21 displays the inclusion and exclusion error rates and the coverage rates of targeting. The coverage rate for those targeted at the food poverty cutoff is 92.2%, that is the predicted per-capita expenditure correctly identifies 92.2% of households whose per capita expenditure is below the food poverty line. For the general poverty line, the coverage rate is 93.8%. The coverage rate is simply one minus exclusion error rate, in which households identified as poor are correctly targeted. The inclusion and exclusion error rates for targeting at the food poverty line threshold are 4.8% and 7.8%, and those targeted at the general poverty line are 5.8% and 6.2%.[22]

(27,463) because of missing consumption expenditure for 1,838 household members.

[22]Inclusion error rate is the proportion of those identified as poor who are not poor, and the exclusion error rate is the proportion of the poor who are not identified as poor.

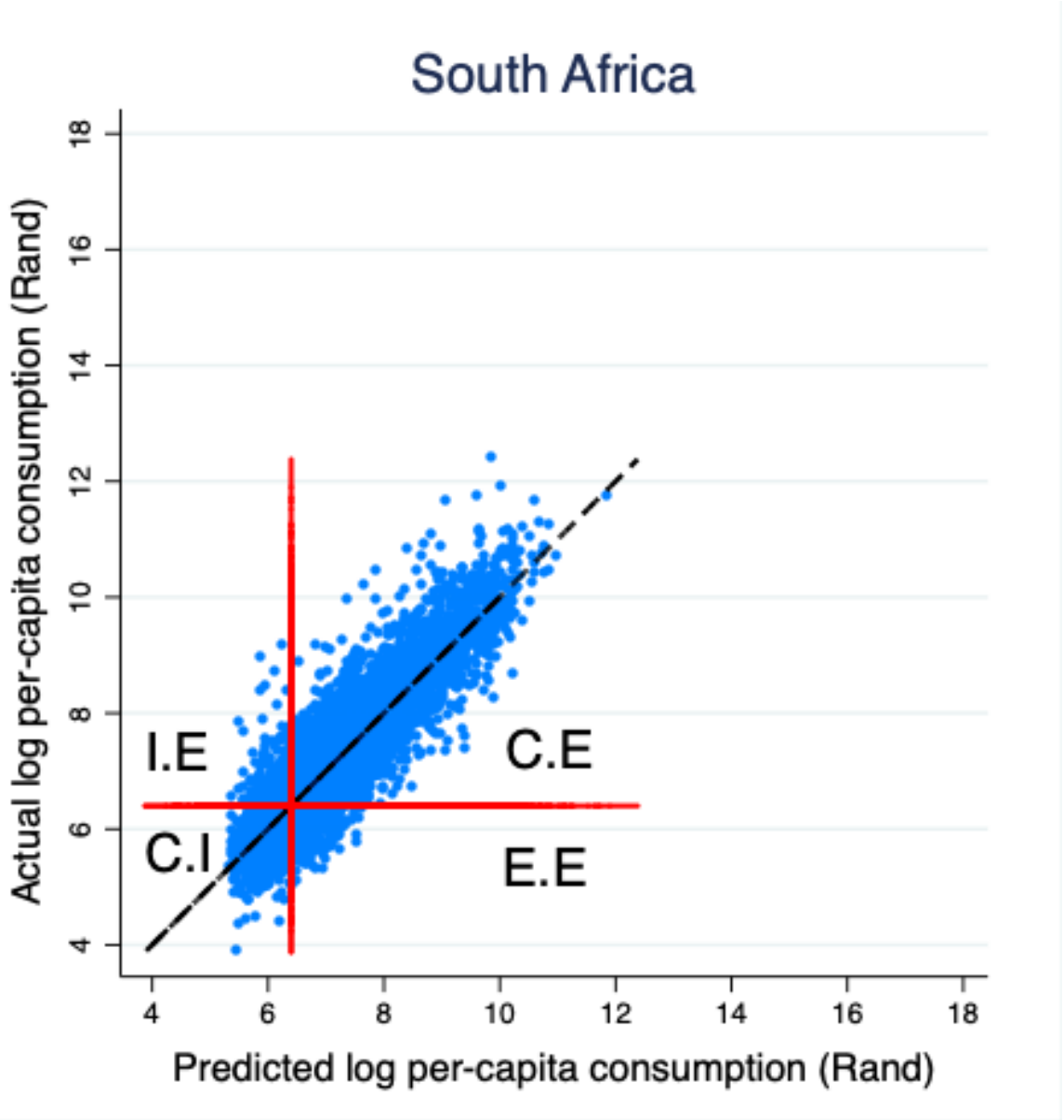
3.4.2 Tradeoffs between Inclusion and Exclusion Error

The accuracy of the PMT for targeting purposes is displayed graphically in Figure 5, which plots actual per-capita consumption against predicted per-capita consumption. Four quadrants are shown 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 must strike a balance between the inclusion and exclusion errors it makes. This figure plots the results with one cutoff a, at 35 percent of the log predicted values, to provide a visualization of the targeting mechanism and the four components (quadrants) of targeted transfers. Clearly, shifting the red vertical line to the left or the right would change the balance of the inclusion and exclusion errors.[23]

For instance, if the government aims to assist those who are poor, then not giving the assistance to anyone (setting the cutoff to zero, $a = 0$) means no transfers, leading to an extremely high exclusion error since everyone below the poverty line is excluded. However, this will 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 the cutoff to infinity, $a = \infty$) leads to no exclusion error because all poor people will get the transfer. Yet, this leads to a very high inclusion error since everyone with high-income status will also receive the transfer. So, varying the cutoff value between these two extremes ($a = 0$ and $a = \infty$) allows one to trace the tradeoffs between inclusion and exclusion errors that the government may encounter. Still, given a limited budget, a higher cutoff point for transfer eligibility means a small transfer will be given to each eligible household.

[23] 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.

Figure 5: Actual and Predicted Household Per Capita Consumption (logged values)



Source: This is from the regression using basic PMT variables. The red lines represent the country's poverty line, 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).

3.5 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 R134,432 and R120,941, respectively. The net aggregate income is explained in section 3.1, and the net

taxable income is the income variable derived from applying the tax codes to net aggregate income to create gross taxable income and then calculating tax liability to the gross taxable income. So, subtracting the tax liability from gross taxable income gives net taxable income. Total expenditure is the sum of food, nonfood, and rent expenditure. The coefficient of variation of households' net worth (7.98) is far larger than the coefficient of variation of the income variables. This suggests substantial heterogeneity in the household wealth distribution, which is consistent with the evidence that wealth is much more unequally distributed than income (Orthofer, 2016). Tax liability is the tax revenue the government generates from the tax paid by individuals.[24]

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

Variable	Mean (Rand)	SD (Rand)	CV
Variables from data:			
Net aggregate income (labor)	121,785	298,368	2.45
Total income	162,152	338,951	2.09
Food expenditure	21,244	33,387	1.57
Nonfood expenditure	65,931	151,307	2.29
Rent expenditure	24,495	39,014	1.59
Total expenditure	116,929	201,997	1.73
Net worth	9,542,006	76,100,000	7.98
Labor income	129,250	185,972	1.44
Non-labor income	42,798	116,970	2.73
Household size	4.39	3.07	0.70
Created variables:			
Gross taxable income (labor)	134,432	332,423	2.47
Net taxable income (labor)	120,941	297,819	2.46
Tax liability	15,928	70,836	4.45

Statistics is done at the individual level. Number of observations: 27,463. CV is coefficient of variation, ratio of SD to mean, all values are weighted.

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 farm observations into rural. The majority of the household sample population for this study are Africans (79.3%), followed by Colored and white $(9\% each)$, and Asian/Indian (2.7%). The geographical type variable classifies about two-thirds (67.2%) of households as

[24]Practically, this tax liability is equal to a government's tax revenue only if tax compliance is perfect.

living in urban settings and slightly less than one-third (32.8%) in rural areas. South Africa has nine provinces: Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, and Limpopo. The highest proportion of households are in Gauteng (27.7%), KwaZulu-Natal (19.2%), and Western Cape (12.3%). 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. Most household heads have upper secondary (30.2%), tertiary (university) (19.1%), or lower secondary education (18.9%).

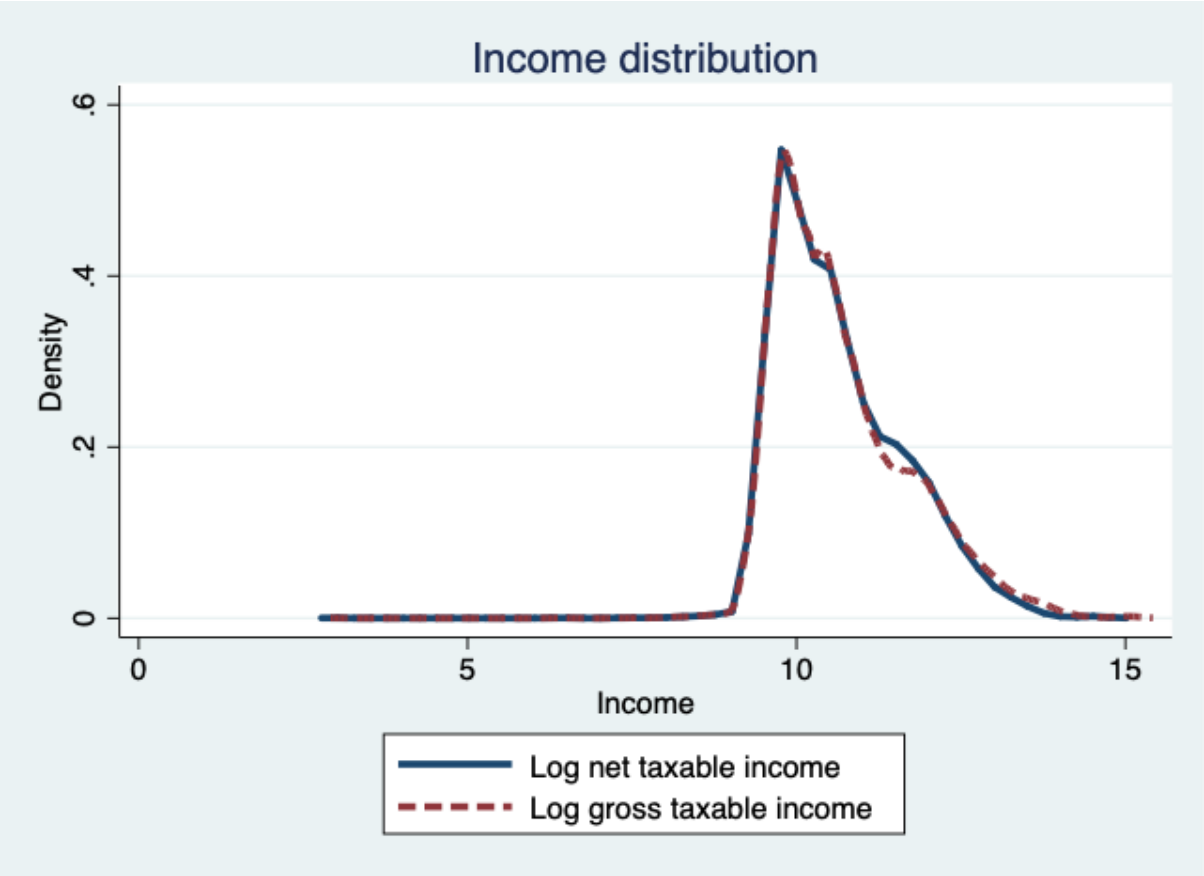
Figure 6 shows the graphical representation of the log of the gross and net taxable income distribution, which are similar. This income distribution is displayed by decile group decomposition in Table 7, with the wealthiest 10 percent of individuals (decile 10) having the highest gross (49.1%) and net (42.8%) income share. The mean of the first six deciles (1-6) are the same because more than half of the population does not pay taxes. This is because their incomes are below the tax threshold, so that their net income is the same as their gross income, as explained in section 3.1.

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

Variable	Frequency	Percent
Race		
African	29,095,736	79.28
Coloured	3,289,572	8.96
Asian/Indian	1,004,609	2.74
White	3,311,602	9.02
Province		
Western Cape	4,986,930	12.3
Eastern Cape	4,343,541	10.71
Northern Cape	1,002,479	2.47
Free State	2,078,000	5.12
KwaZulu-Natal	7,769,296	19.16
North West	2,111,040	5.21
Gauteng	11,233,248	27.7
Mpumalanga	3,378,993	8.33
Limpopo	3,650,883	9.0
Geographical type		
Rural	13,316,866	32.84
Urban	27,237,543	67.16
Household head education		
Primary	7,633,209	13.74
Lower secondary	10,504,666	18.91
Upper secondary	16,776,148	30.2
Tertiary (non-university)	4,822,948	8.68
Tertiary (university)	10,585,965	19.05
No education	5,232,738	9.42

All values are weighted.

Figure 6: Distribution of Log Gross and Net Taxable Income



Source: The author's calculations are based on wave 5 NIDS survey data.

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	13,740	1.4	13,740	1.6
2	18,431	2.1	18,431	2.5
3	22,499	1.8	22,499	2.1
4	30,059	3.4	30,059	4.1
5	37,425	2.8	37,425	3.3
6	47,809	4.6	47,809	5.4
7	67,716	7.3	67,485	8.6
8	105,455	9.1	99,687	10.0
9	181,649	18.4	161,273	19.7
10	551,447	49.1	408,087	42.8

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 Wave 5 of the National Income Dynamics Study (NIDS) data. This section consists of two parts. First, it estimates income inequality using the two Theil inequality measures for the current income distribution, that is, without adjusting for UBI or TCT. Second, it presents a policy simulation that uses the increase in progressive income tax rates to finance either UBI or TCT to examine how the extra revenue generated from a more 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) income[25] distribution under the existing progressive South African tax structure, without considering 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 disparity in the mean incomes between the groups, which can be written as:

$$I_{Total} = I_{Within} + I_{Between} \tag{9}$$

The term I_{Within} is the contribution of income inequality within each group to overall income inequality. The between-group component, $I_{Between}$ calculates the contribution to the overall inequality from the variation in mean income across the different groups.

[25] Same as net taxable income

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 three different tax schedule scenarios. In the first scenario, Scenario 1, I simulate a 80% increase in the marginal tax rate for all tax brackets in the South African tax codes, which generates the revenue needed for a UBI program that transfers to all households an amount equal to the food poverty line. For the second scenario, Scenario 2, I simulated a 13% increase in the marginal tax rate, which generates the revenue needed for a TCT program that provides a transfer equal to the food poverty line only to those individuals whose predicted per capita expenditure is below the food poverty line. I also used the revenue generated by each scenario to fund both a UBI program and a TCT program under the same total budget.

The downside of comparing 80% and 13% increases in the marginal tax rate to two different programs is that they may not be reasonable or politically feasible. Regardless, to fund all households at the food poverty line, an 80% increment in the marginal tax rate is required to raise money to fund the total budget of UBI. But in practice, such a large tax increase is likely to be politically infeasible. Therefore, an additional scenario is included, which is Scenario 3. This third scenario doubles the total budget of Scenario 2, so that the rise in the marginal tax rate for Scenario 3 is fixed at 26%. Similarly, this revenue is used to fund a UBI or TCT program under the same total budget.

Scenario 1: Simulating the Impact of UBI and TCT on Inequality Using a Budget that is Sufficient to Fully Fund UBI:

These simulations compare UBI and TCT both financed by an increase in tax revenue that is sufficient to fund UBI transfers equal to the food poverty line (R6,372 per year) for all individuals in all households in South Africa. The total budget for this amounts to R258.4 billion, which requires an 80% increase in tax rates. For simplicity, I assume that there is no change in the work hours of household members, which means that their pre-transfer gross taxable income remains unchanged after the tax increase and the receipt of the transfer. Also, estimating the impact of the transfers on hours worked is beyond the scope of this study.[26] However, their net taxable income will change according to the change in the marginal tax

[26] Other studies have shown that cash transfers have very little effect on labor supply (Banerjee et al., 2017)

rate. Using equation (2), I increase the marginal tax rate from t to t_k, assuming that y^g remains the same since work hours are constant, and increase in 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:

$$y_k^n = y^g(1 - t_k) + t_k L - F_k + r \tag{10}$$

where the subscript k refers to the percent by which the old tax rate increases (80 percent).

To calculate the total revenue generated, for each household I 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}) for that household. 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}) from this household. To examine the impact of UBI funded by a k percent increase in taxes on the distribution of income, I add y_k^n and UBI to get Y_{UBI}^n, using the equation:

$$y_{UBI}^n = y_k^n + UBI; \quad \text{where } y_k^n = y^n - R_{add} \tag{11}$$

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 budget of R258.4 billion for UBI,[27] the additional revenue generated from this tax increase 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.[28] The transfer amount for the TCT program is estimated as the total budget for UBI divided by the number of those whose predicted per capita consumption is below either food poverty line or below the general poverty line. Separate transfer amounts are calculated for the two poverty lines. After that, the new income distribution with the

[27] From the 80% increase in the marginal tax rates

[28] The transfer amount for each individual targeted at the food poverty line is R26,367 (> R6,372) per year and for general poverty line is R11,794 (< R13,656) per year.

added TCT transfer amount for those targeted is used to calculate new estimates of the Theil inequality measures, T and L, using equations (5) and (6). Finally, the new income distributions under UBI and TCT are compared.

Scenario 2: Simulating the Impact of UBI and TCT on Inequality Using a Budget that Fully Funds TCT:

Here, the simulation compares UBI and TCT using the R41.98 billion in tax revenue that is sufficient to provide a transfer equal to the food poverty line to those households targeted by the TCT, which is those households whose predicted per capita consumption is below the food poverty threshold. The required total budget needed to fund TCT at the food poverty line is R41.08 billion, which requires a 13% increase in all marginal tax rates. The amount of the food poverty line, R6,372 per year, is given to those whose predicted per capita consumption is below the food poverty line. The same approach as in Scenario 1 is followed to simulate a percent increase in the marginal tax rate and to calculate the new total and additional revenue for the simulation based on this budget of R41.08 billion. To estimate the overall impact of this TCT, financed by a 13% increase in the 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 for those households whose predicted per capita consumption is below the food poverty line using the equation:

$$y_{TCT}^n = y_k^n + TCT \tag{12}$$

For those whose predicted per capita is above the food poverty line, $TCT = 0$.

Finally, I consider a UBI for all South Africans that gives a smaller transfer amount of R1,540 per year (less than the TCT transfer of R6,372) to all individuals in all households. This is set so that the total budget of this UBI is equal to R41.08 billion. Lastly, this new distribution of net income with the added UBI transfer amounts for all households is used to calculate new estimates of the Theil inequality measures, T and L, using equations (5) and (6). Then, the change in the distribution of income under UBI and TCT is compared for this scenario.

Scenario 3: Simulating the Impact of UBI and TCT on Inequality Using a Doubling of the Scenario 2 Budget:

For this approach, the total budget is determined by doubling the Scenario 2 budget. Therefore,

the total budget amounts to 82.16 billion, which requires a 26% increase in tax rates, double the 13% tax rates in Scenario 2. The tax revenue generated at 26% is adequate to provide a UBI transfer equal to R3,079[29] to all individuals in all South African households. Using this additional tax revenue of R83.97 billion, I compare UBI and TCT under this scenario. The simulation approach is the same as for the first scenario, using equations (10) and (11) to estimate the new distribution of net income. This is then used to calculate new estimates of the Theil inequality measures using equations (5) and (6).

I then use the same fixed UBI budget of R82.16 billion, generated from the 26% tax increase, to finance a TCT program. As in Scenarios 1 and 2, the TCT transfer amount is set so that the total budget equal 82.16 billion. The transfer is distributed only to those targeted by the TCT program. The transfer amount, when the program includes only individuals whose predicted per capita consumption is below the food poverty line is R12,744 per year, while the transfer fall to R5,700 per year when the program is extended to include all individuals whose predicted per capita consumption falls below the general poverty line. In both cases, the TCT transfer amount equals the total fixed UBI budget, 82.16 billion divided by the number of those whose predicted per capita consumption is below either the food poverty line or the general poverty line. After, new income distributions are estimated with the added TCT transfer amount, and new Theil estimates are obtained using equations (5) and (6). I then compare the new income distributions for UBI and TCT.

[29] The UBI transfer amount here is calculated as the total UBI fixed budget divided by the entire population sample.

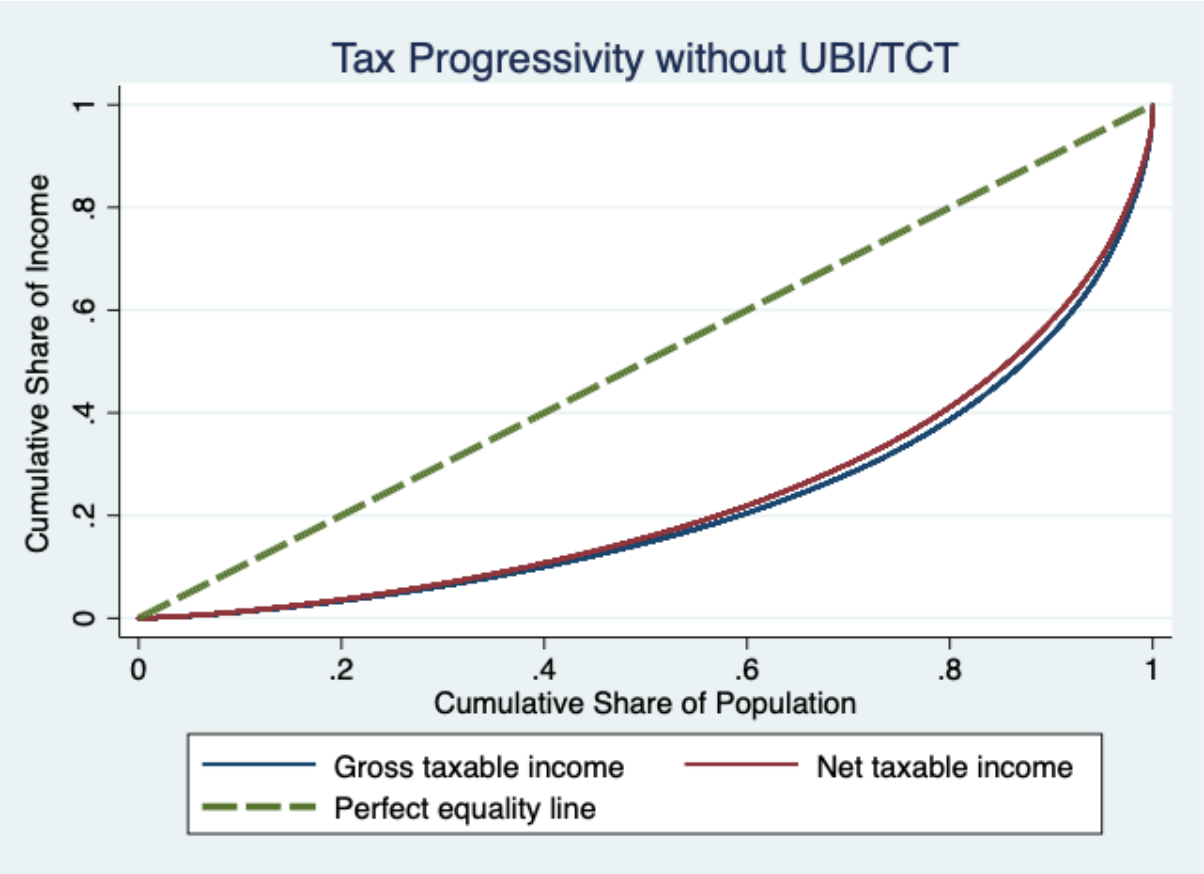
5 Results and Discussion

This section discusses the results. First, it discusses the effect of progressive taxation on inequality, before the UBI or TCT payments are made. Second, it discusses how inequality is further affected by the UBI or TCT payments.

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

Figure 7 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 for net taxable income (Gini: 0.54) is slightly above the Lorenz curve for gross taxable income (Gini: 0.56).

Figure 7: Reduction in Income Inequality under Progressive Taxation without a UBI or TCT



Source: The author's calculations are based on wave 5 NIDS survey data.

Tables 8, 9, 10, and 11 present estimates of the Theil indices T and L, that describe

the group decompositions of income inequality by race, geographical type, province, and household head education. The income distributions used in estimating these indices are gross income, net income at the current SA tax structure, and three net incomes with 80%, 13%, and 26% increases in tax rates, before transfers, respectively. The appropriate comparison is among the different groups for a particular inequality measure (either T or L); since little or nothing can be learned from comparing the two different measures for the same group. For example, we can say that both measures indicate that urban inequality is higher than rural inequality, but we cannot say that the T measure indicates more inequality than the L measure.

Table 8 presents the inequality decomposition by race for gross income, net income at the current tax structure, and three net incomes at 80%, 13%, and 26% tax increase without transfer. Both Theil indices show that using the net income at the current tax structure, inequality among the African group (0.41; 0.47)[30] and the Colored (0.44; 0.43) group are very high, followed by those of the White and the Asian/Indian groups, respectively. However, inequality at the national (country) level (0.51; 0.59) is more pronounced than the subgroup's inequality. In addition, the White (0.41; 0.43) and the Asian/Indian groups (0.34; 0.37) have the lowest levels of inequality, yet they remain high. This gives a clear picture of the very high inequality in South Africa, which remains one of the most racially unequal countries in the world (Seekings and Nattrass, 2008; World Bank, 2018a).[31] One of the main reasons for using 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 relatively small (19%; 22%) compared to the share of inequality within the racial groups, the within-group part.

Therefore, there is substantial inequity within all four races, and the contribution of between-race disparities to overall income inequality is not as large as some might expect. This is consistent with the World Bank (2005) report, which states that within-group inequality contributes at least three-quarters to overall income inequality, and the between-group

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

[31] A World Bank estimate of Gini indexes shows that South Africa has the highest income inequality (0.63) compared to its neighboring African countries (Namibia, 0.59; Suriname, 0.579; Zambia, 0.57; CAR, 0.56), some South and Central American countries (Brazil, 0.489; Belize, 0.498), and Asian countries like Hong Kong, 0.539 and Singapore, 0.459 (World Bank, 2022).

component contributes at most one-quarter. But, if there is a random measurement error in incomes, which is quite likely, then the within-group component, but not the between-group component, will be overestimated, which implies that the contribution of the between-group component to overall inequality will be underestimated.

Comparing inequality across the five income distributions as reported in Table 8 clearly shows that inequality of gross income has the highest levels of inequality, followed by that of the net income at the existing tax structure. Further, an increase in progressive tax rates reduces inequality more even before UBI and TCT payments are made. So, inequality in net incomes with tax increases of 80%, 13%, and 26% reduces inequality more than the net income at the current tax structure. This is seen in columns 6 to 11 of Table 8. The higher the increase in the progressive tax rate, the more inequality is reduced. So, the net income inequality at 80% tax increase without transfers is more reduced than at 13%, and 26%.

The inequality decomposition by geographical type is reported in Table 9. The two inequality measures for net income under the current tax system indicate that rural inequality (0.36; 0.39) is much lower than urban inequality (0.55; 0.63), which is larger than the country-level inequality (0.52; 0.61). Income inequality is exceptionally high in urban settings and at the country level. Relative to the inequality by race decomposition, the between-group disparity contributes very little to overall inequality, less than 10 percent of the total inequality in both measures. This means that differences between mean incomes in urban and rural areas contribute only a small share to overall inequality; instead, there is a substantial disparity within each of these two sectors that accounts for more than 90 percent of overall inequality in South Africa.

Table 10 shows that inequality is very high in all nine provinces, particularly in Western Cape, Eastern Cape, Mpumalanga, Gauteng, Northern Cape, and Limpopo. KwaZulu-Natal, Free-State, and North-West provinces have the lowest inequality among the nine provinces. In the same manner as race and geographical type, between-group inequality contributes a very small proportion to overall inequality, with within-group inequality contributing more than 95 percent. This reflects the considerable inequity within each of the nine provinces.

Finally, the decomposition by the household head's education in Table 11 shows that

households headed by someone with upper secondary education and tertiary university education have higher inequality, (0.53; 0.65) and (0.59; 0.62) respectively than households whose heads have no or low levels of education. Households with a head who has no education have the lowest levels of inequality (0.30; 0.31) compared to all the other education levels. Unlike the decompositions by race, geographical type, and province, the between-group component (24%; 23%) contributes substantially to overall inequality, yet the within-group part remains higher than the between-group component. The inequality indices presented in Table 11 follow the same pattern and explanation of results as in a race, geographical type, and province. Table 18 in the appendix reports the mean incomes of all the group decompositions using net income under the existing tax system.

Table 8: Income Inequality Decomposition by Race (tax progressivity without UBI/TCT)

	Theil Measures for Gross and Net Incomes With and Without New Tax Imposition									
	Gross Income (YG)		Net Income (Yn)		Net Income with 80% (Y80)		Net Income with 13% (Y13)		Net Income with 26% (Y26)	
Subgroups	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**
African	0.452	0.532	0.412	0.474	0.338	0.384	0.364	0.408	0.354	0.398
Coloured	0.484	0.497	0.437	0.434	0.344	0.342	0.367	0.367	0.359	0.360
Asian/Indian	0.389	0.461	0.338	0.370	0.293	0.304	0.315	0.345	0.315	0.341
White	0.454	0.459	0.409	0.427	0.377	0.426	0.390	0.420	0.388	0.420
National	0.563	0.661	0.511	0.591	0.417	0.489	0.445	0.512	0.435	0.502
Within	0.453	0.509	0.412	0.456	0.339	0.385	0.364	0.404	0.356	0.396
Between	0.110	0.152	0.099	0.135	0.078	0.104	0.081	0.109	0.079	0.106
% of Between	19.56	23.03	19.33	22.85	18.65	21.33	18.16	21.21	18.16	21.13

Table 9: Income Inequality Decomposition by Geographical Type (tax progressivity without UBI/TCT)

	Theil Measures for Gross and Net Incomes With and Without New Tax Imposition									
	Gross Income (YG)		Net Income (Yn)		Net Income with 80% (Y80)		Net Income with 13% (Y13)		Net Income with 26% (Y26)	
Subgroups	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**
Rural	0.391	0.444	0.358	0.393	0.308	0.319	0.335	0.348	0.327	0.338
Urban	0.605	0.692	0.552	0.630	0.452	0.545	0.473	0.556	0.465	0.550
National	0.567	0.672	0.516	0.606	0.425	0.509	0.450	0.528	0.441	0.519
Within	0.519	0.628	0.474	0.567	0.394	0.480	0.417	0.497	0.409	0.489
Between	0.047	0.044	0.042	0.040	0.031	0.029	0.033	0.031	0.031	0.030
% of Between	8.37	6.56	8.23	6.54	7.20	5.69	7.32	5.90	7.10	5.71

Table 10: Income Inequality Decomposition by Province (tax progressivity without UBI/TCT)

	Theil Measures for Gross and Net Incomes With and Without New Tax Imposition									
	Gross Income (YG)		Net Income (Yn)		Net Income with 80% (Y80)		Net Income with 13% (Y13)		Net Income with 26% (Y26)	
Subgroups	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**
W. Cape	0.578	0.712	0.535	0.663	0.446	0.577	0.459	0.577	0.453	0.575
E. Cape	0.613	0.954	0.573	0.923	0.497	0.836	0.520	0.825	0.510	0.816
N. Cape	0.687	1.439	0.669	1.452	0.599	1.384	0.597	1.320	0.591	1.319
Free-State	0.442	0.490	0.407	0.440	0.325	0.362	0.343	0.378	0.334	0.370
KwaZulu-Natal	0.397	0.406	0.375	0.377	0.321	0.317	0.333	0.326	0.327	0.320
North-West	0.439	0.477	0.394	0.414	0.307	0.308	0.337	0.342	0.327	0.329
Gauteng	0.610	0.625	0.546	0.549	0.439	0.454	0.467	0.480	0.458	0.472
Mpumalanga	0.664	0.745	0.581	0.611	0.458	0.460	0.508	0.527	0.492	0.509
Limpopo	0.537	0.598	0.491	0.546	0.411	0.459	0.441	0.482	0.431	0.470
National	0.567	0.672	0.516	0.606	0.425	0.509	0.450	0.528	0.441	0.519
Within	0.540	0.645	0.495	0.585	0.409	0.494	0.433	0.511	0.424	0.502
Between	0.027	0.027	0.022	0.022	0.015	0.015	0.018	0.018	0.017	0.017
% of Between	4.69	3.95	4.24	3.60	3.57	2.95	3.94	3.34	3.79	3.20

Table 11: Income Inequality Decomposition by Household Head Education (tax progressivity without UBI/TCT)

	Theil Measures for Gross and Net Incomes With and Without New Tax Imposition									
	Gross Income (YG)		Net Income (Yn)		Net Income with 80% (Y80)		Net Income with 13% (Y13)		Net Income with 26% (Y26)	
Subgroups	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**	**GE(0) = L**	**GE(1) = T**
Primary	0.346	0.381	0.334	0.364	0.287	0.306	0.300	0.314	0.294	0.307
Secondary (L)	0.387	0.388	0.369	0.363	0.312	0.301	0.329	0.316	0.320	0.308
Secondary (Up)	0.565	0.696	0.530	0.650	0.448	0.567	0.461	0.568	0.454	0.563
Tertiary (NU)	0.519	0.538	0.491	0.506	0.413	0.440	0.422	0.442	0.416	0.438
Tertiary (U)	0.648	0.654	0.586	0.622	0.516	0.612	0.538	0.600	0.534	0.601
No education	0.312	0.337	0.295	0.309	0.271	0.267	0.293	0.291	0.288	0.283
National	0.661	0.784	0.602	0.715	0.496	0.614	0.525	0.632	0.514	0.623
Within	0.489	0.591	0.458	0.554	0.394	0.500	0.409	0.502	0.403	0.498
Between	0.172	0.192	0.144	0.161	0.102	0.114	0.115	0.130	0.111	0.125
% of Between	25.97	24.55	23.92	22.53	20.60	18.61	22.02	20.53	21.60	20.03

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 are financed with progressive taxation are presented in Tables 12 and 13. Table 12 provides information on the total and marginal tax revenue (relative to the initial revenue) generated from increases in the marginal tax rate separately for these different total budgets. The extra tax revenue generated from an increase in tax rates is sufficient to fund a UBI at the level of the food poverty line for all South Africans while a 13% increase in tax rate is sufficient to provide a transfer equal to the food poverty line to those households whose predicted income is below the food poverty line. These are the first and second scenarios, respectively.

Table 12: Total and Additional Tax Revenue from Simulating % Increase in MTR

	Total tax revenue (Rand)	**Additional tax revenue (Rand)**
Initial value	255.5 billion	0
13% increase in MTR	297.4 billion	41.98 billion
26% increase in MTR	339.4 billion	83.97 billion
80% increase in MTR	513.8 billion	258.4 billion

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

For the third scenario, which has a total budget twice as large as the second scenario, can fund a UBI program that transfers R3,079 to all South Africans which is less than the food poverty line transfer. This would require a 26% increase in the marginal tax rate that generates additional revenue of R83.97 billion (total budget: 82.16 billion). The analysis of this study is restricted to these total budgets.

5.2.1 Scenario 1: Funding UBI and TCT under the UBI Budget

The additional revenue generated from the 80% increase in the tax rate is sufficient to fund a UBI program that provides everyone in South Africa a cash transfer equal to the food poverty line (R6,372 per year). Alternatively, using this same total budget, a transfer amount of R26,367 could be distributed to only those whose predicted per capita expenditure is below the food poverty line, or R11,794 could be given to those whose predicted per capita expenditure is below the general poverty line, using a TCT program.[32] The transfer amount under the first

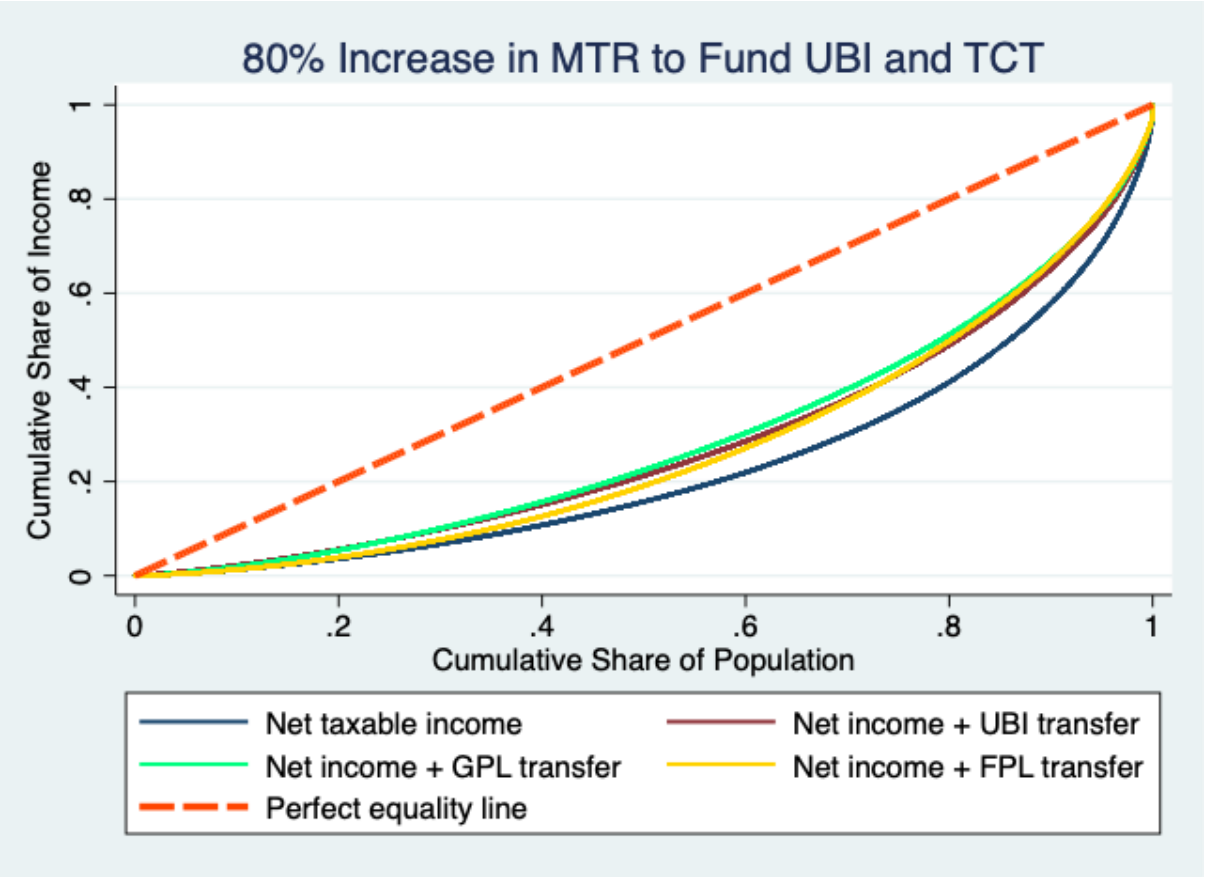
[32] About 58% (14,838) households are targeted at the general poverty line, and 26% (6,637) are targeted at the food poverty line.

alternative (R26,367) is more than the food poverty line (R6,372 per year) and the general poverty line (R13,656 per year), while the amount transferred under the second alternative is less than the general poverty line. This is because more people are targeted under the second alternative than under the first alternative, hence the lower transfer amount.

For Scenario 1, Figure 8 gives a graphical representation of how much overall income inequality is reduced by UBI and by TCT, when funded via tax progressivity. These graphs compare the Lorenz curve of the initial net taxable income to the Lorenz curves of the new net taxable incomes with UBI and TCT. In the case of UBI, Figure 8 reveals a decline in overall income inequality due to the UBI compared to current net taxable income. Figure 8 indicates that TCT program that give transfers only to households with predicted per capita expenditure below the food poverty line or below the general poverty line also reduces income inequality. The decrease in overall income inequality, using the total budget of R258.4 billion, is a little more for the TCT scheme than for the UBI, more specifically for the TCT that provides transfer to all households whose predicted per capita expenditures are below the general poverty line.

The estimates of the Theil T and L inequality indices on how much overall income inequality is reduced under UBI and TCT financed with tax progressivity show similar patterns of reduction in income inequality. For simplicity, I show only results at the national level for both UBI and TCT schemes. This is presented in Table 13, which shows a significant decrease in income inequality at the national level. The results for an 80% increase in tax rates to fund TCT (targeted to those whose predicted per capita expenditure is below either the food or the general poverty line) at the same total budget for UBI show that TCT reduces inequality somewhat less than the UBI scheme when it is targeted only to those whose predicted per capita expenditures are below the food poverty line, but by more than UBI when targeted to those whose predicted per capita expenditures are under the general poverty line. Overall, TCT, when targeted to those whose predicted expenditure is below the general poverty line, reduces income inequality by more than does the UBI scheme.

Figure 8: Reduction in Income Inequality through UBI and TCT for Scenario 1 Budget



Source: The author's calculations are based on wave 5 NIDS survey data.

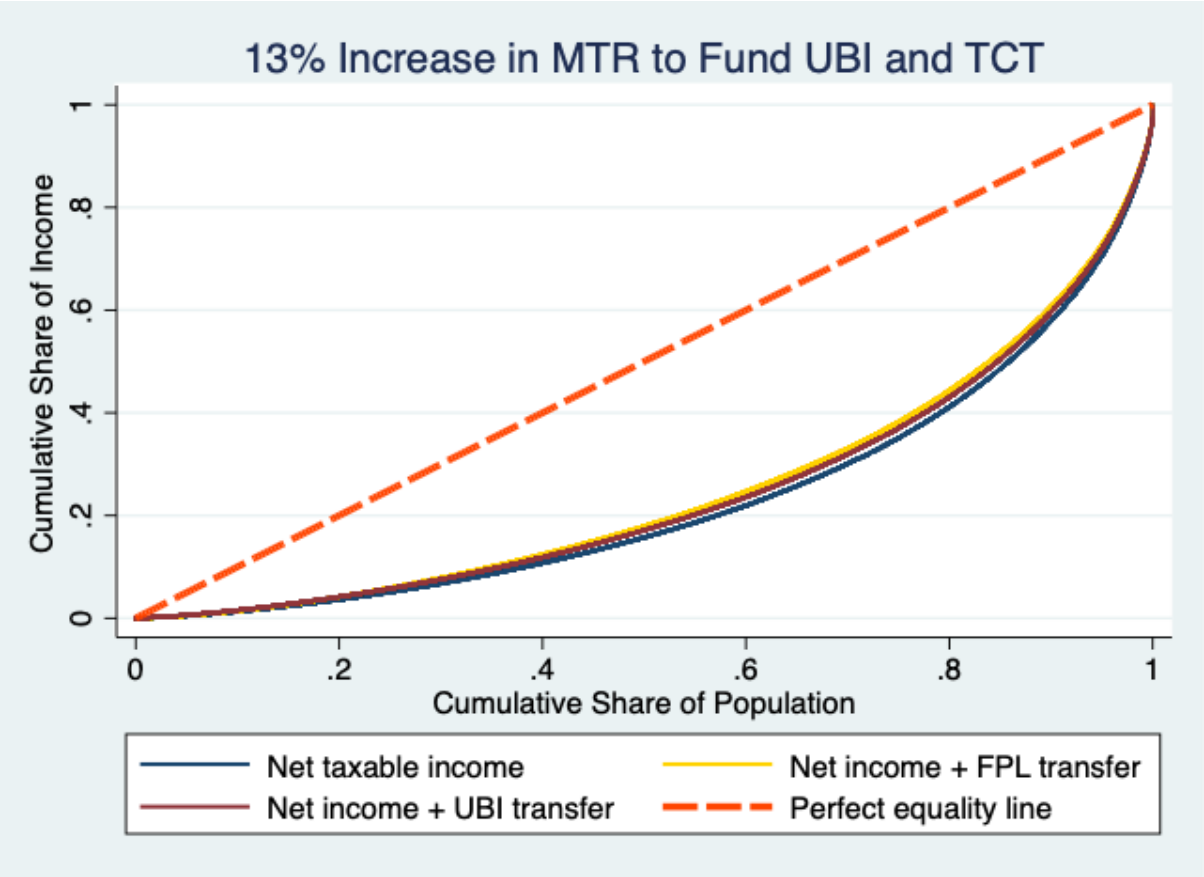
5.2.2 Scenario 2: Funding UBI and TCT under TCT Budget

For this scenario, I consider a TCT that provides a transfer amount equal to the food poverty line of R6,372, but only those people whose predicted expenditure is below the food poverty line. To fully fund this program, the additional revenue required is generated from a 13% increase in the marginal tax rate. I also consider a UBI for all South Africans that gives a much smaller transfer, set so that the total budget of the UBI is equal to this TCT budget. At the same TCT budget, an approximate lumpsum amount of R1,540 (which is much less than the food poverty line) is distributed to all South Africans.

Figure 9 provides a graphical representation of how much overall income inequality is reduced by this TCT and this UBI, again funded via tax progressivity. These graphs compare the Lorenz curve of the initial net taxable income without UBI and TCT to the Lorenz curves of the new net incomes with UBI and TCT. In the case of TCT, Figure 9 reveals that the decline in overall income inequality is reduced to some extent for the net incomes with transfer

compared to the net taxable income without a TCT scheme. Then for UBI, Figure 9 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 higher for the TCT than for the UBI.

Figure 9: Reduction in Income inequality through UBI and TCT for Scenario 2



Source: The author's calculations are based on wave 5 NIDS survey data.

The estimates of the Theil T and L inequality indices that show on how much overall income inequality is reduced under both UBI and TCT financed by a 13% increase in taxes are presented in Table 13. For this smaller budget, UBI has slightly higher income inequality indices than TCT under this scenario, which shows that using this total budget to fund the UBI program reduces income inequality less than using it to finance the TCT program.

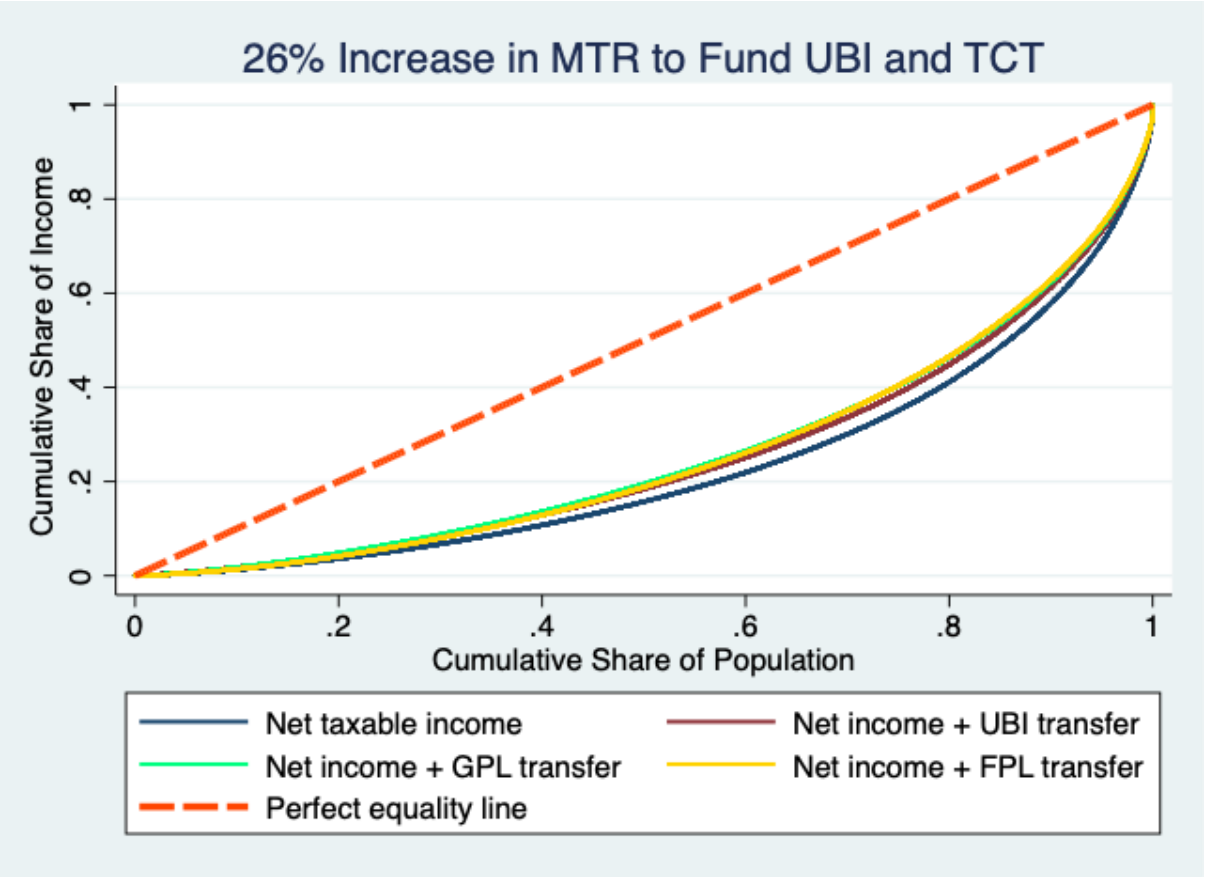
5.2.3 Scenario 3: Funding UBI and TCT under Fixed UBI Budget

This scenario considers a fixed budget that is double the amount provided by Scenario 2. If it is used to fund a UBI program, it would give R3,079 to all South Africans. The additional revenue required to fully fund this fixed budget is generated from a 26% increase in the marginal

tax rate. Alternatively, this same fixed budget, could be used to fund a TCT program that transfers amount of R12,744 to those whose predicted per capita expenditure is below the food poverty line, or transfer R5,700 to those whose predicted per capita expenditure is below the general poverty line. Like Scenario 1, the transfer amount for those whose predicted per capita consumption is below the food poverty line is more than twice than that of those whose predicted per capita expenditure is less than the general poverty line. This is because more people are targeted by the latter TCT program than by the former TCT program.

Figure 10 gives a visual representation of how much overall income inequality is reduced by a UBI or TCT financed by a 26% increase in the progressive income tax. Similar to Figure 8, this graph compares the Lorenz curves of the net taxable income without any transfers to the Lorenz curves of the new net incomes with UBI or TCT transfer. Clearly, from the graph, overall income inequality is reduced by implementing a UBI or TCT program. The pattern in Figure 10 is similar to that of Figure 8. Broadly, income inequality is reduced the most for the TCT program that provides transfers only to those whose predicted per capita expenditures are below the general poverty line.

Figure 10: Reduction in Income inequality through UBI and TCT at Fixed UBI Total Budget



Source: The author's calculations are based on wave 5 NIDS survey data.

Table 13: Income Inequality Changes from Scenarios 1, 2, and 3 (UBI and TCT Financed)

	National Level Theil Measures	
Scenarios	**GE(0) = L**	**GE(1) = T**
Initial inequality index (before UBI or TCT)	0.516	0.606
Scenario 1 (UBI Budget)		
UBI with 258.4 billion	0.335	0.422
TCT with 258.4 billion (food PL)	0.399	0.425
TCT with 258.4 billion (General PL)	0.321	0.386
Scenario 2 (TCT Budget)		
UBI with 41.08 billion	0.462	0.557
TCT with 41.08 billion	0.446	0.530
Scenario 3 (New UBI Budget = Double TCT Budget)		
UBI with 82.16 billion	0.418	0.513
TCT with 82.16 billion (food PL)	0.419	0.484
TCT with 82.16 billion (General PL)	0.395	0.481

Finally, the estimates of how much the Theil T and L inequality indices are reduced under UBI or TCT under the budget of Scenario 3 are presented in Table 13. For a 26% increase

in tax rates to fund a TCT or UBI at the same total budget, that the TCT scheme provides transfers only to those whose predicted expenditure is below the general poverty line reduces income inequality slightly more than does the UBI scheme.

5.3 Overall Inequality Reduction: Comparing UBI to TCT

Given the strong interest in a UBI scheme in South Africa, further discussion comparing a UBI to a TCT is warranted. It is evident in Table 13 that the first scenario, where an 80% increase in tax rate is used to fund a UBI or a TCT, reduces income inequality more than the second scenario, with a much smaller 13% increase in the tax rate that is used to finance a UBI or a TCT. Though a UBI or TCT funded with an 80% increase in tax rate reduces income inequality more than 13% and 26%, it is not reasonable to compare these much smaller 13% increases in tax rates with an 80% increase in tax rates. Comparing the 13% tax increase and the 26% tax increase is more relevant policy because increasing tax rates by 80% is unlikely to be politically feasible, and it may distort economic choices and the labor market in a way that reduces net taxable income, consumption, and total real income.

Tables 14, 15, and 16 report the overall inequality reduction for the three different scenarios by first comparing the inequality indices of the net income at the current tax structure, without transfers to the gross income before taxation. It then compares the inequality of the new net income after increasing taxes (80%, 13%, 26%) but before transferring the funds raised by those taxes. Lastly, inequality indices are shown after implementing UBI or TCT transfers.

As presented in Table 14, the existing tax system reduces inequality by 9.3% as seen by comparing gross income to net income at the.[33] However, the new net income created when tax rates are increased by 80%, without transfer, reduces inequality even more, by 25% relative to the distribution of gross income. Next, inequality decreases even more when the tax revenue from this 80% tax increase is used to fund UBI or TCT. For the net income with a UBI transfer, inequality declines by 39% relative to the distribution of gross income. The TCT transfer reduces income inequality by 33.2% when distributed only to those whose predicted per capita is below the food poverty line. But when this TCT transfer is given to those whose predicted per expenditure is below the general poverty line, inequality decreases by 43% relative to the

[33]The 9.3% is the average of the reduction in the L and T Theil indices. All percent values for inequality reduction are averages of the two Theil indices

distribution of gross income.

Table 15 shows that the new net income with a much smaller tax increase of 13% reduces overall inequality by 17% when compared to the distribution of gross income. The net income with a UBI transfer funded with this 13% increase in tax rates decreases inequality by 17.8% relative to the distribution of gross income, as indicated in Table 15. In contrast, the distribution of net income generated by a TCT transfer funded with a 13% increase in tax rates reduces income inequality by 21.2%, compared to the distribution of gross income.

Table 14: Overall Inequality Reduction: Total Budget Generated from an 80% Increase in MTR

	National Level Theil Measure	
Income	**GE(0) = L**	**GE(1) = T**
Gross income	0.567	0.672
Net income at current SA tax scheme	0.516	0.606
Net income at new tax imposed without transfer	0.425	0.509
Net income at new tax imposed with UBI transfer	0.335	0.422
Net income at new tax imposed with TCT transfer (FPL)	0.399	0.425
Net income at new tax imposed with TCT transfer (GPL)	0.321	0.386

Table 15: Overall Inequality Reduction: Total Budget Generated from a 13% Increase in MTR

	National Level Theil Measure	
Income	**GE(0) = L**	**GE(1) = T**
Gross income	0.567	0.672
Net income at current SA tax scheme	0.516	0.606
Net income at new tax imposed without transfer	0.471	0.556
Net income at new tax imposed with UBI transfer	0.462	0.557
Net income at new tax imposed with TCT transfer	0.446	0.530

The inequality changes for the tax revenue generated from a 26% increase in the tax rates to fund a fixed UBI budget are presented in Table 16. The new net income before any transfers but after a 26% increase in tax rates reduces inequality by 22.5% when compared to the distribution of gross income. When the 26% increase in tax rates is used to fund a UBI, inequality is reduced by 25%. In contrast, the distribution of net incomes from a TCT scheme that distributes transfers only to those whose predicted per capita expenditure is below the food poverty line reduces inequality by 27%. When a smaller transfer is given to those whose predicted expenditure is below the general poverty line, inequality decreases by 29.4%.

As expected, the higher the increase in the tax rate, the more inequality is reduced. In particular, an 80% increase in tax rates, decreases inequality by 43%, a 13% tax increase, reduces inequality by 21%, which is only half of the reduction in inequality from a 80% tax increase, and a 26% increase in tax rates reduces inequality by 29.4%.

Table 16: Overall Inequality Reduction: Fixed UBI Budget Generated from a 26% Increase in MTR

	National Level Theil Measure	
Income	**GE(0) = L**	**GE(1) = T**
Gross income	0.567	0.672
Net incomeat current SA tax scheme	0.516	0.606
Net income at new tax imposed without transfer	0.441	0.519
Net income at new tax imposed with UBI transfer	0.418	0.513
Net income at new tax imposed with TCT transfer (FPL)	0.419	0.484
Net income at new tax imposed with TCT transfer (GPL)	0.395	0.481

In summary, both a UBI or a TCT funded by an increase in taxes reduces income inequality. As one would expect, the decline in income inequality under the larger total budget (80% tax increase) is much larger than the income inequality under the much smaller total budget (13% percent increase in tax) and under a doubling of this smaller budget (26% percent tax increase). Comparing UBI to TCT, in four out of five cases, a TCT reduces inequality by more than a UBI. The one exception occurs when the TCT under the larger budget is used to fund only those whose predicted per capita consumption is below the food poverty line. In general, both the smaller TCT budget generated by a 13% increase in taxes or a doubled budget generated by a 26% rise in the tax rate may be feasible for the government of South Africa to implement. Thus, the relative impacts of a UBI or a TCT program depend on the details of how the TCT is implemented, but for all three budgets there is a TCT that reduces inequality by more than a UBI. Also, there are two main trade-offs between UBI and TCT: the costs of the program and the accuracy of targeting households. It is possible that implementing a TCT program may have a higher administrative cost than a UBI program. Depending on which program a government may implement, these trade-offs must be considered in terms of their cost-effectiveness and benefits.

5.4 Variation in Eligibility Thresholds: Optimal TCT that Reduces Inequality Most

Generally, a TCT program significantly reduces income inequality more than a UBI program, as discussed in section 5.3. But the TCT scheme, so far has considered only two cutoff points, one at the food poverty line and one at the general poverty line. The question remains whether there are other cutoff points at which the TCT will reduce inequality by more than using the food and general poverty lines as cutoff points. To investigate this, I examined other thresholds based on the decile of the predicted per capita expenditure to target households, after which I estimated the transfer amount and evaluated the effect on inequality. This is done in three steps, as discussed below.

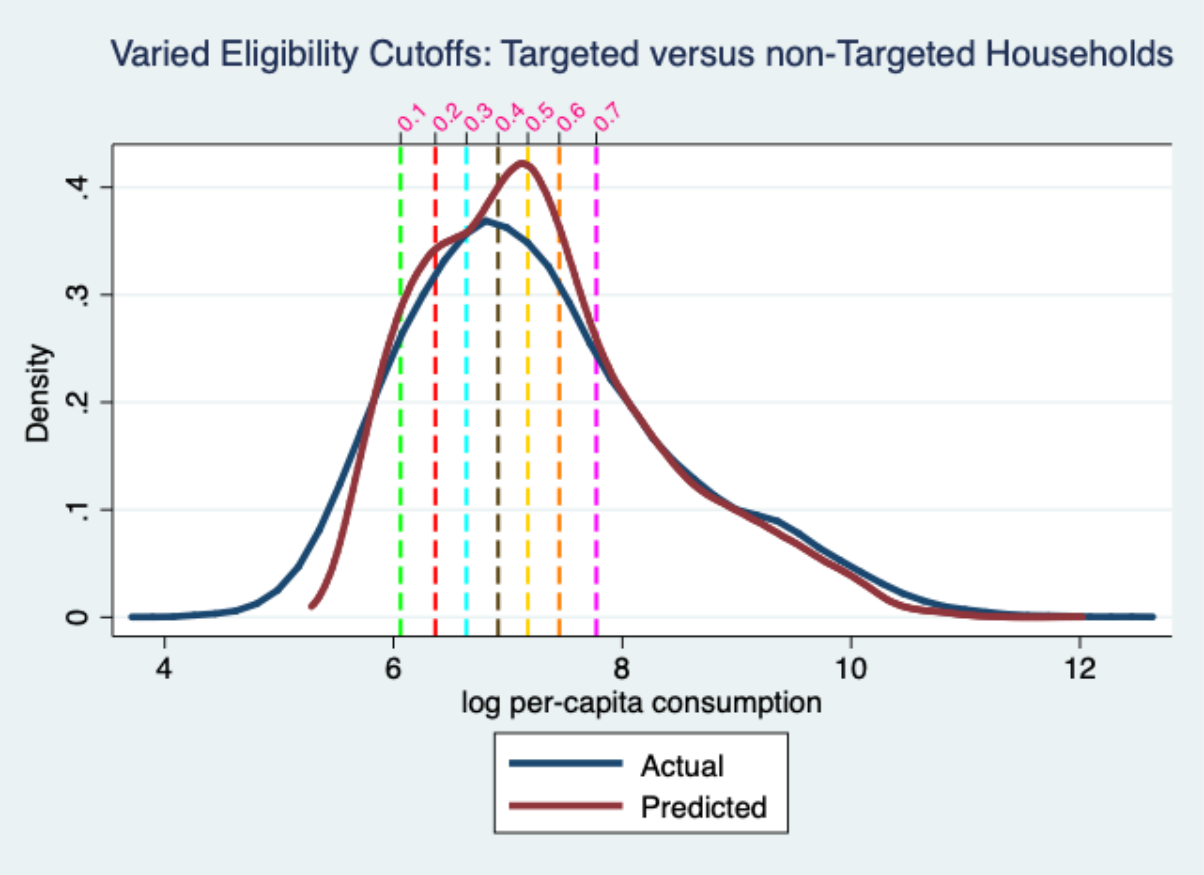
First, I calculated decile cutoff points for predicted per capita expenditure. For example, the poorest 10% of the population has a threshold of R429 per person per month, so that 10% of the sample has a predicted per capita expenditure below this threshold. Another example is that the poorest 30% has a threshold of R763 per person per month, so 30% of the sample has a predicted per capita expenditure below this threshold. Such thresholds are also calculated for the poorest 20%, 40%, 50%, 60%, and 70% of the population. This is visually shown in Figure 11.

Second, I distribute transfers to the poorest 10%, 20%, 30%, 40%, 50%, 60%, and 70% of the population, using these thresholds. I consider only two budgets, the one generated by a 13% increase in tax rates and the one generated by a 26% increase in tax rates to examine which cutoffs reduce inequality the most. The transfer amount for each of these seven groups is calculated by dividing the total TCT budget, funded by either a 13% or a 26% increase in tax rates, by the number of people in each group.

Third, I estimated the two Theil indices for the new net incomes with these TCT transfers. Table 17 reports the per capita income transfer for each threshold and the inequality indices from the two Theil indices. It is evident from the table that income inequality declines as one expands the target population from the poorest 10% of the population to the poorest 40%. But then inequality increase when the target population is expanded further from the poorest 50% to the poorest 70%. Overall, inequality is most reduced when the poorest 30% of the population is targeted to receive a transfer through a TCT program. This threshold is very close to the scheme that targets those whose predicted per capita expenditure is below the

general poverty line for a budget funded with a 26% tax increase. About 42% (10,788 individuals) of the population were targeted under the poorest 30% threshold scheme, and for those whose predicted per capita expenditure is below the general poverty line, approximately 58% (14,838) are targeted. The inclusion and exclusion error rates and the coverage rates of targeting at these different thresholds are presented in Table 21.

Figure 11: Distrubtion of Varied Eligibility Cutoffs Over Predicted and Actual Log Incomes



Source: The author's calculations are based on wave 5 NIDS survey data. 0.1 represent 10% of the population targeted to receive transfer at the threshold of the poorest 10% of the population based on predicted per capita expenditure. 0.2 is 20%, 0.3 is 30%, 0.4 is 40%, 0.5 is 50%, 0.6 is 60%, and 0.7 is 70% of the population.

Table 17: Variation in Eligibility Cutoffs: Optimal Cash Transfer that Reduces Inequality Most

		National Level Theil Measure	
Thresholds & Net income	**Per Capita Income Threshold Transfer (Rand)**	**GE (0) = L**	**GE (1) = T**
Net income at current tax system		0.516	0.606
Food and general poverty line			
TCT at 13% MTR	6,372	0.446	0.530
TCT at 26% MTR (FPL)	12,744	0.419	0.484
TCT at 26% MTR (GPL)	5,700	0.395	0.481
Poorest 10% of the population			
TCT at 13% MTR	10,198	0.458	0.534
TCT at 26% MTR	20,396	0.448	0.500
Poorest 20% of the population			
TCT at 13% MTR	5,470	0.442	0.530
TCT at 26% MTR	10,939	0.409	0.481
Poorest 30% of the population			
TCT at 13% MTR	3,920	0.439	0.530
TCT at 26% MTR	7,840	0.395	0.476
Poorest 40% of the population			
TCT at 13% MTR	3,117	0.441	0.533
TCT at 26% MTR	6,233	0.394	0.479
Poorest 50% of the population			
TCT at 13% MTR	2,622	0.443	0.537
TCT at 26% MTR	5,243	0.395	0.484
Poorest 60% of the population			
TCT at 13% MTR	2,306	0.446	0.540
TCT at 26% MTR	4,612	0.397	0.488
Poorest 70% of the population			
TCT at 13% MTR	2,082	0.450	0.543
TCT at 26% MTR	4,165	0.402	0.493

5.5 Effects of High Marginal Tax Rate and Tax Efficiency Effects

High increases in marginal tax rates can give taxpayers an incentive to change their behavior in different ways that affect their taxable income, the tax revenue base, and tax efficiency. These behavioral changes include changes in labor supply and higher non-compliance in the form of tax evasion and tax avoidance. Tax evasion (failure to pay taxes) is illegal. In contrast, tax avoidance (minimizing taxes) is where individuals think of ways to move their money around legally to avoid high taxes. Tax efficiency is measured as the deadweight loss due to high tax rates resulting from behavioral changes of taxpayers. In general, if the marginal tax rate is increased to raise revenue, the deadweight loss due to taxes will also increase.

Due to data limitations, this study does not estimate the parameters that explain the effect of a high tax rate on the elasticity of taxable income, the tax revenue base, and tax efficiency. Moreover, the focus of this study on raising tax rates to finance UBI or TCT, thereby reducing income inequality, rather than on finding the effect of high tax rates on revenue and tax efficiency. 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 to explore how higher tax rates may affect economic efficiency for South Africa.

Van Heerden et al. (2010) find that tax efficiency decreases with increased taxable income due to high marginal taxes in South Africa. This loss in efficiency is most evident for the case of the wealthiest income group, with a 54.5 percent increase in a 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 increase 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 for the income groups, and the pattern of expansion is the same for all income groups, but they are affected differently. The wide gap is because the wealthiest 50% of people in South Africa receive more than 50 percent of overall income (Orthofer, 2016), which reflects the high income inequality in South Africa. Thomas (2007) estimates that the elasticity of taxable income with respect to taxes is 0.52, with a deadweight loss of 15 percent of the revenue, but this is for the flatter tax rate system of New Zealand. Estimates for the United States, with a more progressive tax schedule like South

Africa, show a deadweight loss ranging from 18 to 37 percent (Robson, 2007).

This study examine the impact of increases in the marginal tax rate by 13, 26, and 80 percent to generate revenue to fund UBI or TCT, as shown in Appendix Table 20. These new tax rates are higher than the standard of 10-20 percent for a low marginal tax rate. For South Africa, even a 13 percent increase in the marginal tax rate may lead to a disincentive to work, tax evasion, tax avoidance, and an increase in the deadweight loss of taxes, which will lead to a loss in economic efficiency. These phenomena need to be taken into account when deciding whether, and how, to implement a UBI or TCT program; but these considerations are beyond the scope of this study and need to be examined in future research before making any policy decisions.

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 income inequality in South Africa. This country has one of the world's most progressive tax systems, yet the world's highest income inequality bedevils it.

I make two significant contributions to the literature. First, I estimated the impact of progressive taxation on overall income inequality and analyzed the nature of inequality in South Africa. Second, I conducted a policy simulation to examine how a UBI or a TCT can be financed by the additional revenue generated from 13, 26, and 80 percent increase in tax rates. More specifically, I implemented three scenarios to evaluate the effects of UBI and TCT on income inequality. I first considered a UBI whose total budget provides a transfer equal to the food poverty line. Then, I use the same total budget, which requires an 80% increase in tax rates, to fund a TCT scheme that provides larger transfers, but only to those "targeted" by the TCT (using a PMT that identifies people whose predicted per capita expenditure is below the food or the general poverty line threshold). I then considered a much smaller total budget that is sufficient to fund a TCT that provides a transfer equal to the food poverty line to those whose predicted per capita expenditure is below the food poverty line. This can be funded by increasing tax rates by only 13%; Alternatively, this same budget can be used to distribute smaller transfers to all South Africans via a UBI. Lastly, I consider a total budget generated by a 26% increase in tax rates. This budget can be used to provide a UBI transfer to the entire South African population, or to fund a TCT program that provides transfers only to those whose predicted per capita consumption is below the food poverty line, or alternatively below the general poverty line.

I find that the overall inequality at the national level is reduced by progressive taxation policy, but only to some extent; inequality remains high. The simulation results show that a UBI or TCT, funded by the additional revenue generated from the different tax increases (13%, 26%, 80%), greatly reduces income inequality. In four out of five cases, given the same total budget, a TCT reduced income inequality by more than a UBI. As one would expect, the larger the total budget, the more inequality decreases.

The relative impacts of UBI and TCT programs depend on the type of TCT implemented, and more generally on the concept of both programs. A TCT with very imperfect targeting may be less effective than a UBI. For this analysis, targeting of households was very effective with an R-squared of 0.78. Overall, a TCT performs better than a UBI in almost all scenarios.

The evidence from this study, combined with similar effects in the literature, suggests that a UBI or TCT implemented by increasing progressive taxation can reduce income inequality. Future extension of this work should investigate how both non-fiscal and fiscal policies, together or separately implemented, can also reduce inequality. Also, future research should estimate the deadweight loss of taxation and FGT (Foster-Greer-Thorbecke) poverty measures.

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Appendix: Tables

Table 18: Mean Net Income of the Subgroups in Group Decomposition

Race		Geographical Type		Province		Household Head Education	
Subgroups	**Mean Income**	**Subgroups**	**Mean Income**	**Subgroups**	**Mean Income**	**Subgroups**	**Mean Income**
African	118,360	Rural	100,568	W. Cape	170,713	Primary	83,145
Coloured	161,741	Urban	185,170	E. Cape	121,221	Secondary (L)	91,052
Asian/Indian	242,375			N. Cape	164,334	Secondary (Up)	120,844
White	516,893			Free-State	125,374	Tertiary (NU)	131,617
				KwaZulu-Natal	123,229	Tertiary (U)	333,939
				North-West	104,299	No education	79,109
				Gauteng	195,083		
				Mpumalanga	172,927		
				Limpopo	134,211		

Table 19: 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)

Table 19: Proxy-means Test Prediction of Income using OLS (continued)

Variables	OLS (Log per-capita consumption)
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)
Parafin	0.033
	(0.059)
Heating energy source:	
Gas	0.027
	(0.021)
Electricity(mains or generator)/Solar energy	0.193***
	(0.068)
Parafin	0.070*
	(0.038)
Other Assets	
Telephone	0.315***
	(0.033)
Radio	-0.021
	(0.017)
TV	0.029
	(0.026)
Satellite TV	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)

Table 19: Proxy-means Test Prediction of Income using OLS (continued)

Variables	OLS (Log per-capita consumption)
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 20: Changes in MTR Compared to 2017/2018 Base Rates

Base Rate	13% Increase	80% Increase	26% increase
18	20.34%	32.40%	22.68%
26	29.38%	46.80%	32.76%
31	35.03%	55.80%	39.06%
36	40.68%	64.80%	45.36%
39	44.07%	70.20%	49.14%
41	46.33%	73.80%	51.66%
45	50.85%	81.00%	56.70%

Table 21: Targeting Errors and Coverage Rates of Different Eligibility Cutoffs

Cutoffs	Inclusion Error Rate	Exclusion Error Rate	Coverage Rate
Food poverty line	4.84%	7.76%	92.24%
General poverty line	5.78%	6.21%	93.79%
Poorest 10% of the population	5.50%	4.53%	95.47%
Poorest 20% of the population	7.15%	5.47%	94.53%
Poorest 30% of the population	7.13%	6.23%	93.77%
Poorest 40% of the population	6.34%	5.89%	94.11%
Poorest 50% of the population	5.85%	5.15%	94.85%
Poorest 60% of the population	4.78%	4.50%	95.50%
Poorest 70% of the population	3.20%	3.23%	96.77%