SPECIALISED MASTER IN INTERNATIONAL AND DEVELOPMENT ECONOMICS

Fiscal Policy and Inequality in Ethiopia: A Microsimulation Analysis
An application of ETMOD

GEBEYEHU, Teklebirhan

Award date:
2023

Awarding institution:
University of Namur

Fiscal Policy and Inequality in Ethiopia: A Microsimulation Analysis

An application of ETMOD

Thesis presented by
Teklebirhan Alemnew Gebeyehu

Supervisor(s)
Professor Romain Houssa (UNamur)

Academic year 2022-23

The project was presented as part of the requirements for the award of the Specialized Master in International and Development Economics Jointly organized by the ESLN and the ESL

Département des Sciences économiques / UNamur • Rempart de la Vierge 8 • 5000 Namur
Ecole d'économie de Louvain / UCL • Place Montesquieu 3 • 1348 Louvain-la-Neuve

Abstract

This paper examines the distributional impact of fiscal policy in Ethiopia, with a special focus on personal income tax (PIT) and value-added tax (VAT). The analysis makes use of the latest version of ETMOD (Tax-benefit microsimulation model for Ethiopia). The results show that increasing PIT on high-income brackets and VAT rates reduces consumption-based inequality in Ethiopia, and it is non-revenue neutral. First, with the increase in the VAT rate from the current value of 15% to 18%, inequality, as measured by the Gini coefficient, reduces by 0.08%. And a further increase in the VAT rate to 20% results in a much larger decline in inequality by 0.13%. Following these reforms, poor households suffer net losses in consumption expenditure, but this effect is quite low compared to the richest households. The possible reason is that the bottom deciles/quintiles also spend large amounts of money on food and non-food items which are subject to VAT even if it is less than the top deciles/quintiles. Second, when we increase the PIT rate on high-income brackets and decrease the PIT rate on the lower-income brackets, inequality reduces by 0.05% and 0.10% Gini coefficient for the two PIT reforms. Moreover, when the 1st and 2nd income brackets are exempted from PIT, inequality decreases by 0.11%. Moreover, the three PIT reforms generate on average Ethiopian Birr (ETB) 33, 860.14 million, and the two VAT reforms generate on average ETB 47,283.36 million in government revenue. Only 12.32 % of the government tax revenue is spent on social security transfers, and the remaining 87.68% is spent on public goods/services and other activities. More specifically, the share of education spending from the total public services spending is 12.49%. Regarding the distribution of public goods/services spending, 52% of public services benefit from government educational spending received by people in the bottom five deciles of equivalised household expenditure. On the other hand, only 28% of social security transfer benefits from pensions are received by people in the bottom five deciles of equivalised household expenditure. In contrast, these results show that the public services channel is well-targeting the poor and vulnerable segments of society than the social security transfers channel. Therefore, the microsimulation result shows that both the VAT and PIT reforms reduce consumption-based inequality better than the existing VAT & PIT policies in Ethiopia by providing essential public goods/services to the poor and vulnerable segments of society.

Keywords: Ethiopia, Personal income tax, Value-added tax, Inequality, ETMOD, EUROMOD

Acknowledgments

First of all, I would like to thank my principal supervisor ***Professor Romain Houssa,*** and internship co-supervisor ***Professor Bart Capéau***, for their persistent guidance, constructive comments, and help during the thesis work. They were always supportive and pushed me to do my best and observe new things.

Besides, I would like to extend my warmest gratitude to the Economics School of Namur and Louvain, and ARES for welcoming me and giving me the chance to study a Specialized Master in International and Development Economics (SMIDE). I have also got a lot of experience, skills, and knowledge from all the professors and members of the Economics School of Namur and Louvain. So, I want to extend my heartfelt thanks to all of them.

Lastly, I would like to thank all my SMIDE classmates for being supportive and family throughout the study year.

Table of Content

List of Tables

List of Figures

Acronyms

ADLI	Agricultural Development-Led Industrialization
AIDS	Almost Ideal Demand System
BOLMOD	Tax-benefit microsimulation model for Bolivia
CEQ	Commitment to Equity
COICOP	Classification of Individual Consumption According to Purpose
COLMOD	Tax-benefit microsimulation model for Colombia
CSA	Central Statistical Agency of Ethiopia
ECUAMOD	Tax-benefit microsimulation model for Ecuador
ESS	Ethiopia Socioeconomic Survey
ETB	Ethiopian Birr
ETMOD	Tax-benefit microsimulation model for Ethiopia
EUROMOD	Tax-benefit microsimulation model for the European Union
FDRE	Federal Democratic Republic of Ethiopia
GHAMOD	Tax-benefit microsimulation model for Ghana
HCES	Household Consumption Expenditure Survey
MicroZAMOD	Tax-benefit microsimulation model for Zambia
MOZMOD	Tax-benefit microsimulation model for Mozambique
NAMOD	Tax-benefit microsimulation model for Namibia
OECD	Organization for Economic Co-operation and Development
PDC	Planning and Development Commission of Ethiopia
PERUMOD	Tax-benefit microsimulation model for Peru
PIT	Personal Income Tax
RWAMOD	Tax-benefit microsimulation model for Rwanda
SAMOD	Tax-benefit microsimulation model for South Africa
SOUTHMOD	Tax-benefit microsimulation models for selected developing countries
SSA	Sub-Saharan African
TAZMOD	Tax-benefit microsimulation model for Tanzania
UGAMOD	Tax-benefit microsimulation model for Uganda
UNDP	The United Nations Development Programme
UNU-WINDER	The United Nations University - World Institute for Development Economics Research
VAT	Value-Added Tax
VNMOD	Tax-benefit microsimulation model for Vietnam

1. Introduction

Despite registering a remarkable economic growth rate in the past two decades, Ethiopia is one of the Sub-Saharan African (SSA) countries characterized by high levels of poverty and increasing inequality (World Bank, 2010, 2020). Based on the World Development Indicator database, income inequality measured by the Gini coefficient increased to 0.332 in 2010 from 0.298 in 2004 and further increased to 0.35 in 2015 in Ethiopia (World Bank, 2023). The possible reason is the welfare trend divergence between urban and rural areas of the country (see World Bank Group, 2020). This is evident that high economic growth rates do not automatically lead to a decline in inequality (Piketty, 2015; Stiglitz, 2015). As explained by Dabla-Norris et al. (2015), income inequality harms macroeconomic stability, economic growth, and human development, undermines investment, reduces the growth elasticity of poverty, and limits economic mobility. Down to the above tribulations, the growth of inequality attracts the attention of policymakers and the forefront of government policy discussions or/and agenda (see Atkinson, 2015).

One of the major justifications for government intervention in economic activity is ensuring the inclusion of all social groups in the economy and equitable distribution of national income or resources. Thus, usually, governments primarily rely on three policies – monetary policies, fiscal policies, and structural reforms - to perform the interventions (see McKay & Wolf, 2023; Carrasco et al., 2022). Recent academic research works on inequality revealed that monetary policy, depending on the type of policy shocks and the stages of the business cycle, can influence inequality by affecting asset prices, savings retribution, policy rate, and inflation (see McKay & Wolf, 2023; Barry & Schneider, 2006; Furceri et al., 2016). Three major potential transmission channels are suggested by the existing literature through which monetary policy can affect inequality: *Asset price channel* (Doepke & Schneider, 2006; Inui et al., 2017; McKay & Wolf, 2023; Taghizadeh-Hesary et al., 2018), *Employment channel* (Bonifacio et al., 2021), and *Saving redistribution channel* (Coibion et al., 2012; Doepke & Schneider, 2006; Taghizadeh-Hesary et al., 2018) (See Section 2.2 for a detailed explanation of the transmission channels through which monetary policy can potentially affect inequality).

The second most vital policy instrument the government has in its arsenal to fight income inequality is fiscal policy. Fiscal policies affect income distribution directly through the channels

of taxes, transfers, and public expenditures; and indirectly, by affecting other factors that influence income inequality (see Odusola, 2006; Salotti & Trecroci, 2018). As one of the most efficient mechanisms of fiscal policy to address income disparities, governments are more reliant on tax policies. Even some of the most prominent economists (such as Atkinson, 2015; Piketty, 2015) also proposed taxation as a powerful remedy to promote a more equal income distribution. Generally, tax policy enhances equality plans through two broad categories of taxation: direct and indirect tax systems (Gasior et al., 2018; World Bank, 2017).

The first one is direct tax: the government may use direct tax (such as personal and corporate income taxes) as a means to redistribute and reduce income inequality. However, the personal income tax system has long been viewed as the most visible and powerful component of the direct tax structure to affect the distribution of income (De Freitas, 2012; Poterba, 2007). Gerber et al. (2018) and Bachas et al. (2021) revealed that the most important characteristic of tax policy to reduce income inequality is the progressivity of the tax structure. In this logic, personal income tax is the best progressive tax instrument since tax liability relative to income rises as income increases (see Hanni et al., 2016). This means, in the personal income tax system, high-income groups are subject to a high level of income tax and distribute resources from the rich to the poor and marginalized segments of society (UNDP, 2019). Thus, it gives more sense that countries with high-income inequality heavily rely on a personal income tax than on other direct taxes that are less progressive as a means to redistribute income (Bird & Zolt, 2005). Generally, the extent of the personal income tax contribution in tackling income inequality mainly depends on its progressivity and the average tax rate (see Cano, 2015; Gerber et al., 2018).

The second type of tax policy on which the government has relied heavily is an indirect tax - taxes imposed on the consumption of goods and services (such as Value Added Tax (VAT)). VAT has arguably been one of the best tax policies of governments worldwide to curve income inequality and is a major source of tax revenue (Capéau et al., 2014; Keen, 2007). Recent empirical studies hotly argued about the suitability of VAT in developing countries. Some (such as Emran & Stiglitz, 2005; Itriago, 2011; Hanni et al., 2015; Alavuotunki et al., 2019) claim that if both the poor and rich pay the same amount of VAT on goods and services, a uniform VAT system will have a strong regressive nature, and adversely affect low-income groups of people who spent a large part of their income on consumption. Consequently, it will aggravate income

inequality in developing countries. However, others (such as Alavuotunki et al., 2019; Alavuotunki & Pirttilä, 2015) are skeptical about the distributional effect of VAT, they claimed that VAT adoption may not undermine the equity development effort in developing countries. Their main justification is: if the VAT system can be a main revenue source of government and a 'money-making machine', the government can use these revenues to finance social transfers and the provision of public services/goods to the poor and marginalized segments of society which can reduce inequality. Since arguments made by both groups can be valid, therefore, the overall distributional effects of the VAT are ambiguous in theory.

Generally, the existing literature identified four major potential transmission channels through which tax policy (especially personal income tax and VAT) can potentially affect inequality: *Income channel* (Martorano, 2018; Younger et al., 2016), the *Consumption channel* (Bird & Zolt, 2005; Emran & Stiglitz, 2005; Itriago, 2011), the *Public services channel* (Alavuotunki et al., 2019; Alavuotunki & Pirttilä, 2015; Itriago, 2011; Jellema et al., 2017), and the *Social Security transfer channel* (Capéau et al., 2014; Luebker, 2011) (See Section 2.1 for a detailed explanation of the possible transmission channels of the distributional impact of tax policy).

Therefore, to build a better and more prosperous Ethiopia, fiscal policies like tax policies are perceived to play a strong role in solving the skewed distribution of income. However, these policy interventions demand a profound understanding of how tax policies reduce the income inequality problem and promote inclusive growth. Thus, the main objective of this study is to run a tax policy micro-simulation on the revised and harmonized versions of the tax-benefit micro-simulation model for Ethiopia (i.e., ETMOD v3.0) using EUROMOD software, which better represents the current tax system and dynamics of the Ethiopian economy to examine the impact of personal income tax and VAT on inequality (For detailed information about the methodology employed in this paper see Section 5).

The empirical analysis of this study has the following stand-out main results we need to give more attention to. The simulation result of VAT reforms confirmed the positive impact of the rise in the VAT rate on the consumption-based income distribution for low-income households. When VAT increases from 15% to 18%, reduces inequality by 0.08% of Gini coefficients. While increasing the VAT to 20% results in a much larger decline in inequality, the Gini coefficient reduces by 0.13%. However, in both reforms, poor households suffer net losses in consumption

expenditure from the VAT increment even if it is quite low compared to the richest households. The possible reason is that the poorest deciles/quintiles also spend large amounts of money on food and non-food items which are subjected to VAT even if it is less than the highest deciles/quintiles. Thus, the simulation result of both VAT reforms revealed a positive impact of the rise in the VAT rate on the consumption-based income inequality reduction efforts in Ethiopia.

Regarding personal income tax, since Ethiopia does not follow a flat personal income tax rate, reform scenarios are done by changing the existing personal income tax schedule rates in a pro-poor favored way (See Appendix A). In reform-1c, when the PIT rate increased much on the high-income recipients by favoring the lowest-income recipients, the PIT reduces inequality by 0.10% Gini coefficient. In reform-1d, the simulation was run by exempting the 1st and 2nd quintiles of the households from PIT to make the personal income tax more pro-poor. The result shows that the first two quintiles' income increased by ETB 167.2 million on average and the last three quintiles pay a disproportionate share of the tax burden – on average their disposable income declined by ETB 403 million. Consequently, inequality declined by 0.11% of the Gini coefficient. These microsimulation results confirm that Ethiopia´s PIT system is progressive since the wealthiest quintiles contribute more in tax payments compared to the poorest quintiles, and consequently, the income share of top-income recipients in post-tax is smaller, and disposable income is more equally distributed among taxpayers.[1]

The rest of the paper is organized as follows: The next section sketches the possible transmission channels of the distributional effect of tax policy and monetary policy and in section 3 the empirical literature reviews and the contribution of this paper are presented. Subsequently, section 4 presents an overview of Ethiopian inequality, the distribution of consumption expenditure & social security transfer, and the existing tax policies. Section 5 explains the methodology used in this study. In section 6, the empirical results of the micro-simulation model with the discussion are presented and finally, section 7 contains the conclusions & recommendations.

[1] Note that in this study a total of seven tax policy reform microsimulations are done (four for PIT and three for VAT). So, this summary is not exhaustive, only the stand-out main results are presented. Please see section 6 for the other simulation results

2. Transmission Channels of the Distributional Effect of Tax Policy and Monetary Policy

This section presents the different types of transmission channels through which tax policy and monetary policy can potentially affect inequality.

2.1. Transmission Channels of Tax Policy

Based on the existing literature, the following four major potential transmission channels of the distributional effect of tax policy (especially personal income tax and VAT) are identified.

The first is the *Income channel:* As stated by Younger et al. (2016) and Martorano (2018), if the tax system (e.g. personal income tax) is progressive the wealthiest quintiles contribute more in tax payment compared to the poorest quintiles, and consequently, the income share of top income recipients in post-tax will be smaller, and disposable income would be more equally distributed among taxpayers. Thus, in progressive taxation, high-income groups are subject to a high level of income tax and distribute resources from the rich to the poor and marginalized segments of society (UNDP, 2019). On the other hand, Younger et al. (2016) also revealed that indirect tax policies (i.e. VAT) indirectly affect households' consumable income by changing the price levels that they pay. In this case, the burden of the tax is on the poorer households.

The second potential transmission channel through which tax policy may affect inequality is the *Consumption channel:* In this channel, tax policy (e.g., VAT) affects poor people who spent a large share of their income on consumption rather than saving or investing; this means the tax burden is on the vulnerable income groups. Consequently, studies showed that poor and middle-class households could potentially lose from changes in the indirect tax system. Thus, through this channel, if the tax system is regressive, households in the bottom quintile will suffer a reduction in real consumption, and aggravate inequality (see Bird & Zolt, 2005; Emran & Stiglitz, 2005; Itriago, 2011). Moreover, in developing countries like Ethiopia, the consumption patterns of poor households rely more on unprocessed agricultural products. So, the exemption of agricultural products from the VAT may also improve the welfare of rural poor households (see Salti & Chaaban, 2010). Generally, if the poor spend a greater share of their income on food than the rich and consumption occurs in the formal sectors, exempting and zero-rating of food and other commonly consumed items by the poor form VAT enables governments to redistribute

wealth/resources to the lower-income groups (see Bachas et al., 2021; World Bank, 2022). On the other hand, like the low-income groups, high-income groups also spent most on foods and other necessities in absolute terms, and therefore the net distributional effect of exempted/reduced rates of VAT on food and other necessities may be zero/low (Capéau et al., 2014).

The third channel is the *Public services channel:* Since tax is the main source of revenue for the government, a tax increase may be necessary from an equity perspective if the collected revenues by the government are used to finance the provision of essential public services (such as education, health, and infrastructure) in poor neighborhoods that can have an impact on poor people's wellbeing and reduce inequality. Indeed, poorer households have far lower rates of access to public services than rich households in developing countries, including Ethiopia. So, through this channel, the provision of public services, especially the provision of basic education and health, has a significant equalizing role (see Alavuotunki et al., 2019; Alavuotunki & Pirttilä, 2015; Itriago, 2011; Jellema et al., 2017). Finally, the *Social Security transfer channel:* social security transfer payments – such as unemployment benefits, social retirement benefits, and child and family allowances – disproportionately benefit the lowest income groups. So, increasing the amount of tax collection channeled into spending on basic social security systems will potentially reduce income inequalities (see Luebker, 2011). Moreover, Capéau et al. (2014) also confirmed that a large fraction of social security contributions is made up of VAT in many countries.

2.2. Transmission Channels of Monetary Policy

Three major potential transmission channels are suggested by the existing literature through which monetary policy affects inequality. The first is the *Asset price channel*: McKay & Wolf (2023) and Doepke & Schneider (2006) argued that expansionary monetary policy, i.e. low-interest rates, causes a rise in the values of long-term assets such as stocks and real estate; which will mainly benefit the high-income households since they possess more stock assets. Moreover, Inui et al. (2017) and Taghizadeh-Hesary et al. (2018) also stated that, since the poor hold their assets in cash, expansionary monetary policy shock is likely to diminish the capital income of the poor strangely. This is because the policy shock reduces the real value of cash.

The second is the *Employment channel:* the implementation of monetary policy may promote or discourage job creation. As argued by Bonifacio et al. (2021), this channel is expected to have a countercyclical response to labor income inequality. Because, for example, in recessions, lower-income households have a high chance of losing their jobs, while implementing loose (expansionary) monetary policy creates employment opportunities, which benefits unemployed, young & less experienced, and lower-paid workers; and reduce the number of peoples whose income is zero. On the other hand, contractionary policy quite pronounced income inequality. The third is the *Saving redistribution channel:* Coibion et al. (2012) revealed that in this channel unexpected decline in the policy rate (expansionary monetary policy) and the rise in inflation will hurt savers and benefit borrowers by lowering the real value of nominal assets and liabilities. Doepke & Schneider (2006) and Taghizadeh-Hesary et al. (2018) also clarified that the impact of the monetary policy shock on inequality depends on the distribution of financial assets and liabilities among the household. Therefore, the channel works countercyclically/procyclically if the rich/poor are lenders while the poor/rich are borrowers.

3. Literature Review

In this section, the two most commonly used methodologies, i.e. the Commitment to Equity (CEQ) and the Tax-benefit micro-simulation models for selected developing countries (SOUTHMOD), for estimating the impact of fiscal policy on inequality are briefly explained, the existing empirical studies are critically reviewed, and finally, the contributions of this study to the existing body of literature in the area is explained.

3.1. Methodologies for Estimating the Impact of Fiscal Policy on Inequality

This section gives a methodological highlight of the two most commonly used methodologies for estimating the impact of fiscal policy on inequality: the Commitment to Equity (CEQ) and the Tax-benefit micro-simulation models for selected developing countries (SOUTHMOD).

Commitment to Equity (CEQ) Methodology: *CEQ Assessment* is the first comprehensive, rigorous, and widely-used fiscal incidence diagnostic microsimulation tool employed to estimate the impact of fiscal policy (taxes and social spending) on inequality and poverty reduction efforts of a particular country (Lustig, 2022). This fiscal policy microsimulation tool is developed by the

CEQ Institute at Tulane University in 2015 to help policymakers in designing tax and benefit policies to reduce inequality and poverty (Lustig & Higgins, 2022).

The main building block to measure the distributional role of taxes and benefits is the definition and construction of pre-fiscal and post-fiscal income concepts. In CEQ, to examine the redistributive effect of fiscal policy we need to construct four basic income concepts, as defined in Lustig (2022) and Lustig & Higgins (2022): market income, disposable income, consumable income, and final income. As illustrated in Figure-1, *Market income*, also called *primary/original income*, is the total current income before direct taxes. *Disposable income* is market income minus direct personal income tax minus all contributions to social insurance schemes plus direct government transfers (cash transfers). *Consumable income* is disposable income minus indirect taxes plus indirect subsidies (such as energy and food price subsidies). Finally, *Final income* is consumable income plus the monetized value of government in-kind transfers minus copayments or user fees when they exist.

Thus, the redistributive impact of fiscal policy can be measured by taking the difference in incomes before and after the tax policy intervention, which is the difference between the Gini for the market income and the Gini for the income after taxes and transfers (Lustig, 2022; Lustig & Higgins, 2022).

Generally, the CEQ Assessment framework has three advantages: i) it is comprehensive – it considers the direct cash & in-kind transfers, price and product subsidies, and includes both direct and indirect taxes. ii) The CEQ assessment project is implemented in more than 80 countries across the world, and the methodology, framework, and principles of the CEQ assessment tool enable researchers to make cross-country comparisons across years. iii) the CEQ assessment tool requires relatively little data to construct the pre-fiscal and post-fiscal income concepts for equity analysis.[2]

[2] For more information about CEQ, see Lustig (2022) and https://commitmentoequity.org/

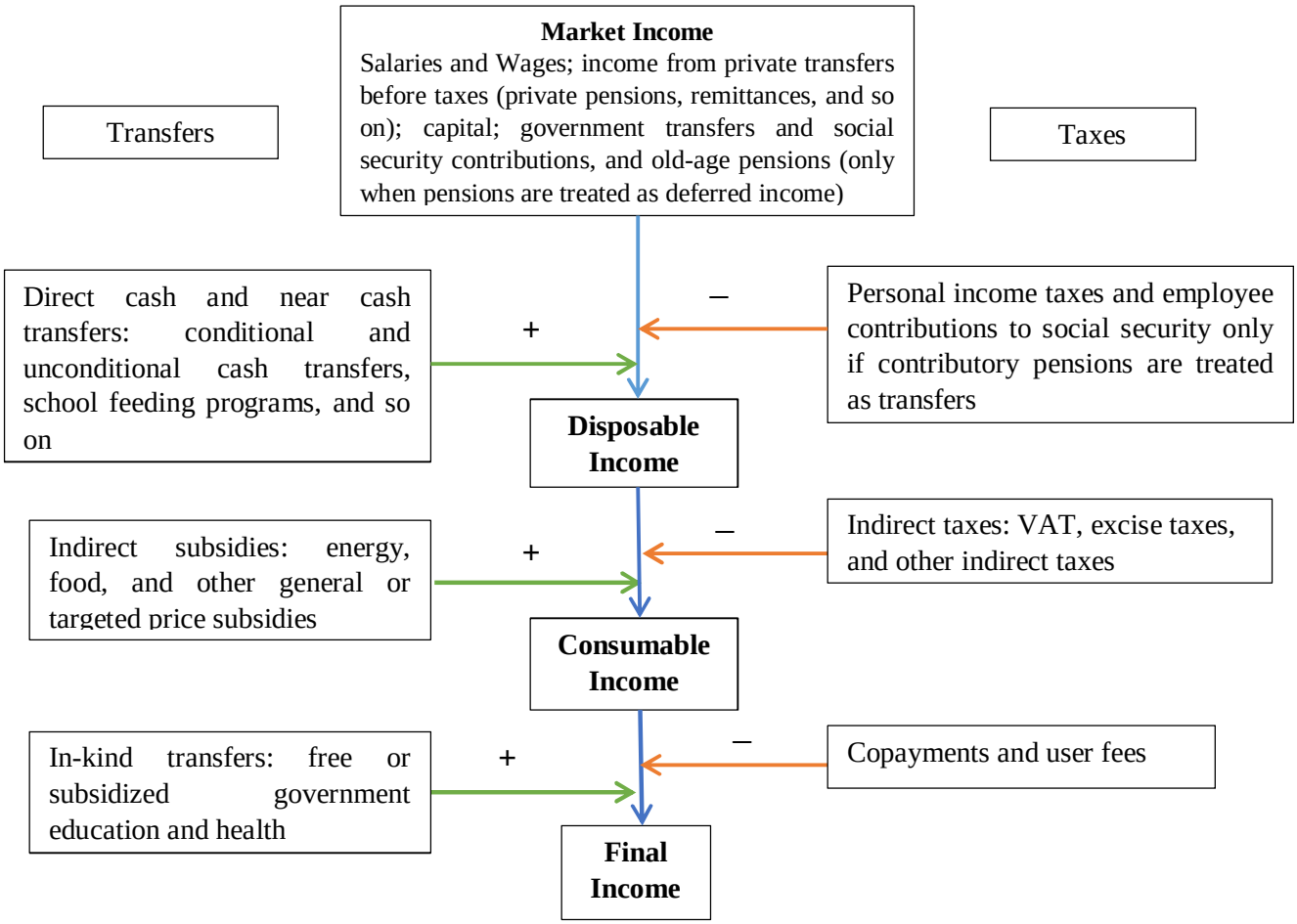

Figure 1: Basic Income Concepts in CEQ

Source: Adopted from Lustig (2022); Lustig & Higgins (2022)

Tax-benefit micro-simulation models for selected developing countries (SOUTHMOD): It is s a static tax-benefit microsimulation model developed by the UNU-WIDER project that includes the tax-benefit microsimulation models for developing countries and operates with the EUROMOD platform/software. Currently, SOUTHMOD models are available for the following countries: Nine models in Africa - Ethiopia (ETMOD), Mozambique (MOZMOD), Ghana (GHAMOD), Namibia (NAMOD), Tanzania (TAZMOD), Rwanda (RWAMOD), South Africa (SAMOD), Uganda (UGAMOD), and Zambia (MicroZAMOD); four in Latin America – Bolivia (BOLMOD), Colombia (COLMOD), Ecuador (ECUAMOD), and Peru (PERUMOD), and one in Southeast Asia Viet Nam (VNMOD). These models enable researchers and policymakers to estimate the effects of taxes and benefits on inequality and poverty in each country (Shahir & Figari, 2023).

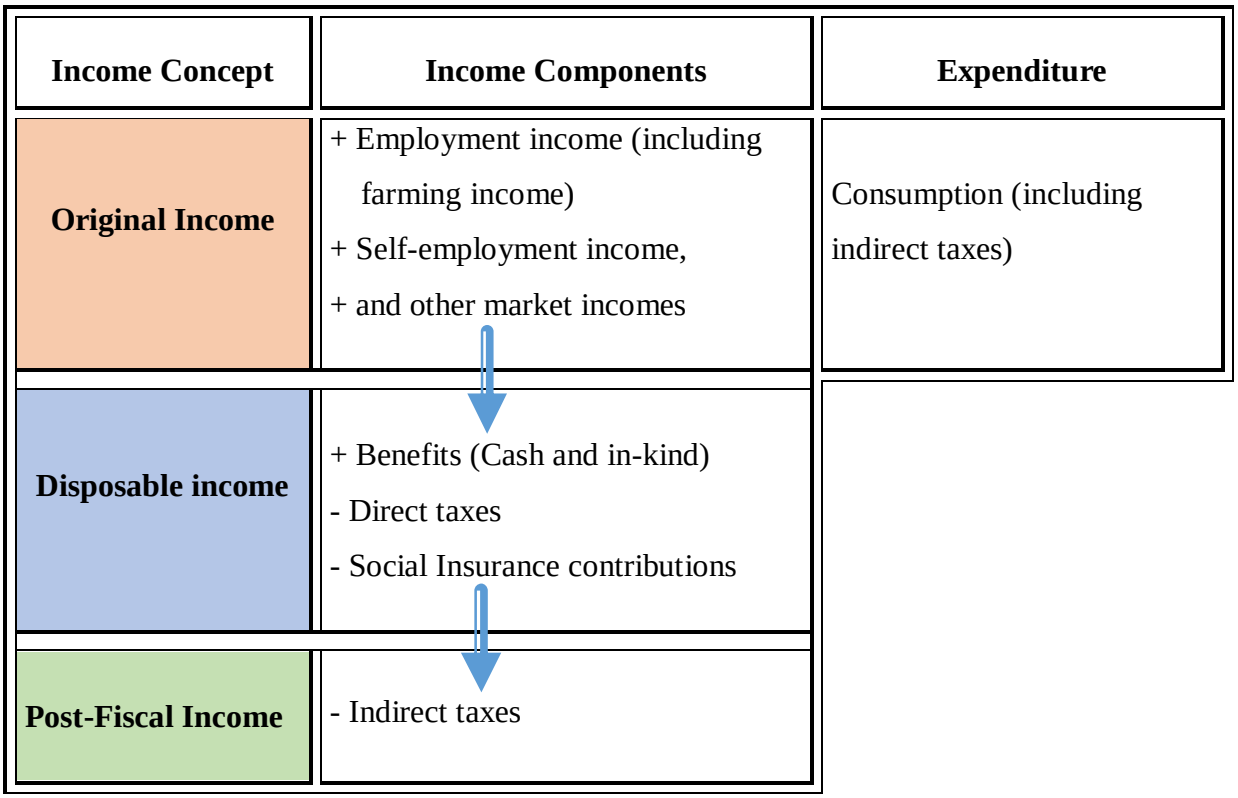

Figure 2: Income/welfare concepts in SOUTHMOD for distributional analysis

Source: Based on Gasior et al. (2018) and UNU-WINDER (2022)

Note: Benefits include pensions (when available). Consumption is as it is defined in each of the underlying datasets.

As shown in Figure 2, the model used a variety of different income and expenditure concepts for distributional analysis. Figure 2 shows the key income concepts used in SOUTHMOD for distributional analysis. As explained in Gasior et al. (2018) and UNU-WINDER (2022), in SOUTHMOD, the distributional measures are calculated based on the three broad income concepts: original income, disposable income, and post-fiscal income. *Original income* is the income before any taxes have been paid and benefits received – includes self-employment income, employment income, and other market incomes. *Disposable income* is the income after receipt of benefits and the payment of direct taxes and social insurance contributions. In-kind benefits are also included in this income accounting. Finally, *Post-fiscal income* is income after the deduction of indirect taxes from disposable income. Note that, since own production is an

important source of welfare in many developing countries, the income lists are included in the disposable income category for income-based poverty and inequality measures. [3]

While expenditure is the actual amount of money spent on items, in SOUTHMOD, it is indicated by consumption - which includes not only the purchased items by the households but also items produced by the household itself and/or received from non-household members.[4]

Comparison between CEQ and SOUTHMOD: As explained in Gasior et al. (2018); Paulus & Sutherland (2016)[5]; Shahir & Figari (2023); and UNU-WINDER (2022, 2023), this sub-section gives a short highlight on the differences and similarities between CEQ and SOUTHMOD. *Similarities:* Both methodologies have comprehensive methodological guidelines. *Differences (Advantages of SOUTHMOD over ECQ):* First, SOUTHMOD gives users full access to micro datasets for all countries with documentation, while CEQ doesn't provide users with harmonized micro-data. Second, SOUTHMOD provides custom-built and stand-alone software for modeling tax-benefit systems, i.e. EUROMOD, but CEQ does not provide (executable) software programs. Third, SOUTHMOD has fully developed and validated microsimulation models for the 13 countries, CEQ doesn't have. Finally, SOUTHMOD provides regular updates each year for all countries, but not by CEQ.

3.2. Empirical Literature Review and the Contribution of the Paper

This section presents a critical review of the existing empirical studies, and in line with the existing empirical study's limitations, the contributions of this paper to the existing body of literature in the area.

In recent times, the distributional effect of fiscal policy (especially, tax policy) in different countries examined by different studies (such as Alam et al., 2017; Alavuotunki et al., 2019; Alavuotunki & Pirttilä, 2015; Arunatilake et al., 2017; Cancho & Bondarenko, 2017; Cano, 2017; Hanni et al., 2015; Jellema et al., 2017; Salti & Chaaban, 2010). Moreover, in Africa,

[3] In the Commitment to Equity (CEQ), original income is referred to as 'Market Income'. 'Net Market Income' is defined as Market Income minus personal income and payroll taxes; and 'Disposable Income' is defined as Net Market Income plus direct transfers.

[4] For more information about SOUTHMOD see Shahir & Figari (2023), UNU-WINDER (2022), and https://www.wider.unu.edu/project/southmod-simulating-tax-andbenefit-policies-development.

[5] Note that, since SOUTHMOD is the extended and amended from EUROMOD to use in a developing country context, the system for both models works in the same way and have the same characteristics, except the dataset and policy rules.

studies conducted by Gasior et al. (2018); Goldman et al. (2021); Hill et al. (2017); Inchauste et al. (2017); Jouini et al. (2018); Lara Ibarra et al. (2019); Younger et al. (2016), and Younger et al. (2017) also examined the effect of fiscal policy on income inequality. The main findings of all the above-listed studies are presented as follows:

Alavuotunki & Pirttilä (2015) estimate the effect of value-added tax on inequality using OLS estimations for all countries of the world whose data exist and adopted the VAT system. The estimation result revealed that the adoption of VAT has a benign effect on inequality - increasing the Gini coefficient on average by 1.63 percentage points, for the period 1975-2000. In the same fashion, Alavuotunki et al. (2019) also estimate the effect of VAT on income distribution by including all countries that adopt VAT for which data exist, but they excluded former Soviet Union countries due to data credibility. And they found that due to the VAT adoption, income-based inequality has increased on average by 3.95 percentage points of the Gini coefficient, while consumption-based inequality has remained unaffected. Similarly, via a microeconomic simulation methodology, Salti & Chaaban (2010) examine the inequality implications of a uniform increase in the VAT in Lebanon using a survey conducted in 2004/2005 by employing the Almost Ideal Demand System (AIDS) methodology of demand estimation. They discovered that inequality, measured by the simple ratio of the richest 20% of households to the poorest 20%, increases from 4.1 to 6 among Lebanese consumers due to a 2% increase in VAT.

In Jordan, Alam et al. (2017) found that, in the context of the Commitment to Equity (CEQ) methodology, the marginal contributions of personal income taxes (PIT) to the changes in the Gini coefficient (measured at consumable income) is 0.008, implying that PIT reduces income inequality, but the effect is low. However, indirect taxes (sales taxes) are non-equalizing (-0.001), implying that indirect taxes increase income inequality. Likewise, Cano (2017) study the effect of personal income tax on income distribution in Ecuador between 2007 and 2011 using a static micro-simulation model. The simulation result shows that the redistributive effect of personal income tax is low - the Reynolds-Smolensky redistribution index revealed that income inequality declined from 0.66 to 0.65 in 2008 and from 0.64 to 0.63 in 2010. This is attributed to legal tax deductions which enable rich people to have a high likelihood of reducing their taxable income than poor people. By the same token, Hanni et al. (2015) also reported a weak distributional effect of personal income tax in a study conducted in 17 countries in Latin

America. Their study demonstrates that the Gini coefficient declined on average by 2% due to the progressivity of personal income tax, this very small redistributive impact is due to the low tax collection capacity of the countries.

By employing the CEQ methodology, Arunatilake et al. (2017) finds that personal income taxes have a negligible redistributive role – just reduce inequality by 0.25% Gini coefficient in Sri Lanka, while VAT increases income inequality by 0.0016 Gini points. Similarly, by applying the same methodology in Georgia, Cancho & Bondarenko (2017) estimated that PIT reduces inequality by 2.2% of the Gini coefficient, while the marginal contribution of VAT increases inequality by 1% of the Gini coefficient. From these two results, we can understand that the distributional contribution of PIT is positive, while negative for VAT. However, in Indonesia, Jellema et al. (2017) found that the marginal contribution of VAT to income inequality is 0.0015 Gini points under the CEQ methodology, which implies that VAT reduces income inequality even if it is by a low amount.

Despite the importance of the perceived distributional effects of fiscal policy in Africa, the empirical evidence is scant. The main findings of the above-mentioned studies in Africa are presented as follows.

By employing the newly developed micro-simulation models[6] for Ethiopia, Mozambique, Ghana, South Africa, Zambia, and Tanzania, Gasior et al. (2018) found that indirect tax (i.e. VAT) increases inequality in all six countries under study. The study found the biggest distributional effects in Ethiopia and Tanzania. The simulation result estimates that VAT reform leads to a 2.6 and 2.2 percentage point increment of the Gini coefficient for Ethiopia and Tanzania, respectively. However, direct taxes have positive distributional effects in all six countries studied. For example, in Ethiopia and Tanzania, the direct tax system reduces the Gini coefficient by 3.7 and 2.2 percentage points, respectively. For Ethiopia, personal income taxes (PIT) are credited to 93% of this inequality reduction. Moreover, in Ethiopia, Hill et al. (2017) also confirm that fiscal policy (all types of taxes and transfers are considered) reduces income inequality using the CEQ methodology - the Gini coefficient declined from 0.322 to 0.302. Here

[6] The micro-simulation models used by this research are ETMOD, MOZMOD, GHAMOD, TAZMOD, SAMOD, and MicroZAMOD, which are Tax-benefit micro-simulation models for Ethiopia, Mozambique, Ghana, Tanzania, South Africa, and Zambia, respectively - developed by UNU-WIDER as a part of SOUTHMOD (Tax-benefit micro-simulation models for selected developing countries) project.

we should note that in Ethiopia the above two studies found different results on the distributional impact of VAT. This difference is attributed to the methodological and data set (Gasior et al. (2018) used the 2010/11 household survey data and Hill et al. (2017) used the 2013/14 Ethiopia Socioeconomic Survey) differences employed by the two studies.

Goldman et al. (2021) and Inchauste et al. (2017) applied the CEQ methodology to quantify the distributional impact of the main tax programs in South Africa, and they found comparable results. More specifically, Goldman et al. (2021) revealed that the personal income tax reduces inequality by 3.26 Gini points, while VAT has an insignificant impact on inequality (measured at consumable income) in South Africa. Similarly, Inchauste et al. (2017) also confirm that personal income tax reduces income inequality by 0.032 Gini points in South Africa, while the marginal contribution of indirect tax (i.e. VAT) is neutral.

The impact of Tunisia's tax on inequality using the CEQ methodology was estimated by Jouini et al. (2018), and the estimation result revealed that fiscal policy reduces inequality by 0.09 Gini points (the Gini coefficient declines from 0.44 to 0.35) - tax accounts about 30 percent of the decline. By using a similar methodology, Lara Ibarra et al. (2019) also confirm that Egypt's fiscal system managed to reduce income inequality - the Gini coefficient falls from 0.33 to 0.28.

In Ghana, using CEQ methodology, Younger et al. (2017) revealed that the effect of the fiscal system on inequality was moderate - the Gini coefficient declined by 0.035. Which is the lowest compared to the average of most middle-income countries (the average Gini coefficient is 0.076). More specifically, direct taxes have a small but statistically significant effect on income inequality, with a Gini coefficient of 0.012. While the distributional impact of VAT is neutral. Likewise, Younger et al. (2016) also find that indirect tax's redistributive effects are significant but weaker in Tanzania - reducing income inequality by 1.7 percentage points of the Gini coefficient. Overall, the activities of the fiscal system of Tanzania reduce inequality by 5.1 percentage points of the Gini coefficient, which seems like a weaker effect.

Thus, in line with the above-listed existing study's limitations, this study has the following contributions to the existing body of literature in the area.

First, the existing studies (especially in Africa) found mixed results on the distributional impact of tax policy due to a difference in the tax structure of the countries, the application of different

methodologies, using different measures of income inequality, using different data sets, etc. Therefore, these mixed findings motivate the researcher for further studies to provide additional and convincing evidence to policymakers through the usage of more accurate data and/or better tools (i.e., using ETMOD v3.0 running on EUROMOD software, and it used the three waves of the Ethiopia Socioeconomic Survey (ESS): 2013-14, 2015-16, and 2018-19), which are compatible with the current Ethiopian tax system.

Second, to the best of the researcher's knowledge, there are only two pieces of empirical evidence (Gasior et al., 2018; Hill et al., 2017) that examine the effect of tax policy on income inequality in Ethiopia. But both studies have the following limitations that motivate the researcher to investigate the issue again. The first study is, as briefly explained above, the analysis by Hill et al. (2017) is a little bit aggregate – putting all tax types in one category. Thus, the analysis of this study does not offer conclusions about whether specific taxes are desirable or not. That means it is very difficult to understand the specific effects of each tax system and vague for policymakers. Moreover, the study used outdated data (the 2005 SAM and the 2010/11 household survey data) – which didn't consider many tax reform measures taken by the Ethiopian government; especially, in July 2016, the government of Ethiopia changed the personal income tax brackets and in 2019 the revised VAT law introduced new exemptions of goods and services (see Harris & Seid, 2021). Thus, this study assesses how each tax instrument (i.e. the personal income tax and VAT) affects income inequality in Ethiopia by using the revised and harmonized versions of the tax-benefit micro-simulation model for Ethiopia (i.e. ETMOD v3.0)[7] – this version is based on the three waves of the Ethiopia Socioeconomic Survey (ESS): 2013-14, 2015-16, and 2018-2019, which are used for 2020, 2021 and 2022 policy systems/years in ETMOD (see Shahir & Figari, 2023). [8]

The second paper is, as briefly explained above, the study conducted by Gasior et al. (2018) that employed ETMOD v1.0 to estimate the distributional effect of tax policy. However, the study has the following major limitations: **(i)** the microdata used in ETMOD v1.0 used the 2013/14

[7] ETMOD is a tax-benefit micro-simulation model for Ethiopia developed by UNU-WIDER and other partners, and the first version (ETMOD v1.0) was launched in July 2017. Currently, ETMOD v3.0 released. Detailed coding of tax and benefit legislation ('policy rules') and representative household-level data on incomes and expenditures ('micro data') are the two building blocks of ETMOD (see Mengistu et al., 2017; Shahir & Figari, 2023).

[8] In the latest tax-benefit micro-simulation model for Ethiopia (i.e., ETMOD v3.0), the 2020–2022 policy systems (i.e. ET_2020, ET_2021, and ET_2022) are underpinned by the 2018/19 ESS dataset.

Ethiopia Socioeconomic Survey (ESS), which covered only rural areas and small towns, so it can't be considered nationally representative. So, any results the study gets may not reflect the stance of the target population (Ethiopia) and it is difficult to generalize the result. But, in this study, the fourth wave of ESS (2018/19) is used for the 2020 - 2022 policy systems (i.e. ET_2020, ET_2021, and ET_2022) of ETMOD v3.0, which covered all rural and urban areas of Ethiopia, so the fourth wave of ESS can be considered nationally representative (see Mengistu et al., 2017; Shahir & Figari, 2023). **(ii)** Recently, the Ethiopian government takes many tax reform measures. Reforms related to the objective of this study are: in July 2016, the government of Ethiopia changed the personal income tax brackets and in 2019 the revised VAT law introduced new exemptions for goods and services (see Section 4.3 and Harris & Seid, 2021). However, ETMOD v1.0 doesn't consider these policy reforms/changes, so this study needs an update on its result to provide relevant policy recommendations by considering Ethiopia's current tax structure/system. As used in this study, VAT and personal income tax reforms are carefully coded in ETMOD v3.0 (see Mengistu et al., 2017; Shahir & Figari, 2023).

4. Background of Ethiopia

This section, first, gives an overview of Ethiopian inequality (in Section 4.1) and the distribution of household consumption expenditure and social security transfer in Ethiopia (in Section 4.2), then present the feature of the existing major types of taxes in Ethiopia (in Section 4.3), and finally, outline the percentage contribution of the different tax types to the total tax revenue of the Ethiopian government (in Section 4.3.1).

4.1. Inequality in Ethiopia

In recent years, despite the remarkable achievement in economic growth and reduction of the poverty rate, income inequality has been increasing over time in Ethiopia even though a positive sign was seen in the late 1990s and the beginning of the 2000s (Argaw, 2017; World Bank, 2015).

As shown in Figure 3, the decline in income inequality was observed between 1995 and 2004 with the Gini index declining by 14.8 percentage points, from 44.6 percent in 1995 to 29.8 percent in 2004. Correspondingly, Figure 4 also shows that the income share held by the highest 20 percent of the population decline from 51.6 percent in 1995 to 39.4 percent in 1999. But, the

income share of the bottom 20 percent of the population, on average, increased from 6.3 percent in 1995 to 9.4 percent in 1999, i.e., by 3.1 percentage points. Moreover, the share of income held by the bottom 10 percent increased from 2.6 percent to 4.1 percent, i.e., by 1.5 percentage points. As a very poor country, this inequality result is consistent with the overall picture of Ethiopia with a low per capita income. Studies (Cornia & Martorano, 2019; Devereux et al., 2005; MOFED, 2002; World Bank, 2015) confirmed that the egalitarian land-holding system applied by the government of Ethiopia in 1997 brings more equal income distribution in the rural part of the country and since the majority of the population is rural this leads to a low national Gini index.

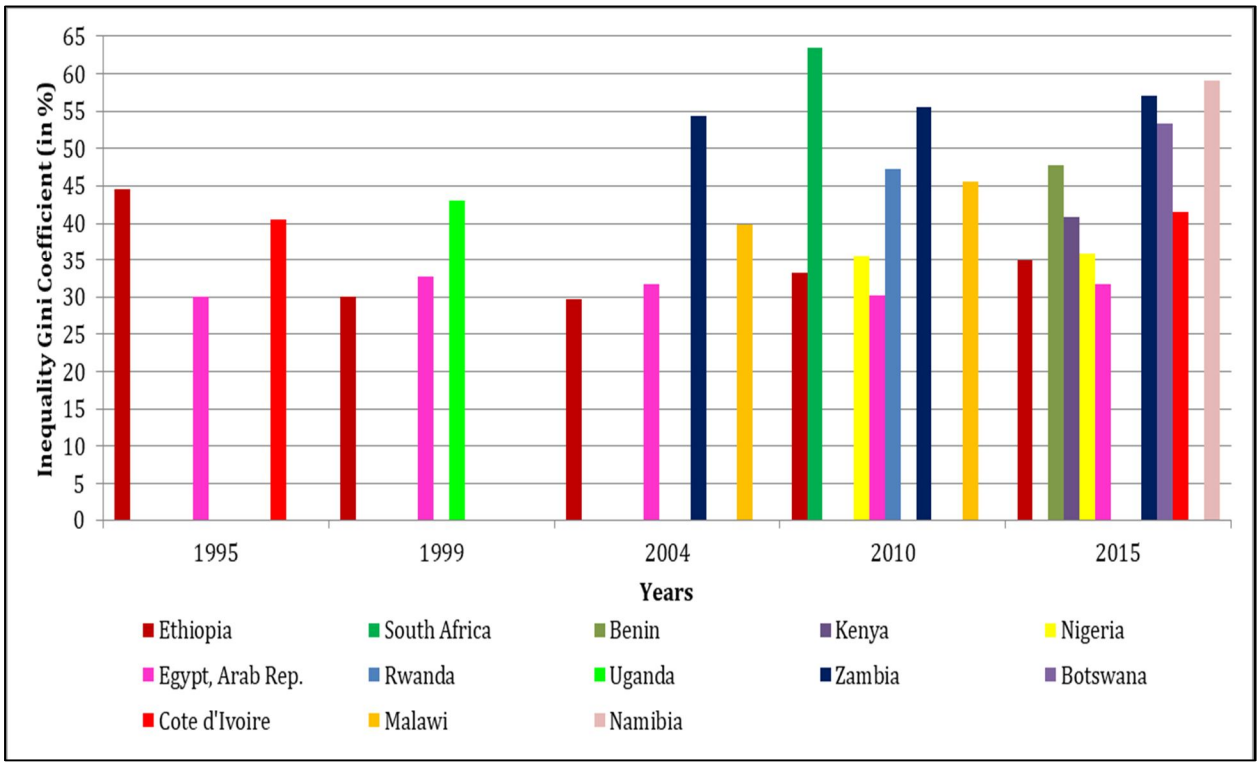

Figure 3: Gini Index: Distribution of income among individuals in Sub-Saharan African countries

Source: Data are taken from the World Bank, WDI online database, accessed May 2023.

Note: For comparison, in each year (in which Ethiopia has Gini index data), the selection of other Sub-Saharan African countries depends on the availability of Gini index data.

According to the 2022 World Economic Outlook database, over the past 11 years, Ethiopia's economy has been among the fastest growing in the world at an average of 10.8% per year in real terms between 2005 and 2015 (IMF, 2023). However, consistent with Piketty's (2015) and Stiglitz's (2015) view, Ethiopia's rapid and sustainable economic growth does not automatically

translate into an accelerated reduction in inequality, and the inequality level getting worse (Gebeyehu et al., 2018). As shown in Figure 3, income inequality measured by the Gini coefficient increased to 33.2% in 2010 from 29.8% in 2004, and further increased to 35% in 2015. Likewise, Figure 4 also illustrates that the income share held by the highest 20% of the population increased from 39.3% in 2004 to 43% in 2015. While the income share of the lowest 20% of the population decreased to 7.3% in 2015 from 9.4% in 2004.

However, compared to other Sub-Saharan African (SSA) countries, over the past 11 reporting years, Ethiopia has had relatively low and stable inequality. In 2015, next to Egypt, Ethiopia recorded the lowest income inequality measured by the Gini coefficient. The Gini index was 31.8%, 35%, 35.9%, 40.8%, 41.5%, 47.8%, 53.3%, 57.1%, and 59.1% for Egypt, Arab Rep., Ethiopia, Nigeria, Kenya, Cote d'Ivoire, Benin, Botswana, Zambia, and Namibia, respectively. And, the trends of the Gini coefficients of consumption inequality reported in Table 1 show that the national Gini index fluctuated within a narrow range of 30% - 35% between 1999 and 2015. As explained by Cornia & Martorano (2019) and UNDP (2019), the egalitarian land-holding system applied by the government of Ethiopia in 1997 has contributed to a more equal income distribution in the rural part of the country, and since the majority of the population is rural this policy has an enormous contribution to the decline in the national Gini index. Moreover, the country's structural transformation gave much attention to and was dominated by labor-intensive and less skill-intensive activities which had a moderate impact to reduce inequality. Generally, the main driving force for Ethiopia's success in having low and stable inequality is the adoption of the Ethiopian government's national development strategy called Agricultural Development-Led Industrialization (ADLI) - modernized agriculture, opened up agricultural markets, and invested in infrastructure – made a significant contribution to the country's success (Cornia & Martorano, 2019; UNDP, 2019).

From Figure 4, over the reporting years, we observe that the most noticeable change in the relative income differences is the relative income of the top 20% in comparison to the bottom 20% of the population. The reason for this relative income difference is the existence of a high level of income inequality in urban areas and a relatively low level of income inequality in rural parts of Ethiopia due to equal annually earned agricultural income (World Bank, 2015). And also as a result of increasing divergence in welfare trends (i.e. consumption) between rural and urban

areas (World Bank Group, 2020). Moreover, Caracciolo & Santeramo (2013) and Debebe & Zekarias (2020) also established that the increasing trend of income inequality over time in Ethiopia might be due to the vague welfare-oriented planning process of the government

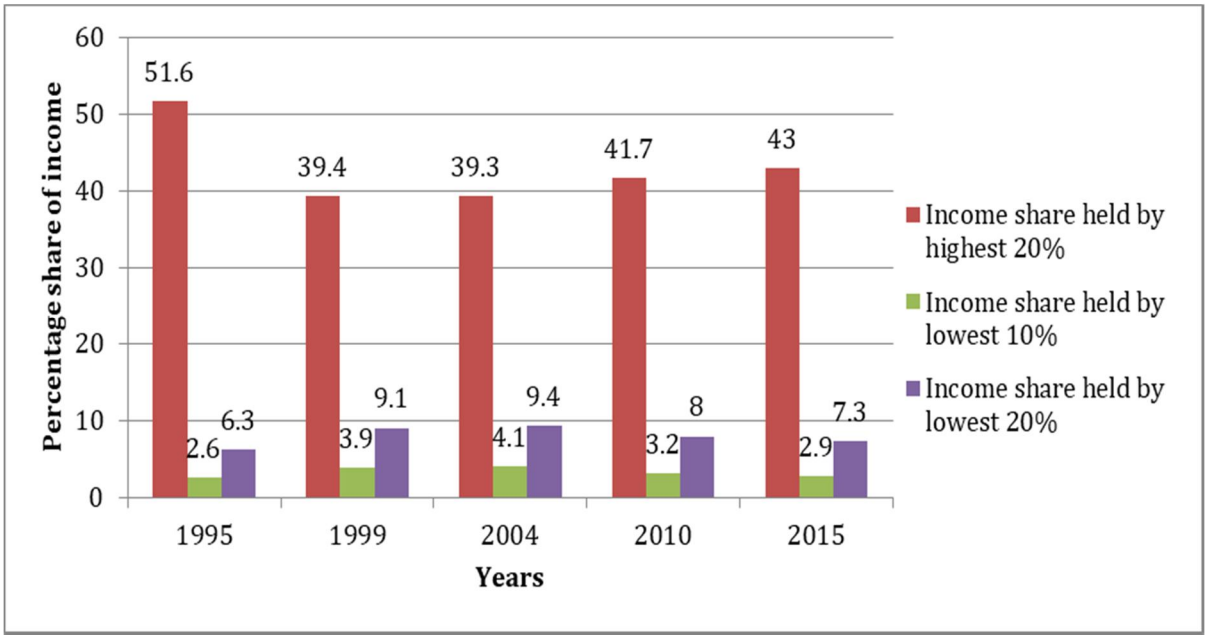

Figure 4: The percentage share of income by subgroups of the population

Source: Data are taken from the World Bank, WDI online database, accessed March 2023.

4.2. Distribution of Household Consumption Expenditure and Social Security Transfer in Ethiopia

In this section, the general distribution of equivalized household consumption expenditure (both food and non-food consumption expenditures) and social security transfer in Ethiopia across deciles is presented by employing the 2019 Ethiopia Socioeconomic Survey (ESS).

As shown in Table 1, generally, the equivalized average monthly food consumption expenditure of the richest deciles was larger than the poorest deciles for both food and non-food consumption in Ethiopia.[9] The average equivalized monthly food consumption expenditure of the first decile in 2022 was ETB 4351, while the average food consumption spending of the tenth decile was 7.4 times higher, i.e. ETB 3317. Regarding non-food consumption expenditure, the average

[9] The classification of consumption expenditure is done based on the United Nation Classification of Individual Consumption According to Purpose (COICOP) 2018 (United Nations, 2018)

equivalized monthly expenditure for the first decile was ETB 1054 per household, whereas, for the tenth decile, it was 2.7 times higher, i.e. ETB 2921.

Table 1: The monthly consumption expenditure share (in ETB)

Deciles	The mean of food expenditure	The mean of non-food expenditure	Share food in all market expenditure (%)	Share food in total expenditure (%)	Share food in total food (%)	Share non-food in total non-food (%)
1	451	1054	30	22	1.7	3.7
2	739	1315	36	26	3.0	4.9
3	908	1472	38	28	3.9	6.0
4	1117	1502	43	31	5.1	6.4
5	1122	1567	42	29	5.5	7.1
6	1314	1639	44	33	7.3	8.4
7	1593	1728	48	35	9.2	9.3
8	1793	1793	50	39	12.1	11.3
9	2294	2020	53	43	17.2	14.1
10	3317	2921	53	46	35.1	28.8
Total	**1733**	**1860**	**48**	**38**	**100.0**	**100.0**

Source: Authors' calculations using STATA. Data are taken from the 2019 Ethiopia Socioeconomic Survey (ESS) & ETMOD Version 3.0

Note: the second and the third column are the means of food and non-food expenditures of the households to which the 10 percent poorest individuals of society belongs.

With this, the ratio of the average equivalized consumption expenditure of the lowest and the highest decile shows that the richest deciles have the largest consumption spending than the poorest deciles, and a harsher ratio was observed in the food consumption expenditure category. Thus, similar to the simulation result of this paper in section 6, the richest households pay more VAT taxes than the poorest, and households in the top quintile will suffer a reduction in real consumption, and consequently inequality reduced. Moreover, the government collected more tax revenue to finance the provision of essential public services and social security services which have an impact on poor people's well-being and reduce inequality (See Section 6.2).

However, as shown in Table 1, the non-food consumption expenditure of the lowest quintiles is much better in contrast to their food consumption expenditure. This is why in the simulation result of this study we notice that the poor/vulnerable households suffer net losses from the VAT increment, even if it is quite low compared to the richest households, and makes the

distributional impact of VAT negligible (see Section 6.2). Here we should note that even if the lowest quintiles/deciles spend some amount of money on food consumption, most of the food categories are exempted from VAT (See section 4.3), which makes them less vulnerable/liable to VAT. However, like the low-income groups, high-income groups also spent most on foods and other necessities in absolute terms, and therefore the net distributional effect of exempted/reduced rates of VAT on food and other necessities is low in Ethiopia (see Section 6.2).

As elucidated by Luebker (2011), social security transfer payments – such as unemployment benefits, social retirement benefits, and child and family allowances – disproportionately benefit the lowest income groups. So, it is believed that increasing the amount of tax collection channeled into spending on basic social security systems will potentially reduce income inequalities. In Ethiopia, the main social security transfer payment tool the government has been using for many decades is social retirement benefits. Since the fourth wave of the Ethiopia Socioeconomic Survey (ESS) has only collected data on old age pension benefits received by the members of the household (see CSA & LSMS-ISA, 2023), our focus is only on the social retirement benefit category, i.e. the old-age pension benefits.

The decile distribution of the social security transfer calculations from the survey data reported in Table 2 revealed that the average equivalized monthly old-age pension benefits received by the lowest five deciles were on average ETB 646.22, while for the top five deciles; it was on average ETB 995.03. This means the old-age pension benefits received by the first five deciles were 1.54 times lower than the top five deciles. Moreover, as Table 2 shows only 28.5% of the pension is transferred to the lowest five deciles; the remaining is transferred to the top five deciles.

The above results revealed that old-age pension benefits transfer favored the richest deciles, and a more harsh result is found in the 3rd & 4th deciles of the households. This shows that most of the Ethiopian government's social retirement benefits are directed to the richest households. The above ratio of the average monthly old-age pension benefits received by the first three quintiles and the last two quintiles in Ethiopia is not consistent with the analysis of Luebker (2011), who revealed social security transfers (social retirement benefits in this case) disproportionately benefit the lowest income groups of the population. Thus, this confirms VAT plays an important

distributional role not through social security transfer in Ethiopia but rather through public services provision which has an impact on poor people's well-being (See Section 6.2).

Table 2: The monthly social security transfer across deciles (in ETB)

Deciles	Number of old age pension receivers in each decile	Old age pension benefits received (N=212)		
		The average benefit received in ETB	Total benefit received	
			In ETB	In %
1	13	895.35	23,739,646.78	8.2%
2	13	593.48	15,097,599.16	5.2%
3	9	692.89	13,598,816.07	4.7%
4	11	467.72	13,368,711.82	4.6%
5	27	581.63	16,205,768.51	5.6%
6	18	876.49	35,957,813.90	12.5%
7	27	397.74	16,156,385.11	5.6%
8	25	587.89	19,798,159.34	6.9%
9	34	1,195.99	49,357,697.04	17.2%
10	35	1,917.01	84,485,901.93	29.4%
Total	212	875.50	287,766,499.66	100.0%

Source: Authors' calculations using STATA. Data are taken from the 2019 Ethiopia Socioeconomic Survey (ESS) & ETMOD Version 3.0

Note: The third column is the mean of the old age pension benefits received by the households to which the 10 percent poorest individuals of society belongs.

4.3. Tax Policies in Ethiopia

Like other countries, taxes are major sources of revenue for the Ethiopian government to supply public goods and services like roads, municipal services, power, education, health and other public infrastructures, and public security services. As Ethiopia achieves a fast economic growth rate and finances public expenditures, the government becomes more reliant on domestic revenues (FDRE & Unicef, 2018; Jebessa et al., 2005).

Since 1992/93, the economic policy of the Ethiopian government has shifted from a central planning economic system to a market-oriented economic system. Following the economic policy shift, the government of Ethiopia introduces a series of wide-ranging tax policies and

administration reforms. Despite these reforms and the increase in revenue of the government, the overall budget deficit has been increasing over time (see FDRE & Unicef, 2018; Harris & Seid, 2021; Muñoz & Cho, 2003).

The Ethiopian Taxation system has two major categories: direct (such as personal income tax, business profit tax, rental income tax, and others) and indirect taxes (such as Value added tax (VAT), turnover tax (TOT), Excise tax, and others) (see Harris & Seid, 2021; Jebessa et al., 2005). In this section, the feature of the major types of taxes in Ethiopia, and the percentage contribution of the different taxes to the total tax revenue of the Ethiopian government are presented. The major types of taxes are:

a) *Employment / Personal Income Tax:* The revised Federal Income Tax Proclamation No. 979/2016 stated that personal income tax is imposed on an employee who receives an employment income during the month or part thereof at the rate specified in Table 3. The proclamation indicated that an individual's wages, salary, bonuses, allowances, gratuities, commission, and any other remuneration received by an employee are treated as employment income. Moreover, fringe benefits, compensation for redundancy or loss of employment, or golden handshake payments are also a part of employment income (see FDRE, 2016).

Table 3: Employment income tax rates in Ethiopia

Employment income (per month, ETB)	Applicable rate (%)
0-600	0
601-1,650	10
1,651-3,200	15
3,201-5,250	20
5,251-7,800	25
7,801-10,900	30
Over 10,900	35

Source: Federal Income Tax Proclamation (No. 979/2016)
Note: Ethiopian Birr (ETB) is the official currency of Ethiopia

b) *Business Profit Tax:* This tax is imposed on the taxable business income / net profit generated from entrepreneurial activity. In the Ethiopian tax system, businesses are classified

into three categories - A, B, and C – based on whether the business is registered as a separate legal entity or not, and annual business turnover which measures the size of the business. The Federal Income Tax Proclamation 979/2016 stated that the threshold for Category A firms is 1 million Birr, between 500,000 - 1 million Birr for Category B firms, and for Category C firms it is below 500,000 Birr. Category A firms are subjected to the same tax rate (30% of their profit) (see FDRE, 2016; Mascagni & Molla, 2018). Taxable business income of other taxpayers shall be taxed under the following schedule presented in Table 4:

Table 4: Business income tax rates for unincorporated businesses

Taxable business income (per year, ETB)	Tax Rate (%)
0–7,200	0
7,201–19,800	10
19,801–38,400	15
38,401–63,000	20
63,001–93,600	25
93,601–130,800	30
Over 130,800	35

Source: Federal Income Tax Proclamation (No. 979/2016)

c) *Value Added Tax (VAT):* In 2003, following the approval of the Value Added Tax Proclamation No. 285/2002, VAT is introduced into the Ethiopian tax system (Harris & Seid, 2021). VAT is imposed on consumer expenditure, and collected by the sellers on behalf of the government from the buyers on business transactions and imports. A taxpayer can be an individual, firm, or company, as long as it is registered for VAT. Based on the amended federal VAT Proclamation No. 1157/2019, it is compulsory to register for VAT if the annual turnover of the persons/businesses is ETB 1 million and above (FDRE, 2019). In Ethiopia, the standard rate of VAT is 15%. However, as stated under Article 7(2) and Article 8 of the VAT Proclamation No. 285/2002, to reduce the deterrent effect of VAT on the consumption of goods and services which have enormous social benefits, the VAT proclamation introduced zero rating and exemptions (see Table 5). In recent years, even if there are no additional zero rates introduced, the number of goods and services exempted from VAT are increased (Harris & Seid, 2021).

Table 5: Key VAT-exempted and zero-rated items in Ethiopia

Exempted items	Zero-rated items
Real estate services (including both the rental and sales of a dwelling)	The export of goods and services
Financial services/permits and license fees	International transportation (and goods/services directly connected to the delivery of this service)
The sale or import of a national or foreign currency or security	Gold supplied to the National Bank of Ethiopia
Religious and other related cultural services	The supply/sale of a 'going concern' (i.e. transfer of business)
Health/medical services, educational/childcare services, books, and printed materials	
Transportation services, utilities (electricity and water), and kerosene/imported cement	
Goods and services for humanitarian aid	
Mosquito nets, condoms, water treatment chemicals, and prescription drugs/eyeglasses	
Basic foodstuffs (e.g. *injera*, bread, milk, unprocessed grains, oil seeds, wheat flour; but excluding most vegetables)	
Key agricultural inputs, including fertilizers, pesticides, poultry feed, and improved seeds and saplings	

Source: Harris & Seid (2021); Federal VAT proclamation (No. 285/2002 and No. 1157/2019)

Note: The above lists of VAT-exempted and zero-rated items may not be exhaustive because the Ministry of Finance has been given the power to exempt any goods and services by directive at any time. Therefore it is difficult to catch up all in time with directives since the directives are not accessible easily/online.

d) *Turnover Tax (TOT):* The Federal Turnover Tax Proclamation No. 308/2002 introduced TOT into the Ethiopian tax system in 2003. Based on this proclamation, it is compulsory to register for TOT if the annual turnover of the persons/businesses is below ETB 1 million and not registered for VAT. In Ethiopia, 2% is the standard TOT rate on locally sold and rendered goods and services by tractors, contractors, grain mills, and combine harvesters, while it is 10% for other services. In addition, under Article 7 (1) of the Turnover Tax

Proclamation No. 308/2002, some goods and services are exempted from TOT (see FDRE, 2002b).

e) *Excise Tax:* Through the ratification of the federal Excise Tax Proclamation No. 307/2002, the Excise tax was introduced into the Ethiopian tax system in 2003. In 2020, the Ethiopian government issued a new excise tax proclamation (No. 1186/2020). Excise duty rates now range from 0% to 500%, with the tax would be imposed on certain demand inelastic luxury and basic goods, as well as on goods that are harmful to health and causes social problems (e.g., tobacco, alcohol.). Some certain businesses or goods are also exempted from excise tax (see FDRE, 2002a, 2020). Based on the Federal Excise Tax Proclamation No. 1186/2020, the excise tax would be imposed on goods and services per the tax rate schedule presented in Table 6.

Table 6: Excise tax rates for goods and services in Ethiopia

Description of Goods and Service	**Tax Rate**
Oils and fats	30%, 40%, and 50%
Sugar and sugar confectionery	20% and 30%
Chocolate and food preparations containing cocoa	30%
Soft drinks powder	25%
Beverages and spirits	Between 10% and 80%
Tobacco and tobacco products	20% and 30%
Salt	25%
Mineral fuels, oil, and oil products	30%
Perfumes, beauty products, and toilet water	100%
Fireworks	100%
Plastic shopping bags	ETB 40 per kg
Rubber tires	5%
Textiles and textile products	30% on carpets, and 8% on all other textile products
Artificial flowers, fruits, foliage, and articles made of artificial flowers, fruits, and foliage	10%
Human hair and wigs	40%

Asbestos and asbestos products	20%
Precious/semi-precious stones, and Natural/cultured pearls	20%
TV broadcast receivers, cameras, Video recording or reproducing apparatus	10%
Pickups, Jeeps, Land Rovers, station wagons, utility cars, motor passenger cars, and similar vehicles	Between 5% & 500% depending on the type of the vehicle, age, and the engine size

Source: Federal Excise Tax proclamation (No. 1186/2020)

4.3.1. Government Revenue by Tax Type

Figure 5 illustrated that, despite a nominal increase in tax collection, the total tax revenue as a percentage of GDP in Ethiopia is very low compared to its tax capacity. Over the reporting period 2001 - 2020 the average tax revenue was 8.23% of GDP, and in 2020 reported at 6.2 % of GDP. In comparison, according to the OECD 2022 revenue statistics in Africa, the average tax-to-GDP ratio of the 31 African countries was 16.0% in 2020 (OECD, 2022). Thus, Ethiopia's tax revenue as a percentage of GDP is much lower than the African average and most African countries.

The Ethiopian government tax collection sources can be categorized into three broad groups based on the tax base they are levied on: *domestic direct taxes* - taxes on income and profits; *domestic indirect taxes* - taxes on domestic goods and services; and *trade taxes* - indirect taxes on foreign trade (Harris & Seid, 2021; Shahir & Figari, 2023).

Table 7 provides detailed information on the percentage share of individual tax types on the total tax revenue of the Ethiopian government for the fiscal years of 2016/17 to 2020/21. By far domestic direct taxes have been the largest contributors to the government tax revenue - contributing 44.1% and 45.37% of total tax collections in 2018/19 and 2020/21, respectively. From the domestic direct tax category, business profit tax and personal income tax are contributing 22.70 and 17.29 percent of the total tax revenue in the 2020/21 fiscal year, respectively, and make them the major source of revenue for the government of Ethiopia in this category.

While domestic indirect taxes contribute 25.46% in the 2020/21 fiscal year. However, VAT, TOT, and excise tax on domestic and imported goods are by far the largest individual contributor to the overall tax collections of the Ethiopian government. They comprise about 37.94% of total tax revenues in the 2020/21 fiscal year, with 24.52% of tax revenue contribution from domestic transactions and 13.42% of tax revenue contribution from imports (excluding TOT). Even though the domestic direct taxes contribution increased, the contribution of indirect tax revenue from all sources showed a small reduction from the 2016/17 to 2020/21 fiscal year. This may be due to the high sensitivity of trade taxes to international market situations.

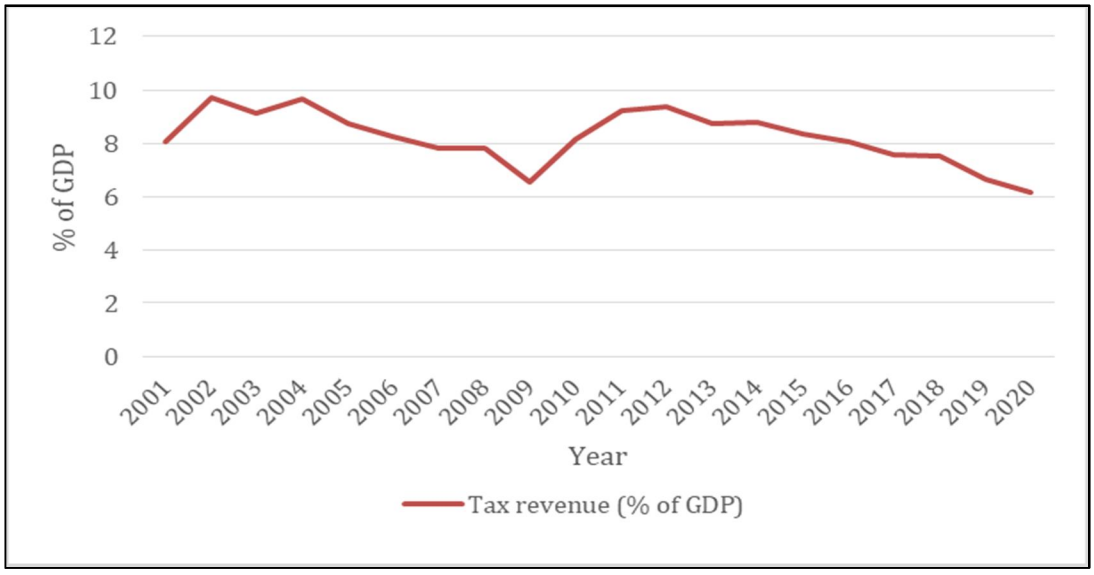

Figure 5: Tax Revenue (% of GDP) in Ethiopia

Source: Data are taken from the World Bank, WDI online database, accessed March 2023.

Table 7: Contribution of the different taxes to total tax revenue from 2016/17 to 2020/21 (in %)

Tax Type	2016/17	2017/18	2018/19	2019/20	2020/21
Domestic direct taxes	**38.51**	**39.27**	**44.10**	**42.41**	**45.37**
Business profit tax	20.09	19.80	21.19	21.59	22.70
Personal income tax	13.11	13.57	15.33	15.02	17.29
Withholding income tax on imports	1.46	1.49	1.30	1.47	1.39
Rental income tax	0.89	0.74	0.88	0.87	0.87
Agricultural income tax	0.17	0.18	0.14	0.12	0.13
Other income tax	1.30	1.54	3.38	1.52	1.15
Urban land lease fee	0.86	1.29	1.05	0.86	0.87
Rural land use fee	0.17	0.17	0.14	0.12	0.12
Interest income tax	0.34	0.41	0.57	0.71	0.71
Capital gains tax	0.11	0.09	0.11	0.13	0.15
Domestic indirect taxes	**29.65**	**29.29**	**29.04**	**27.36**	**25.46**
VAT, TOT, and Excise taxes	28.83	28.59	28.13	26.31	24.52
Stamp duties	0.82	0.70	0.91	1.05	0.94
Trade duties and taxes	**31.84**	**31.44**	**26.87**	**30.23**	**29.17**
VAT and Excise taxes	14.79	14.52	12.43	14.26	13.42
Customs duties	10.94	10.90	9.16	10.14	10.01
Surtax on imports	6.12	6.02	5.28	5.83	5.74

Source: Data are taken from SOUTHMOD Country report: Ethiopia (Shahir & Figari, 2023)

5. Methodology

This section briefly explains the major feature of the tax-benefit microsimulation model for Ethiopia (ETMOD), how the taxes microsimulation approach is executed in ETMOD, and the associated datasets used in the simulation. Moreover, the tax policies reforms covered by the model, modeling assumptions, and the adjustment/updates of the dataset used in ETMOD to achieve the stated objective of this study are presented. Finally, this section also presents how tax policies are modeled in ETMOD, a brief description of the income inequality indicator used in

the ETMOD, and the approaches used to measure the value and the distribution of public service spending.

5.1. Tax Microsimulation Approach in ETMOD

Microsimulation models have been widely utilized to examine the effects of policy reforms on a sample of economic agents. Microsimulation techniques in public policy analysis have the following robust advantages: first, it fully considers the heterogeneity of economic agents observed in micro-datasets and identifies who are the possible winners and losers of the policy reform with accuracy. Second, since the result of microsimulation can be aggregated at a macro level, it enables expertise to evaluate the implication of the policy reform on the government budget – i.e. the aggregate financial cost/benefit of a reform (Bourguignon & Spadaro, 2006).

Recently, due to its strong advantage over the "Representative Agent Approach" and the availability of data and computations, the usefulness of microsimulation techniques to analyze the distributional impact of tax policies and reforms is intensifying and deepened (Capéau et al., 2014; Gasior et al., 2018). In this study, the latest version of the tax-benefit microsimulation model for Ethiopia (i.e., ETMOD version 3.0, released in 2023) is used to estimate the effects of tax policy measures on income inequality. This microsimulation model is managed, developed, and maintained by UNU-WIDER in collaboration with the tax-benefit microsimulation model for the European Union (EUROMOD) team at ISER (University of Essex), and the University of Insubria. The model allows the implementation of ex-ante and ex-post policy analyses (Gasior et al., 2018; Shahir & Figari, 2023).

Generally, ETMOD is a static tax-benefit microsimulation model, developed under the tax-benefit microsimulation models for selected developing countries (SOUTHMOD) project of UNU-WIDER, and operates with the EUROMOD platform. The first version (ETMOD v1.0) was launched in July 2017. Detailed coding of tax and benefit legislation (policy rules), and representative household-level data on incomes and expenditures (microdata) are the two building blocks of ETMOD (see Mengistu et al., 2017; Shahir & Figari, 2023). To simulate personal income tax (PIT) and Value-added tax (VAT) reforms, the ETMOD used microdata on labor market status, gross incomes, and other characteristics of individuals and households to the tax and benefit rules (Gasior et al., 2018).

In this study, to evaluate the effect of fiscal policy on income inequality in Ethiopia, the tax policies that have been simulated in ETMOD are personal income tax and value-added tax. The proposed VAT policy (variable name in ETMOD: ***vat_et***) and PIT policy (variable name in ETMOD: ***tin_et***) reforms are applied to the 2022 policy systems of ETMOD v3.0 (i.e., ET_2022), which is underpinned by the 2018/19 ESS dataset to examine the distributional effects of these tax policy reforms in Ethiopia.

Regarding the selected tax policies for simulation in ETMOD, a personal income tax reform came into effect in July 2016 with the ratification of the revised Federal Income Tax Proclamation No. 979/2016. In the new proclamation, even though the tax rates have remained the same, the income tax brackets are changed (see section 4.3 for details). This policy reform is coded in ETMOD v3.0 (Shahir & Figari, 2023). Moreover, according to Article 65 of the Federal Income Tax Proclamation No. 979/2016, incomes from casual employment, medical treatment of the employee paid by the employer, pension contribution of the employer, gratitude payments, reimbursement of travel expenses, travel allowances, and hardship allowance are exempted from personal income tax (see FDRE, 2016). However, due to data limitation, ETMOD v3.0 exempts only employer pension contributions from income tax (Shahir & Figari, 2023).

VAT amendment was made in 2019 following the ratification of the federal VAT Proclamation No. 1157/2019. One of the major revisions was the additional exemption of items (see section 4.3 for details) (FDRE, 2019). This policy reform is also carefully coded in ETMOD v3.0. Moreover, since the existing ESS dataset doesn't explicitly show which commodities were bought from VAT and TOT-registered sellers, the 15% standard VAT rate is imposed on all VAT-eligible consumer goods in ETMOD (Shahir & Figari, 2023).

5.2. Data used in ETMOD, Data Adjustments, and Assumptions

The tax-benefit microsimulation model for Ethiopia (ETMOD) is developed based on rich representative household microdata. The ETMOD mainly uses the four waves of the Ethiopia Socioeconomic Survey (ESS) conducted by the World Bank Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) team and the Central Statistical Agency (CSA) of Ethiopia. The first round of the survey was collected in 2011/12. The second and third waves were carried out in 2013/14 and 2015/16, respectively. Finally, the fourth round of the

survey was conducted in 2018/19 (CSA & LSMS-ISA, 2018, 2020a, 2020b, 2023; Shahir & Figari, 2023).

The first wave of the ESS (ESS1) covered only the rural areas and small towns, with 333 enumeration areas. The second (ESS2) and third waves (ESS3) of the ESS were extended to all urban areas and created a panel dataset for urban households. These two waves covered all areas of Ethiopia except six zones of Somalia region and three zones of Afar, so they can be considered nationally representative surveys. And, the number of enumeration areas is expanded from 333 to 433 areas (CSA & LSMS-ISA, 2018, 2020a, 2020b; Shahir & Figari, 2023). Finally, the fourth wave of the ESS (ESS4) is not a continuation of the previous three ESS waves; rather it is a baseline survey for the future waves planned by CSA & LSMS-ISA. The survey was conducted in 541 enumeration areas of Ethiopia, of which 244 are urban and 297 are rural. Unlike previous survey waves, the fourth wave is not only nationally representative but also representative for each of both rural and urban areas of Ethiopia's 11 regions. And, the 2018/19 wave dataset contains 28,719 individuals in 6,770 households (CSA & LSMS-ISA, 2023; Shahir & Figari, 2023). For more details see Table 8, this shows the main features of the Ethiopia Socioeconomic Survey (ESS) starting from the second wave.

Table 8: ETMOD database description

	ESS2	**ESS3**	**ESS4**
Years of Collection	2013/14	2015/16	2018/19
Period of collection	September 2013 – April 2014	September 2015 – April 2016	September 2018 – August 2019
Number of households	5,262	4,954	6,770
Rural	3,323	3,272	3,115
Small towns	453	427	-
Urban	1,486	1,255	3,655
Enumeration areas	433	433	541
Income reference period	2014	2016	2019
ETMOD input file	et_2014_a4	et_2016_a5	et_2019_a2

Source: Data are taken from SOUTHMOD Country report: Ethiopia (Shahir & Figari, 2023)

ETMOD v3.0 was designed by the three waves of the Ethiopia Socioeconomic Survey (ESS): 2013-14, 2015-16, and 2018-19. In ETMOD v3.0, the policy systems from 2020 to 2022 (i.e., ET_2020, ET_2021, and ET_2022) are underpinned by the 2018/19 ESS dataset. However, to maintain consistency between the survey dataset year and policy year, the income and expenditure figures are updated to the simulation years by using the 'Uprating Function' – employed when the dataset is used in more than one policy system. Moreover, the consumer price index (CPI) and wage index are used to uprate the monetary values and the wage income earned by public servants in the dataset, respectively (see Shahir & Figari, 2023). [10]

However, all waves of ESS neglected the nine major components of household consumption expenditure items: tap water; health; repair and maintenance; vehicles and spare parts; recreation; software and communication; education; financial services; and domestic workers. To solve this problem, the Household Consumption Expenditure Survey (HCES) conducted by CSA in 2015/16 is used to impute the missing components of household expenditure in ETMOD. Thus, for poverty and distributional analysis, HCES is the primary source of data (see Shahir & Figari, 2023). [11]

5.3. Modeling of Tax policy in ETMOD

In ETMOD, as theoretically underpinned by De Agostini et al. (2017), households are assumed to consume a fixed share of their budget on a certain commodity or service, i.e. ***constant budget shares approach***. However, in the case of a reform scenario, the absolute expenditure is adjusted proportionally to the budget change.

Let the household's observed budget is denoted as $\boldsymbol{E^{obs}}$, the observed expenditure share spent on commodity k is denoted as $\boldsymbol{w_k^{obs}}$, the observed expenditure on commodity k is denoted as $\boldsymbol{x_k^{obs}}$, the observed income and the new disposable income under the reform scenario on the household level are denoted as $\boldsymbol{ils\_dispy^{obs}}$ and $\boldsymbol{ils\_dispy}$, respectively. Thus, under the constant budget share assumption, the total expenditure on commodity k by household h, $\boldsymbol{e_k^h}$, is:

[10] For detailed information about the updated income and expenditure figures to the simulation years in ETMOD v3.0 see Shahir & Figari (2023)

[11] For detailed information about the imputation of household consumption expenditure on the missing items in ESS from the HCES see Shahir & Figari (2023)

$$e_k^h = \frac{ils\_dispy}{ils\_dispy^{obs}} w_k^{obs} E^{obs} = \frac{ils\_dispy}{ils\_dispy^{obs}} x_k^{obs} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

However, in a developing country's context, many households have zero or very low incomes even after imputing the monetary value of their own production. Thus, to deal with this fact, disposable income is replaced by expenditure in equation (1), and the newly simulated expenditure on each commodity is

$$e_k^h = \frac{ils\_con}{xhh^{obs}} w_k^{obs} E^{obs} = \frac{ils\_xhh\_s}{xhh^{obs}} x_k^{obs} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where xhh^{obs} is represent the observed household expenditure in the base year and ils_con captures the simulated household's expenditure possibilities under a reform scenario. Moreover, ils_con is also known as a 'simulated consumption' and assumes that a hypothetical benefit (tax) adds (reduces) household consumption by the same amount. Finally, $\frac{ils\_xhh\_s}{xhh^{obs}}$ is captured in the overall rate of expenditure growth.

Therefore, as explained by De Agostini et al. (2017), both savings and expenditures on durable & nondurable commodities are determined based on the constant budget share assumption that the income shares are the ones obtained in the baseline. So, in this version of ETMOD v3.0, the savings rate is kept constant, instead of nominal savings. Note that the Indirect Tax Tool (ITT)[12] imputes the baseline expenditures xhh^{obs}on the baseline disposable income ils_dispy^{obs} on the household level**.** Moreover, savings on the household level in the baseline are the residual of the difference between baseline disposable income and baseline expenditures. Mathematically,

$$S_0^h = ils\_dispy^{obs} - xhh^{obs} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

But the reform savings (S_1^h) of the joint direct and indirect tax simulation under constant shares is presented as follows:

$$S_1^h = \frac{S_0^h}{ils\_dispy^{obs}} ils\_dispy \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

[12] ITT is the ETMOD Indirect Tax Tool to simulate expenditures and indirect taxes.

The linear relationship between consumer (unit) price q_k and producer (unit) price p_k for commodity k after the VAT is:

$$\boldsymbol{q_k = (1 + t_k)p_k} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \mathbf{(5)}$$

Where t_k is VAT rate (a share of producer price) applicable for commodity k .

Household expenditures and Value-added tax liability on commodity k depend on VAT parameters and household consumption. Thus, in equation (2), the total expenditures on commodity k by household h, e_k^h , can be rewritten as

$$\boldsymbol{e_k^h = q_k x_k^h = (1 + t_k)p_k x_k^h} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . \mathbf{(6)}$$

Household's total VAT liability, $\boldsymbol{T_k^{h,v}}$, defined as follows:

$$\boldsymbol{T_k^{h,v} = t_k p_k x_k^h}$$

However, from equation (6) we can obtain

$$\boldsymbol{p_k x_k^h = \frac{e_k^h}{(1 + t_k)}} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . \mathbf{(7)}$$

Thus, specific values for value-added taxes can be calculated as follows

$$\boldsymbol{T_k^{h,v} = \frac{t_k}{(1 + t_k)} e_k^h} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . \mathbf{(8)}$$

The expression presented in equation (8) allows us to calculate the Value-added tax liability from observed expenditures and consumer prices.

In the practical implementation of ETMOD, calculating total household expenditure valued at producer prices requires removing taxes from expenditures recorded in the survey in the input data of the model. For modeling VAT in ETMOD v3.0, equation (2) slightly rewrite using the notation of variables names used in the ETMOD model after the constant VAT rate *($VAT_rate*) defined, before applying it to the income list *ils_vat_std*. We collect all simulated VAT into our

output variable as *tva_s*. Thus, the amount of VAT paid can be calculated in ETMOD v3.0 as follows

$$\boldsymbol{tva\_s = ils\_vat\_std * \$VAT\_rate} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(9)}$$

5.4. Income Inequality, Progressivity, and Redistributive Capacity Indicators with ETMOD

To assess the effects of personal income tax and VAT on income inequality, the most extensively used inequality indicator is employed – that is the Gini Index. It takes values ranging from 0 (total equality) to 100 (maximum inequality). For a more holistic examination of the income inequality effects of the above-mentioned tax reforms, the sample individuals are breakdown by income groups on the bases of the mean and median income/consumption and quintile shares.

As explained by Sen (1973); Damgaard & Weiner (2000); and Dorfman (1979), for unordered size data, the Gini coefficient is calculated as the relative mean absolute difference – it is the mean of the difference between every possible pair of individuals, divided by the mean size μ, to normalize for scale. In this case, the Gini coefficient, G is:

$$\boldsymbol{G = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}|x_i - x_j|}{2n^2\mu}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(10)}$$

Where, x_i is the wealth/income/consumption expenditure of person i, and there are n persons,

However, if the data is ordered by increasing the size of individuals, as explained by Damgaard & Weiner (2000), and (Dixon et al., 1987) the Gini Coefficient is

$$\boldsymbol{G = \frac{\sum_{i=1}^{n}(2i - n - 1)x_i}{n^2\mu}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \textbf{(11)}$$

Where x_i are the sizes sorted from smallest to largest, $x_1 \leq x_2 \leq \cdots \leq x_n$.

To simulate the impact of tax policy reforms on income inequality, the baseline Gini coefficients are calculated in ETMOD v3.0 by using the ESS and HCES surveys. The consumption-based Gini coefficient is calculated using the same calorie-based equivalence scale used by the Ethiopian government Planning and Development Commission (PDC) to calculate official indices (see Shahir & Figari, 2023). As explained above, the inequality panel of the simulation result shows the Gini coefficient index of the baseline and reform. If the Gini index difference between the baseline and the reform is less (greater) than zero, it indicates that the tax reform has

helped out to reduce (escalate) inequality. While, for the marginal contribution analysis the reverse is true. Moreover, the panel also shows the P80/P20 ratio (the ratio of the income of those at the 80th percentile of the distribution to the income of those at the 20th percentile) and the income distribution at each quintile. Finally, the analysis also executed an in-depth statistical analysis of income distribution and inequality and produced the simulation results of different indices (such as the *Kakwani index, Reynolds-Smolensky index, Redistribution index, Atkinson inequality index, and Net average tax rate*) to measure the progressive and redistributive capacity of the tax policies under examination.

As explained by Enami et al. (2022), and Hanni et al. (2015), the Kakwani index ($\boldsymbol{\pi^K}$) measures progressivity as a departure from proportionality. Under the Gini framework, it tells us how progressive a social intervention is. Mathematically, it is the difference between the concentration coefficient for the tax and the Gini coefficient of pre-tax income:

$$\boldsymbol{\pi^K = quasi\_Gini\,(tax) - Gini\,(pre\_tax\ income)} \quad \ldots\ldots\ldots\ldots \quad \mathbf{(12)}$$

Thus, a positive (negative) Kakwani index means that the tax is progressive (regressive) and the post-tax inequality decreases (increases).

Moreover, the Reynolds-Smolensky Index ($\boldsymbol{\pi^{RS}}$) is the most commonly used measure of the redistributive capacity of the tax policy (Hanni et al., 2015). In the Reynold-Smolensky index ($\boldsymbol{\pi^{RS}}$), redistribution is measured as the difference between the Gini index of income before tax ($\boldsymbol{G_{Y+T}}$) and the concentration index of disposable income ($\boldsymbol{C_Y}$), ordered by income before tax (Lambert, 2001, cited in Mantovani, 2018).Mathematically, $\boldsymbol{\pi^{RS}}$ is

$$\boldsymbol{\pi^{RS} = G_{Y+T} - C_Y} \qquad \boldsymbol{\pi^{RS} \leq G_{Y+T}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \mathbf{(13)}$$

Here the assumption is the absence of re-ranking, that is, the ordering of persons according to income before and after tax is the same. In this case, the concentration index of disposable income ($\boldsymbol{C_Y}$) and the Gini index of disposable income ($\boldsymbol{G_Y}$) are coincide.

We should note also that the redistributive effect of tax policy depends not only on progressivity but also on the level. In other words, it is determined by the departure from proportionality and the level of the tax. So, the Reynolds-Smolensky Index is expressed as follows

$$\pi^{RS} = \left[\frac{t}{1-t}\right](\pi^{K}) \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (14)$$

Where $\left[\frac{t}{1-t}\right]$ is the net average tax rate (net effect), t is the average tax rate (it is the ratio of total tax revenue and total taxable income).

However, in real tax-benefit systems, the existence of re-ranking is inevitable even if marginal nominal tax rates are lower than 100%. The re-ranking effect (R) describes the effects of tax on horizontal equity, that is, how tax influences the ranks of income units in the transition from pre-tax income to post-tax income (Lambert, 2001, cited in Mantovani, 2018).[13]

To be able to take into account the presence of re-ranking effect a few changes in equations (13) and equation (14) are required. Thus, Reynolds-Smolensky Index with re-ranking effect(π_r^{RS}), is

$$\pi_r^{RS} = G_{Y+T} - G_Y = (G_{Y+T} - C_Y) - R = \left[\frac{t}{1-t}\right](\pi^{K}) - R \quad \ldots \ldots \ldots \ldots \ldots (15)$$

Where G_Y is the Gini index of disposable income. The ordering variable is disposable income plus taxes. Re-ranking effect (R) is the difference between the Gini and concentration index of disposable income:

$$R = G_Y - C_Y \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (16)$$

Thus, a positive (negative) Reynolds-Smolensky index implies that the post-tax reform inequality decreases (increases).

Finally, the Atkinson Index, also known as the Atkinson inequality index, is a useful measure of inequality to show which end of the distribution contributed most to the observed inequality by incorporating a sensitivity parameter (ε), known as the level of inequality aversion (Atkinson, 1970). Mathematically, an empirical distribution with n elements, the Atkinson indices can be expressed as:

$$Atk(\varepsilon) = 1 - \frac{1}{\bar{y}}\left(\frac{1}{n}\sum_{i=1}^{n} y_i^{1-\varepsilon}\right)^{\frac{1}{1-\varepsilon}} \qquad if\ \varepsilon \neq 1 \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots (17)$$

[13] For re-ranking due to vertical and horizontal inequity see Mantovani, 2018, pg.13.

$$Atk(\varepsilon) = 1 - \frac{1}{\bar{y}}\left(\prod_{i=1}^{n} y_i\right)^{\frac{1}{n}} \qquad if\ \varepsilon = 1 \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..(18)$$

Where y_i denotes the wealth of household i, $\bar{y}$ is the sample average, and ε is the level of aversion to inequality.

The Atkinson index lies between zero and one and increases with inequality. If the sensitivity parameter is high (approaches to one), the marginal social welfare of an increase in income is higher for the bottom of the income distribution. But if it is zero, the marginal social welfare of an increase in income is similar for both the lower and higher end of the income distribution, a complete equality situation (Atkinson, 1970; Kneeshaw et al., 2020).

5.5. Approaches to Measure the Value and Distribution of Public Service Spending across Individuals/Households

This section presents the approaches used to measure the value of public services and the distribution of them to individuals & households following the study of Aaberge & Langørgen (2006), Callan et al. (2008), Marical et al. (2008) European Union (2013), Ogden & Phillips (2023), and Verbist & Förster (2020).

The regular way of estimating the monetary value of government services is to use a *production-cost approach*. This approach assumes that the value of public services transferred to the beneficiaries is equal to the cost of providing or producing them (Aaberge & Langørgen, 2006; Callan et al., 2008; Verbist & Förster, 2020). However, according to Aaberge & Langørgen (2006), this approach disregards the variation of costs in providing public services by the local governments. Moreover, this approach neglects differences in quality and efficiency in public service production and provision within and across countries. Nevertheless, the production cost approach still delivers a useful yardstick by offering an estimate of the monetary value of government services.

The second issue is how to allocate the spending of public services across the population. Two standard approaches are forwarded by literature to assess the distribution of public services spending across the population, namely the *actual consumption approach* and the *insurance-value approach* (Aaberge & Langørgen, 2006; Marical et al., 2008). However, the 2018/19

Ethiopian Socio-Economic survey only has data on the currently attending pupil in public schools which enables us to measure the distribution of the public service benefits from educational spending. So, in this analysis, public services are proxied by education services. In much of the literature, the actual consumption approach is the most commonly adopted and appropriate method to measure the distribution of educational spending. In this approach, each pupil that currently participates in education is assigned a public service spending that equals the cost of producing these services in the corresponding level of education to measure the distribution of educational service spending. Mathematically, the total educational expenditure is divided by the enrolment number (pupils currently using these services) in each education level (primary, lower secondary, and upper secondary) providing an estimate of the value received per pupil. This approach assumes that participants at a given education level and country receive an equal share of the value (Callan et al., 2008; European Union, 2013; Marical et al., 2008; Verbist & Förster, 2020).

Therefore, in measuring the distribution of educational spending across income groups, we may be particularly interested in measuring the educational spending on different groups conditional on the number of educational enrollments in each income group, i.e. multiplying the educational value received per pupil by the number of enrollments in each income groups.

5.6. Performed Tax Policy Reforms

To understand the comprehensive picture of the distributional impact of PIT and VAT, several hypothetical policy reform scenarios are considered:

First, ***personal income tax policy reform:*** This part presents four hypothetical reform scenarios considered in the analysis, expecting to reduce the richest quintiles' disposable income and thus reduce income inequality. Those are ***reform – 1a*****:** the objective of this simulation scenario is to estimate the marginal contribution of PIT adoption in Ethiopia.[14] Thus, the simulation estimated the difference in the Gini coefficient for an income concept with and without a given policy intervention (i.e., personal income tax). ***Reform – 1b, Reform – 1c & reform-1d:*** these three hypothetical personal income tax reform scenarios are done by changing the existing personal income tax schedule rates in a pro-poor favored way. Especially, for reform-1d, I constructed a

[14] Marginal contribution is measured by the difference between Gini coefficient for an income concept before and after a given tax or benefit policy intervention (Enami et al., 2022; Hill et al., 2017) .

hypothetical personal income bracket to exempt the 1st and 2nd quintiles of the households from PIT to make the personal income tax more pro-poor (see Appendix -A to observe the changed rate in each income bracket). In the PIT policy reforms, the Ethiopian government was stuck only on changing the personal income tax brackets. So, these two reforms aim to recommend additional reform techniques to the government by checking whether it is possible to reduce the existing inequality level by increasing the personal income tax schedule rate or not.

Second, ***Value-added tax policy reform:*** in this case three VAT policy reform scenarios are considered, expected to have a greater effect on the rich´s consumption expenditure than the poor and thus reduce income inequality. The first scenario is ***reform – 2a:*** this simulation scenario estimated the marginal contribution of VAT introduction. Thus, the analysis estimated the difference in the Gini coefficient with and without a given intervention (i.e., Value-added tax). The second & third scenarios are ***reform – 2b & reform – 2c:*** the distributional impact of the proposed VAT reforms in Ethiopia is estimated by postulating to increase the standard VAT rate from 15% to 18% (reform-2b) and then to 20% (reform-2c).

All the above seven hypothetical policy reforms were chosen to show the distributional impact of different types of tax policy changes. The analyses used the 2022 policy system of ETMOD v3.0 as a baseline system and applied the seven reform scenarios in this policy system of ETMOD.

6. Empirical Results

Do personal income tax and value-added tax have a considerable contribution to reducing inequality in Ethiopia? How does income inequality in Ethiopia change if different personal income tax and value-added tax rates are taken into account? This section tries to throw light on these policy-relevant questions by employing the static microsimulation approach called Tax-benefit micro-simulation model for Ethiopia (ETMOD v3.0) based on the 2022 policy system.

6.1. The Impact of Personal Income Tax on Inequality & Income Distribution

Beginning with the marginal contribution, the simulation results show that personal income tax is progressive and reduce inequality (Table 9).[15] Interestingly, the microsimulation result of the 2022 policy system of the ETMOD v3.0 shows that the marginal contribution of the adoption of

[15] Marginal contribution is measured by the difference between Gini coefficient for an income concept before and after a given tax or benefit policy intervention (Enami et al., 2022; Hill et al., 2017) .

personal income tax (PIT) to the changes in the Gini coefficient is 1.27%, consumption-based Gini coefficient declined from 36.68% to 35.41%. The next element to note is that the simulation result of an alternative measure of inequality, which compares the ratio of the average disposable income of the richest 20 percent of the population (5^{th} quintile share) to the average disposable income of the bottom 20 percent of the population (1^{st} quintile share), shows that the P80/P20 ratio decreases by 0.03 points due to the adoption of personal income tax. These simulation results confirmed that the introduction of personal income tax significantly reduces consumption-based inequality in Ethiopia. This is attributed to the progressivity nature of Ethiopia's personal income tax system; it is also confirmed by the results of the *Kakwani* and *Reynolds-Smolensky Indices* (discussed in further detail below in Table 11).

The last part of Table 9 illustrates how PIT policy intervention affects different quintiles of the income distribution. Without the adoption of PIT, about 32% of total income in Ethiopia is concentrated and owned by the richest quintile (5^{th} quintile) of the population, while, the population's poorest quintile (1^{st} quintile) holds approximately 12% of the total income. When the PIT was introduced, the entire five-quintile income shares declined. In contrast, the analysis observed the largest reduction is in the income share of the richest quintile. The implication of the quintiles of income distribution result is consistent with the result of the Gini coefficient and the Kakwani progressivity index, which implies that the richest quintiles contribute more to tax payments compared to the poorest quintiles.

Finally, the best possible channel in which PIT affects inequality in Ethiopia is through the disposable income channel. Since PIT in Ethiopia has a progressive nature, the wealthiest quintiles contribute more to PIT payments than the poorest quintiles. Consequently, the income share of top-income recipients in post-tax is smaller, and disposable income is more equally distributed among taxpayers. This channel is highly acknowledged by Younger et al. (2016), Martorano (2018), and UNDP (2019) in their study as explained in Section 2.1, and the results of this study are consistent with the findings of the above-mentioned empirical studies.

Table 9: Marginal contribution of VAT & PIT introduction on inequality and income distribution

Indicators	PIT Reform-1a			VAT Reform-2a		
	With PIT (Baseline-2022)	***Without PIT***	***Difference***	***With VAT (Baseline-2022)***	***Without VAT***	***Difference***
Gini (household income)[16]	0.3541	0.3668	0.0127	0.3541	0.3582	0.0041
P80/P20	2.64	2.67	0.03	2.64	2.67	0.03
Consumption-based income/expenditure distribution (in million ETB), by household group						
1st quintile	15,960.34	16,097.30	136.96	15,960.34	16,824.06	863.72
2nd quintile	21,869.57	22,225.82	356.25	21,869.57	23,114.12	1,244.55
3rd quintile	24,928.48	25,220.54	292.06	24,928.48	26,538.94	1,610.46
4th quintile	28,884.11	29,334.55	450.43	28,884.11	30,569.20	1,685.09
5th quintile	42,149.74	42,922.82	773.08	42,149.74	44,899.49	2,749.75

Note: 1st quintile – poor households with the lowest income, 2nd quintile – poor households with low income, 3rd quintile – households with medium income, 4th quintile – households with high income, 5th quintile – households with the highest income

Source: Authors' calculations from ETMOD v3.0 estimation

Two more simulations are executed in different hypothetical scenarios to get a more comprehensive result and understanding of the distributional impact of personal income tax in Ethiopia. The additional simulation is done on two hypothetical personal income tax reform scenarios which are done by changing the existing personal income tax schedule rates (Appendix - A to understand how the hypothetical PIT rate reforms are formulated).

Thus, the result of the Gini coefficient and P80/P20 ratio of equalized disposable income in both PIT reform scenarios are presented in Table 10. In Reform-1b, the simulation result revealed that the rise in the PIT rate has a benign effect on inequality, and decreases income inequality by 0.05% of the Gini index. However, in Reform-1c, the distributional impact of PIT increases as the PIT rate increases, reducing inequality by 0.10% Gini index. As shown in the quintile income distribution simulation result, the impact is improved because in Reform-1c compared to Reform-1b, the wealthiest quintiles contribute more in tax payments compared to the poorest quintiles. Regarding the P80/P20 ratio, the simulation result revealed that in Reform-1b, there is

[16] Since the sign of the marginal contribution is positive, the adoption of personal income tax is equalizing (Enami et al., 2022).

no change in the ratio of the disposable income share between the richest and poorest households – which shows the increased tax rate in each income bracket is not enough to bring a significant effect on income redistribution. But, in Reform-1c, household income inequality reduces as the P80/P20 ratio decreases by 0.01 points.

Table 10: Inequality and household income distribution implications of the rise in PIT rate

Indicators	Reform- 1b			Reform - 1c		
	Baseline, 2022	***Reform***	***Difference***	***Baseline, 2022***	***Reform***	***Difference***
Gini (household income)	0.3582	0.3577	-0.0005	0.3582	0.3572	-0.0010
P80/P20	2.67	2.66	0.00	2.67	2.66	-0.01
Consumption-based income distribution (in million ETB), by household group						
1st quintile	16,824.06	16,784.89	-39.16	16,824.06	16,710.49	-113.56
2nd quintile	23,114.12	23,014.77	-99.35	23,114.12	22,896.79	-217.33
3rd quintile	26,538.94	26,453.39	-85.56	26,538.94	26,396.34	-142.60
4th quintile	30,569.20	30,446.34	-122.86	30,569.20	30,325.86	-243.35
5th quintile	44,899.49	44,730.78	-168.71	44,899.49	44,474.79	-424.70

Source: Authors' calculations from ETMOD v3.0 Estimation

As illustrated by Figure 6, between reform-1b and reform-1c, the largest decline is observed in the disposable income share of the richest quintile (the 5th quintile) by ETB 168.71 million in reform-1b and ETB 424.70 million in reform-1c, which is approximately 4.3 and 3.7 times higher than the poorest quintile (the 1st quintile), respectively. Moreover, an additional simulation was run by exempting the 1st and 2nd quintiles of the households from PIT to make the personal income tax more pro-poor, i.e. reform-1d.[17] As a result, reported in the green color of Figure 6, the first two quintiles' income was increased by ETB 167.2 million on average due to the reform and the burden of the tax was fall on the shoulder of the last three quintiles – on average their disposable income decline by ETB 403 million. Consequently, inequality declined by 0.11% of the Gini coefficient – a decline from 0.3582 to 0.3571 Gini points. These all microsimulation results confirm that Ethiopia´s personal income tax system is progressive since the wealthiest quintiles contribute more in tax payments compared to the poorest quintiles, and consequently,

[17] Reform-1d is designed to see the effectiveness of PIT in reducing inequality by putting more tax burden on the richest quintiles (3rd, 4th, & 5th) and exempting the poorest quintiles (1st and 2nd). It is an extreme case.

the income share of top-income recipients in post-tax is smaller, and disposable income is more equally distributed among taxpayers.

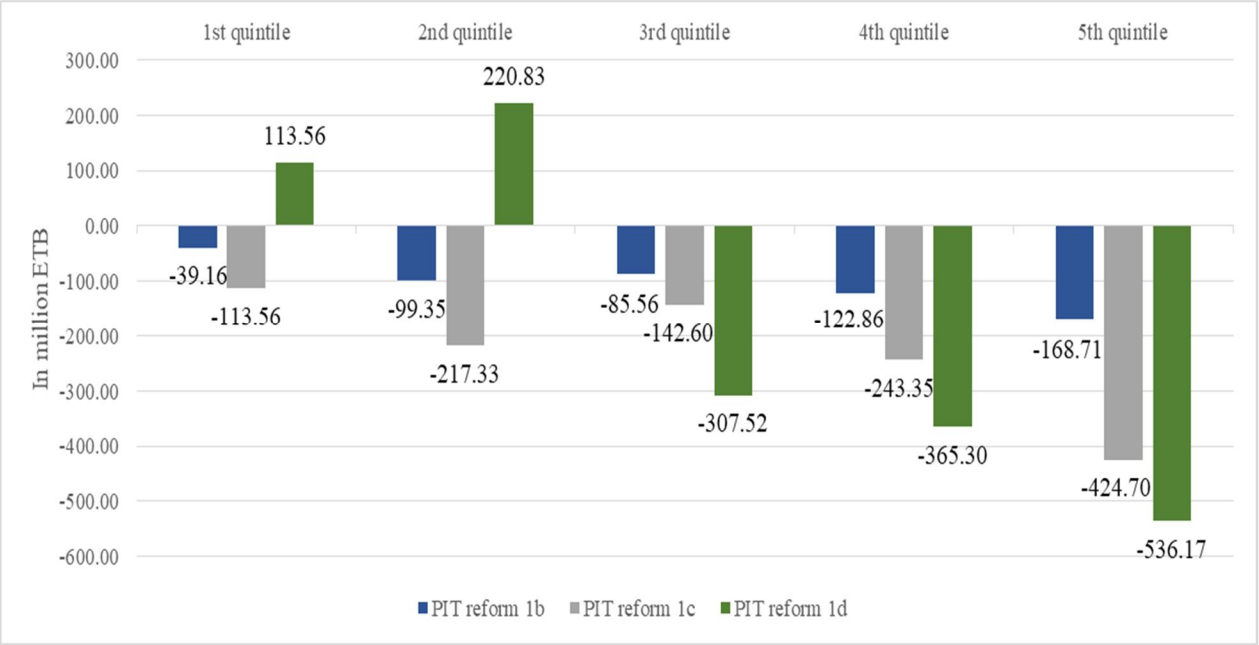

Figure 6: The impact of the personal income tax reforms on household disposable income, by quintiles (change from the baseline).

Source: Authors' calculations from ETMOD v3.0 estimation

Overall, the simulation results of the three reforms (i.e., reform-1b, reform-1c, and reform-1d) confirmed that the fiscal policy under examination (i.e., personal income tax) is progressive and reduce inequality. So, the analysis suggested that the government of Ethiopia can reduce the existing inequality level by increasing the personal income tax schedule rate and putting more tax burden on the top income recipients. This type of policy reform gives the government extra technique on PIT policy reform since the Ethiopian government is stuck only on changing the personal income tax brackets.

6.1.1. Progressivity and Redistributive Capacity of Personal Income Tax

This section sheds light on the progressive and redistributive effects of the above two personal income tax reform scenarios (i.e., reform-1b and reform-1c). To illustrate the progressive and

redistributive capacity of personal income tax, the analysis used different standard indices and presented the simulation results in Table 11.

Concerning the progressivity nature of this particular fiscal policy intervention, in addition to the marginal contribution analysis discussed above, this analysis uses a standard progressivity measure: the *Kakwani Index.* As shown in Table 11, the simulation finding of the *Kakwani index* of progressivity revealed that personal income tax is absolutely progressive (concerning disposable income) since the coefficient is positive.[18] This shows that, in Ethiopia's personal income tax system, tax liability relative to income rises as income increases. As shown in Tables 9 & 10; this is why the after-tax income inequality is reduced. Similarly, the simulation result of the *Reynolds-Smolensky Index* of progressivity confirmed that, in both reforms, the values of the Reynolds-Smolensky Index are greater than the baseline value, this simulation result showed the positive redistributive effect of the personal income tax in Ethiopia.[19]

Regarding the redistributive capacity of personal income tax policy, as presented in Table 11, the simulation result of the *redistribution index* shows that both reforms robust the redistribution of income in the society. So, the *Kakwani, Reynolds-Smolensky, and redistribution indices* implied that high-income groups are subject to a high level of personal income tax and enable the government to redistribute resources from the rich to the poor and marginalized segments of society because of the PIT reforms as it is also indicated in Figure 6. So, the tax policy under analysis is progressive and has a good redistributive capacity in Ethiopia.

Finally, to determine which end of the income distribution contributed most to the detected income inequality, the analysis employed the *Atkinson inequality index*. The simulation result of the Atkinson index shows that society's willingness to scarify more of their income to have equal incomes is large, as indicated by the two inequality aversion parameters.[20] Here we should note that when the level of inequality aversion (ε) increases, the magnitude of the Atkinson inequality

[18] Positive Kakwani coefficients imply the intervention is progressive, and it is regressive if the Kakwani coefficient is negative (Kakwani, 1977).

[19] Note that, in SOUTHMOD, negative incomes are recorded as zero within the model. This is not innocent since a large number of peoples in the survey reported negative income. For more information see the SOUTHMOD Modelling Conventions, available at https://www.wider.unu.edu/sites/default/files/Projects/PDF/SOUTHMOD_Modelling_Conventions_20220512_0.pdf

[20] The personal income tax is increases over the reforms as revealed by the Net average tax rate index in Table 11.

index also increases, this implies that the society is willing to give up more shares of total income to achieve income equality.

Table 11: Progressivity and redistributive capacity of personal income tax reform

Indices	Baseline	Reform_1b	Reform_1c	Reform_1b Diff. w.r.t. Baseline	Reform_1c Diff. w.r.t. Baseline
Atkinson inequality index (ε = 0.25)	0.3938	0.3937	0.3920	-0.0001	-0.0018
Atkinson inequality index (ε = 0.75)	0.8597	0.8591	0.8578	-0.0006	-0.0020
Kakwani index	0.0858	0.0838	0.0906	-0.0020	0.0048
Reynolds-Smolensky index (with re-ranking effect)	0.0067	0.0075	0.0095	0.0008	0.0028

Note: For the Atkinson inequality index, the inequality aversion parameters are 0.25 and 0.75

Source: Authors' calculations from ETMOD v3.0 estimation

Generally, all the above four simulation results of the PIT reform scenarios revealed that personal income tax is progressive, redistributive, and more effectively targets the poor in Ethiopia. In comparison to the current PIT policy, the proposed PIT reforms may produce a better result from an equity point of view. And the consistency of all the above simulation results of the indices shows the robustness of the result of the model.

6.1.2. Winners & Losers, & the tax burden of the PIT Reforms

Table 12 shows the share of households whose equivalized disposable income increases (winners) or decreases (losers) against the baseline and is distributed across the deciles of the baseline. Surprisingly, but similar to the implication of the P80/P20 ratio in Table 9, Table 12 also confirmed that there are no winners in the reform-1b – this may be due to the increased tax rate in each income bracket is may not enough to bring a significant effect. While, in reform-1c, the average percentage of winners under reform-1b is 1.7% for all deciles and all households whose equivalized disposable income increases are found between decile 4 and decile 10. Regarding the losers of the reform, the result revealed that the losers of the reform are the richest deciles, especially, in the 9^{th} and 10^{th} deciles 32.6%, and 49.3% of households whose equivalized disposable income decreases with respect to the baseline under reform-1b, respectively.

However, there are no losers between the 1st decile and 3rd decile. In contrast, it was 29.4% for the 9th decile and 48.4% for the 10th decile under reform-1c, but there are no losers between the 1st decile and the 5th decile. In this reform, we observe a slight decline in the share of peoples who loses in each decile because of the reform. Generally, this result implies that the share of households in the richest deciles whose equivalized disposable income decreases more than the poorest deciles' share.

Moreover, Table 13 illustrates the average tax burden distribution among taxpayers in each decile. The average tax burden increases to 8.2% in reform-1b, and 9.7% in reform-1c from the baseline average tax burden of 6.8%. As the personal income tax increases the average tax burden of the 8th, 9th, and 10th deciles increases, in contrast, the average tax burden of the first five deciles is almost zero. Therefore, the above two results confirm that top deciles are disproportionately burdened with personal income tax as compared to the bottom deciles. These results are consistent with the result we have found in the quintile distribution of income in Table 10 and Figure 6.

Table 12: Winners and losers in the PIT reform with respect to the baseline (in %)

Decile	Winners		Losers	
	Share Reform-1b	***Share Reform-1c***	***Share Reform-1b***	***Share Reform-1c***
1	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0
4	0.0	0.5	0.5	0.0
5	0.0	1.1	1.1	0.0
6	0.0	3.2	3.2	0.1
7	0.0	4.3	8.0	3.7
8	0.0	3.2	13.5	10.3
9	0.0	3.1	32.6	29.4
10	0.0	0.9	49.3	48.4
All	**0.0**	**1.7**	**12.7**	**11.0**

Source: Authors' calculations from ETMOD v3.0 estimation

Table 13: Average tax Burden (in %)

Decile	Total Baseline (Baseline)	Total Reform-1b	Total Reform-1c
1	0.0	0.0	0.0
2	0.0	0.0	0.0
3	0.0	0.0	0.0
4	0.0	0.1	0.0
5	0.0	0.0	0.0
6	0.3	0.4	0.2
7	1.0	1.4	1.2
8	1.8	2.4	2.3
9	4.9	6.3	6.7
10	8.2	9.7	11.7
All	**6.8**	**8.2**	**9.7**

Source: Authors' calculations from ETMOD v3.0 estimation

6.2. The Impact of Value-Added Tax on Inequality and Household Income Distribution

This section illustrates the marginal contribution of VAT adoption on inequality in Ethiopia by employing the 2022 policy system of ETMOD v3.0. The analysis of the microsimulation scenario, as presented in Table 9 of column 2 (i.e., "VAT Reform-2a") above, shows that the introduction of Value added tax (VAT) has a positive marginal effect on household consumption expenditure distribution. The simulation result shows that the marginal contribution of the VAT to the reduction in the Gini index is 0.41%, a decline of the Gini coefficient from 0.3582 to 0.3541. This implies the distributional effect of VAT is negligible, and this low distributive impact is due to the low tax collection capacity of the country and households in the bottom quintiles suffer a reduction in consumption due to the increase in the standard VAT rate (illustrated by the quintile income distribution in Table 9 and Figure 7). Similarly, the simulation results of both the P80/P20 ratio and quintiles of the expenditure distribution are consistent with the above-simulated result of the Gini coefficient which implies that income inequality is declining due to the adoption of value-added tax. More specifically, the simulation result of the P80/P20 ratio of equalized disposable income revealed that, before the introduction of VAT, the richest households have post-tax disposable incomes that are 2.67 times those of the poorest

households, while after the introduction of VAT, it declines by 0.03 points. This result confirmed that income inequality decreases slightly in Ethiopia by 0.03 points due to the introduction of a value-added tax system.

Moreover, as shown in Table 9 above, the simulation result of the quintile of income distribution shows all household groups in the baseline year are affected by the reform. All household groups face a decline in consumption-based disposable income due to the introduction of VAT but in different magnitudes. In contrast, still, the largest decline is observed in the disposable income share of the richest quintile (the 5^{th} quintile) by ETB 2,749.75 million, which is approximately 3.2 times higher than the poorest quintile (the 1^{st} quintile). As presented in Table 1 of section 4.2, the possible reason a decline in disposable income share is observed is due to the distribution pattern of consumption (Food & Non-Food) expenditure - the poorest deciles/quintiles also spend large amounts of money on food and non-food items even if it is less than the highest deciles/quintiles. So, the increment of the VAT rate significantly affected the poorest households (see Table 1 of Section 4.2). Still, the richer households are disproportionately burdened with value-added tax as compared to poorer households since their consumption expenditure is larger than the poorest section of the households as presented in Table 1– which is very important for distributional activities of the government for the reasons mentioned in the next paragraph.

This is not surprising to observe the progressive nature and reducing inequality effect of VAT in Ethiopia: given that it accounted for more than 33.2% of tax revenue collection in the 2019/20 fiscal year (Harris & Seid, 2021), and end up financing a large part of social spending for the government of Ethiopia. The possible channel in which VAT adoption affects inequality in Ethiopia could be through a rise in government revenues, the simulation result revealed that the government gained an additional ETB 177, 312 million due to the introduction of VAT, and used to finance the provision of essential public services which have an impact on poor people's wellbeing and reduce inequality. This result and justifications are consistent with the findings of Alavuotunki et al. (2019), Alavuotunki & Pirttilä (2015), Itriago (2011), and Jellema et al. (2017), which shows the significant distributional role of VAT through public service channel.

VAT could also affect inequality through different levels of VAT rate exemptions and reductions that are targeted to benefit the low-income groups of the population, which are stated under Article 7(2) and Article 8 of the VAT Proclamation No. 285/2002 of Ethiopia (see section 4.3).

The exemptions in value terms benefit the low-income groups the most and improve the progressivity of the VAT – this channel is highly acknowledged in the study of Bachas et al. (2021) and World Bank (2022) who vowed the importance of VAT exemptions and reductions to solve the problem of inequality. Thus, applying tax exemptions and reduced rates to food and other commonly consumed by the poor would therefore enable governments to redistribute wealth to the poor. This justification is consistent with the food expenditure distribution result found in Table 1, the lowest deciles/quintiles also spend large amounts of money on food. Therefore, the exemption and zero rates of VAT will reduce the disincentive of food consumption by lower-income households (see Table 1 of Section 4.2).

As well, as shown in Table 14, to understand a more complete picture of the redistributive impact of VAT in Ethiopia, the analysis performed two additional hypothetical simulation scenarios on the 2022 policy system of ETMOD v3.0. The distributional impact of the proposed VAT reforms in Ethiopia is estimated by postulating to increase the standard VAT rate from 15% to 18% and then to 20%. As discussed in the methodology section, the simulations considered VAT-exempted and zero-rated items (see Section 4.3).

Table 14: Inequality and household income distribution implications of the rise in VAT, yearly

Indicators	**VAT at 18% (Reform-2b)**			**VAT at 20% (Reform-2c)**		
	Baseline, 2022	***Reform***	***Difference***	***Baseline, 2022***	***Reform***	***Difference***
Gini (household income)	0.3541	0.3533	-0.0008	0.3541	0.3527	-0.0013
P80/P20	2.64	2.64	0.00	2.64	2.64	0.00
Consumption-based income/expenditure distribution (in million ETB), by household group						
1st quintile	15,960.34	15,776.83	-183.51	15,960.34	15,626.26	-334.07
2nd quintile	21,869.57	21,627.17	-242.41	21,869.57	21,469.07	-400.50
3rd quintile	24,928.48	24,657.76	-270.72	24,928.48	24,492.82	-435.66
4th quintile	28,884.11	28,504.58	-379.53	28,884.11	28,277.45	-606.67
5th quintile	42,149.74	41,696.23	-453.51	42,149.74	41,218.63	-931.11

Source: Authors' calculations from ETMOD v3.0 estimation

The main takeaway from Table 14 is that the simulations of the 18% and 20% VAT reforms in Ethiopia show that a slight increase in the standard VAT rate has decreased income inequality by

0.08 % and 0.13% of the Gini index, respectively. This low distributive impact is attributed to the low tax collection capacity of the country and the decline in consumption in the bottom quintiles as a result of the increase in the standard VAT rates (see Figure 7). Moreover, the analysis also observed that the distributional impact of the VAT reform increases as the level of the standard VAT rate increases. However, inequality measured by the simple ratio of the richest 20% of households (5^{th} quintile) to the poorest 20% (1^{st} quintile) shows no change in both reforms of VAT. This seems the redistributive impact of both VAT reforms is neutral among Ethiopian consumers. This may be attributed to the fact that, even though the richest households pay more VAT taxes than the poorest, they pay less as a proportion of their income; and households in the bottom quintile suffer a reduction in consumption due to the reform. As a result of it, the distributional impact of VAT in Ethiopia is negligible/neutral. This result can be explained by the justification of Capéau et al. (2014) who revealed that, like the low-income groups, high-income groups also spent most on foods and other necessities in absolute terms, and therefore the net distributional effect of exempted/reduced rates of VAT on food and other necessities may be zero/low (Capéau et al., 2014).

Here we should also note that a simple increase in tax rate may not produce the needed welfare gain for the poorest deciles. A study by Babatoundé et al. (2023) stated the importance of estimating the optimal tax rate in policy reforms to bring substantial impact. In comparison to the existing VAT policy in Benin, their optimal tax rate yields a higher welfare gain for the poorest deciles. Therefore, it is always important to decide the optimal level of the VAT rate to generate a better welfare gain for low-income groups.

Figure 7 and the last part of Table 14 summarize the impact of the rise in the standard VAT rate on the different household consumption expenditure quintiles under the two VAT reform scenarios. It is observed that the simulation of a 3% points increase in standard VAT rate (from 15% to 18%) reduced the consumption expenditure of the lowest income groups (1^{st} quintile) by ETB 184 million, and a nearly ETB 454 million decrease in that of the richest households (5^{th} quintile). Similarly, the simulation result of an increase in the standard VAT rate from 15% to 20% shows a much larger decline in all groups of household consumption expenditures. It is noticed that the extent to which poor/vulnerable households suffer net losses from the VAT increment is quite low compared to the richest households. As presented in Table 1 of section

4.2, the possible reason for a decline in consumption expenditure share of the lowest quintiles is due to the distribution pattern of consumption (Food & Non-Food) expenditure - the poorest deciles/quintiles also spend large amounts of money on food and non-food items even if it is less than the highest deciles/quintiles. So, the increment of the VAT rate negatively affected the poorest households – which pay more tax (see Table 1 of Section 4.2). This shows that the Ethiopian government's VAT-exempted and zero-rated items lists are not exhaustive. However, the richer households are disproportionately burdened with value-added tax as compared to poorer households since their consumption expenditure is larger than the poorest section of the households as presented in Table 1 of Section 4.2 – which is very important for the distributional activities of the government. This shows that the current VAT system in Ethiopia is clearly progressive. Thus, the simulation result of both VAT reforms revealed a positive impact of the rise in the VAT rate on the consumption-based income inequality reduction efforts in Ethiopia.

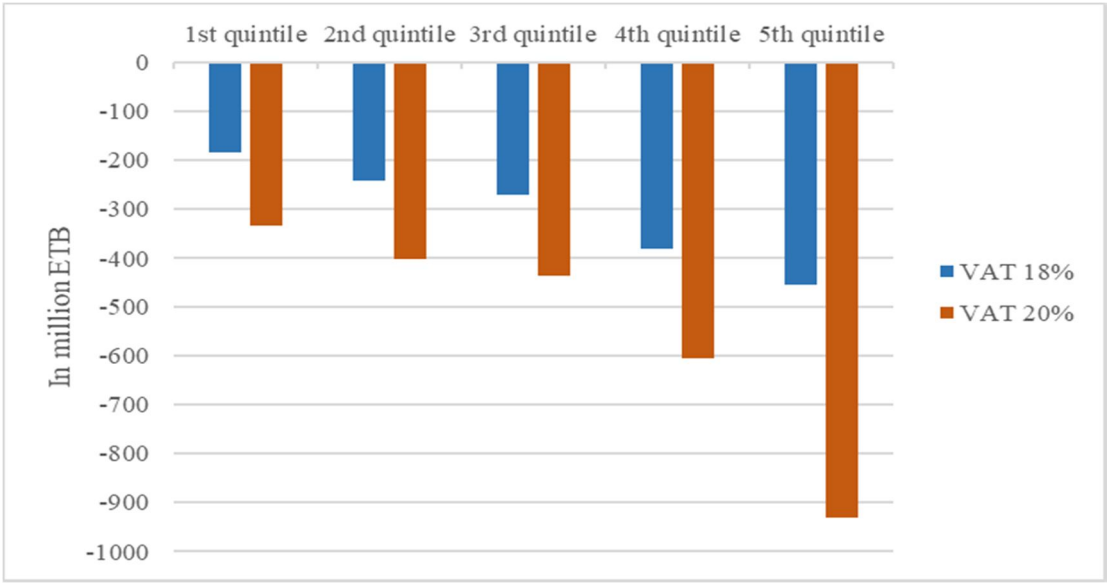

Figure 7: The impact of the rise in the standard VAT rate on household consumption expenditure, by quintiles (change from the baseline).

Source: Authors' calculations from ETMOD v3.0 estimation

6.3. Revenue Implication of the Tax Reforms and the Distribution of Social Security Transfer and Public Service Spending Across Deciles

The government revenue implication of the PIT and VAT reforms is shown in Table 15. The simulation result shows that the amount of tax revenue the government generated from direct

taxes increased from ETB 18,638.24 million in reform-1b to ETB 39,812 million in reform-1c, and further increased to ETB 43,130.18 million in reform-1d when the personal income tax liability of the richest people increases across reforms.

Similar to households, in SOUTHMOD, the government is assumed to spend a fixed share of its budget on certain public goods/services or social security transfers, i.e. constant budget shares approach. Thus, as presented in the baseline of ET_2022, only 12.32 % of the government revenue is spent on social security transfers. In monetary terms, from the total government revenue of ETB 272,187.51 million through taxes only ETB 33,532.91 million (12.32%) is spent on social security transfers in the 2022 fiscal year, the remaining 87.68% (ETB 238654.6 million) of the government revenue goes to public goods/services and other activities, from this, the share of education spending is 12.49%. Therefore, based on the above assumption, in Table 16 and Table 17, we present how these tax revenues are shared among social transfers and public services across deciles.

Table 15: Government revenue implication of the tax reforms (in million ETB), yearly

Government Revenue through taxes	ET_2022 (Baseline)	Difference to base				
		PIT Reforms			VAT Reforms	
		Reform-1b	Reform-1c	Reform-1d	Reform-2b	Reform-2c
From Direct Taxes	94,874.92	18,638.24	39,812.00	43,130.18	0.00	0.00
From Indirect Taxes	177,312.59	0.00	0.00	0.00	35,462.51	59,104.21

Source: Authors' calculations from ETMOD v3.0 estimation

As explained previously, based on the constant budget shares approach, only 87.68% of the government tax revenue is spent on public goods/services. Based on this assumption, we estimate the distribution of public goods/services spending across deciles. However, the 2018/19 Ethiopian Socio-Economic survey only has data on the currently attending pupil in public schools which enables us to measure the distribution of the public good/service benefits from educational spending. So, in this analysis, public goods/services are proxied by education. According to the Ethiopian Ministry of Finance Report, the total educational spending of the Ethiopian government was ETB 43,314,541,530 in the 2018/19 fiscal year, which is 12.49% of

the total government spending. Thus, the educational spending share is 12.49 % of the budget share of public service spending in each reform.

In this thesis, the measure of the distribution of public services spending follows two steps: first, the monetary value of public services is estimated using **the *production cost approach***. In this approach, the transfer to the beneficiaries is assumed to equal the average cost of providing or producing the service. According to the Ethiopian Ministry of Finance Report, the total educational spending of the Ethiopian government was ETB 43,314,541,530 in the 2018/19 fiscal year. Thus, based on the production cost approach, ETB 43,314,541,530 spent on public services (in this case education) is assumed to equal ETB 43,314,541,530 worth to households or individuals. The second step is to estimate the allocation of these public service (in this case education) benefits across the population. In vast literature (for example, European Union, 2013; Ogden & Phillips, 2023; Verbist & Förster, 2020) the ***actual consumption approach*** has been used to assess the value of educational service per receiver (pupil). This approach measures each pupil's actual usage by allocating the value of education service to the individuals that are using the service. That means dividing the total educational expenditure by the total enrolment number in each education level (primary, lower secondary, and upper secondary) provides an estimate of the value received per pupil. Note that this approach assumes that participants at a given education level and country receive an equal share of the value. So, with the gross enrolment number of 26,082,698 students, the value received per pupil is ETB 1660.66, i.e. the benefit from the education services.

In the 2018/19 fiscal year, the individuals under investigation only receive ETB 11.13 million from the total ETB 43.31 billion educational spending of the Ethiopian government. As shown in Table 16, 52% of educational services benefit from government educational spending received by people in the bottom five deciles of equivalized household expenditure. Moreover, the highest receivers of educational service benefits are the second and third deciles of the bottom distribution of equivalized household expenditure, and the fifth and ninth deciles are the two lowest educational spending benefit receivers. Therefore, the estimated result shows that the distribution of public service benefits from educational spending is pro-poor.

Table 16: Distribution of public service benefits from educational spending (in ETB), yearly

Deciles	Currently Attending pupil in public school	Total Educational service value received by the pupils	In %	After the PIT reforms (change from the baseline)			After the VAT reforms (change from the baseline)	
				Reform-1b	Reform-1c	Reform-1d	Reform-2b	Reform-2c
1	671	1,114,304.10	10.01	209.28	447.04	484.30	398.20	663.66
2	766	1,272,066.98	11.43	238.91	510.33	552.86	454.58	757.63
3	694	1,152,499.32	10.35	216.46	462.36	500.90	411.85	686.41
4	706	1,172,427.27	10.53	220.20	470.36	509.56	418.97	698.28
5	621	1,031,271.01	9.26	193.69	413.73	448.21	368.53	614.21
6	697	1,157,481.31	10.40	217.39	464.36	503.06	413.63	689.38
7	678	1,125,928.73	10.11	211.47	451.70	489.35	402.35	670.59
8	666	1,106,000.79	9.93	207.72	443.71	480.69	395.23	658.72
9	559	928,309.97	8.34	174.35	372.42	403.46	331.73	552.89
10	646	1,072,787.56	9.64	201.49	430.38	466.25	383.36	638.94
Total	**6704**	**11,133,077.05**	**100.00**	**2,090.96**	**4,466.38**	**4,838.63**	**3,978.42**	**6,630.71**

Source: Authors' calculations

Note: the deciles of the currently attending pupil in public school are constructed by the equivalized household expenditure.

As explained above, based on the constant budget shares approach, only 10.15% of the government tax revenue goes to social security transfers. Based on this assumption, we estimate the distribution of social security transfer spending across deciles. The 2018/19 Ethiopian Socio-Economic survey only has data on the old age pension which enable us to measure the distribution of the social security benefits received by the people. So, in this analysis, social security transfers are proxied by old-age pensions. As shown in Table 17, only 28% of social security transfer benefits from old-age pensions are received by people in the bottom five deciles of equivalized household expenditure. Moreover, the highest old age pension benefit was received by those in the sixth, ninth, and tenth deciles of the top distribution of equivalized household expenditure, and the second, third, and fourth deciles are the three lowest old age pension benefit receivers. Therefore, the estimated result shows that the distribution of social security transfer from old age pension is not pro-poor.

In comparison, the above results show that the public goods/services channel is well-targeting the poor and vulnerable segments of society than the social security transfers channel. Therefore, the microsimulation result shows that both the VAT and PIT reforms reduce consumption-based

inequality better than the existing VAT & PIT policies in Ethiopia by providing essential public goods/services to the poor and vulnerable segments of society.

Table 17: Distribution of monthly social security transfer – Old age pension benefits (in ETB)

Deciles	Number of Old age Pension receivers in each decile	Total benefits received	In %	After the PIT reforms (change from the baseline)			After the VAT reforms (change from the baseline)	
				Reform-1b	Reform-1c	Reform-1d	Reform-2b	Reform-2c
1	13	895.35	8.25%	156.06	333.36	361.14	296.94	494.90
2	13	593.48	5.25%	99.25	212.01	229.68	188.84	314.74
3	9	692.89	4.73%	89.40	190.96	206.88	170.10	283.49
4	11	467.72	4.65%	87.89	187.73	203.37	167.22	278.70
5	27	581.63	5.63%	106.54	227.57	246.53	202.71	337.84
6	18	876.49	12.50%	236.39	504.93	547.02	449.77	749.61
7	27	397.74	5.61%	106.21	226.87	245.78	202.09	336.81
8	25	587.89	6.88%	130.15	278.01	301.18	247.64	412.73
9	34	1,195.99	17.15%	324.48	693.10	750.87	617.38	1028.96
10	35	1,917.01	29.36%	555.41	1186.38	1285.26	1056.77	1761.28
Total	**212**	**875.50**	**100.00%**	**1,891.78**	**4,040.92**	**4,377.71**	**3,599.44**	**5,999.08**

Source: Authors' calculations

7. Conclusion and Policy Implications

This paper estimated the impact of fiscal policy on inequality in Ethiopia, by employing the 2022 policy system of the static tax-benefit microsimulation model for Ethiopia (ETMOD v3.0). Two main elements of Ethiopian fiscal policy were analyzed: personal income tax and VAT policies, and obtained several empirical simulation results. The microsimulation results indicate that Ethiopia's personal income tax and value-added tax policies are progressive and equalizing. The main findings of the analysis of the two tax policies are summarized as follows.

On the personal income tax (PIT) side, it generates most of Ethiopia's direct tax revenue as explained in section-4.3 and although it is progressive and reduces inequality as confirmed by the microsimulation results. As shown in reform-1a, the simulation result revealed that the marginal contribution of personal income tax to the Gini index is estimated at 1.27% points, implying personal income tax is reducing inequality and progressive since the wealthiest quintiles contribute more in tax payments compared to the poorest quintiles. Moreover, the additional simulation (i.e., hypothetical PIT reform-1b and 1c) results confirmed that the

distributional impact of personal income tax has increased as the personal income tax rate increases, reducing inequality by 0.05% Gini index in reform-1b and by 0.10% Gini index in reform-1c. Moreover, in reform-1d, the simulation was run by exempting the 1st and 2nd quintiles of the households from PIT to make the personal income tax more pro-poor. The result shows that the first two quintiles' income increased by ETB 167.2 million on average and the last three quintiles pay a disproportionate share of the tax burden – on average their disposable income declined by ETB 403 million. Consequently, inequality declined by 0.11% of the Gini coefficient – a decline from 0.3582 to 0.3571 Gini points. These findings suggest that it would be possible to reduce the existing inequality level by increasing the personal income tax schedule rate. Similarly, the results of the *Kakwani* and *Reynolds-Smolensky Indices* also confirmed the absolute progressivity and positive redistributive effect of the personal income tax in Ethiopia. Finally, the *Atkinson inequality index* revealed that society is willing to give up more shares of their total income to achieve income equality in Ethiopia.

On the value-added tax (VAT) side, due to the adoption of the VAT policy in Ethiopia, the reduction in inequality across income groups is also observed in the microsimulation results. As shown in reform-2a, the result revealed that VAT provides a very small marginal contribution to distributive efforts, a decline of 0.41% Gini index, implying that VAT is progressive and has a weak distributive role. Moreover, the results also confirmed that the wealthiest quintiles in Ethiopia bear the burden of VAT as compared to the poorest quintiles, and this helps the government to redistribute these resources to the low-income groups to raise their welfare level. As well, additional two hypothetical reforms scenarios (i.e., hypothetical VAT reform-2b (+3% VAT) and 2c (+5% VAT)) are executed, and the simulation result of both VAT reforms confirmed the positive impact of the rise in VAT rate on the consumption-based income distribution for low-income households - reduces the Gini index by 0.08% for reform-2b and by 0.13% for reform-2c, but poor households hurt from the VAT reform even though they hurt small net losses compared to the richest households.

Moreover, the three PIT reforms generate on average ETB 33, 860.14 million and the two VAT reforms generate on average ETB 47,283.36 million in government revenue. Only 12.32 % of the government tax revenue is spent on social security transfers, and the remaining 87.68% is spent on public goods/services and other activities. More specifically, the share of education spending

from the total public services spending is 12.49%. Regarding the distribution of public goods/services spending, 52% of public services benefit from government educational spending received by people in the bottom five deciles of equivalised household expenditure. On the other hand, only 28% of social security transfer benefits from pensions are received by people in the bottom five deciles of equivalised household expenditure. In contrast, these results show that the public services channel is well-targeting the poor and vulnerable segments of society than the social security transfers channel. Therefore, the microsimulation result shows that both the VAT and PIT reforms reduce consumption-based inequality better than the existing VAT & PIT policies in Ethiopia by providing essential public goods/services to the poor and vulnerable segments of society.

Thus, this paper recommended the government increase both the VAT and PIT rates to achieve equality in society, with concrete mitigation measures (public service spending, tax exemptions, etc.) well-targeting the poor and vulnerable segments of society. Indeed, in Ethiopia, to achieve equitable distribution of income fiscal policy already goes a long way. Nevertheless, the levels of inequality have been increasing over time, which is a worrying and unacceptable economic phenomenon. Thus, more can and should be done by the government of Ethiopia to narrow down the income gap between rich and poor and strengthen the effectiveness of the fiscal policy.

As the simulation result revealed, the distributional impact of VAT is negligible in Ethiopia. This result shows that VAT deserves more attention from a distributional point of view. Therefore, it is advised that exemptions on least pro-poor should be eliminated to improve the distributional role, and progressivity, and enhance tax collections. Whereas, personal income tax reduces inequality but its effect is small in magnitude compared to some low-income countries (such as 2.2% Gini points in Tanzania). This indicates that there is plenty of room to improve the distributional impact of personal income tax in Ethiopia. Therefore, intensifying the personal income tax collection efforts to widen the tax base, especially among the richest households, is one of the pieces of suggestion forwarded by this analysis.

Generally, in Ethiopia, it is evident that the distributive capacity of the tax system is still limited due to several factors the tax system faced, especially with the tax administration. Therefore, it is necessary to improve and digitalize the tax administration/system to accompany the desired policy changes.

Finally, to observe the full picture of the impact of fiscal policy, I would like to suggest future researchers broaden the study to examine all types of taxes and transfers by paying adequate attention to the role of the informal sector in policy reforms and optimal tax rates.

References

Aaberge, R., & Langørgen, A. (2006). Measuring the benefits from public services: The effects of local government spending on the distribution of income in Norway. *Review of Income and Wealth*, *52*(1), 61–83.

Alam, S. A., Inchauste, G., & Serajuddin, U. (2017). The Distributional Impact of Fiscal Policy in Jordan. *CEQ Working Paper 44*.

Alavuotunki, K., Haapanen, M., & Pirttilä, J. (2019). The Effects of the Value-Added Tax on Revenue and Inequality. *Journal of Development Studies*, *55*(4), 490–508. https://doi.org/10.1080/00220388.2017.1400015

Alavuotunki, K., & Pirttilä, J. (2015). The consequences of the value-added tax on inequality. *WIDER Working Paper 2015/111*. https://www.wider.unu.edu/sites/default/files/Publications/Working-paper/PDF/wp2015-111_0.pdf

Argaw, B. A. (2017). Regional inequality of economic outcomes and opportunities in Ethiopia: A tale of two periods. *WIDER Working Paper 2017/118*. https://www.wider.unu.edu/sites/default/files/wp2017-118.pdf

Arunatilake, N., Inchauste, G., & Lustig, N. (2017). The Incidence of Taxes and Spending in Sri Lanka. *CEQ Working Paper 63*.

Atkinson, A. B. (1970). On the Measurement of Inequality. *Journal of Economic Theory*, *2*(3), 244–263. https://doi.org/10.1007/978-1-4684-8848-7_7

Atkinson, A. B. (2015). Inequality: What Can Be Done? *Harvard University Press, London*. http://journal.um-surabaya.ac.id/index.php/JKM/article/view/2203

Babatoundé, A., Capéau, B., & Houssa, R. (2023). Welfare Effects of Indirect Tax Policies in West Africa. *CESifo Working Paper No. 10381*.

Bachas, P. J., Gadenne, L., & Jensen, A. (2021). Informality, Consumption Taxes and Redistribution. *CID Faculty Working Paper, No. 401*. https://doi.org/10.2139/ssrn.3951329

Bird, R. M., & Zolt, E. M. (2005). The limited role of the personal income tax in developing countries. *Journal of Asian Economics*, *16*(6), 928–946. https://doi.org/10.1016/j.asieco.2005.09.001

Bonifacio, V., Brandao-Marques, L., Budina, N., Csonto, B., Fratto, C., Engler, P., Furceri, D., Igan, D., Mano, R., Narita, M., Omoev, M., Pasricha, G. K., & Poirson, H. (2021). Distributional Effects of Monetary Policy. In *IMF Working Paper, WP/21/201*. https://doi.org/10.1007/978-3-031-10302-5_9

Bourguignon, F., & Spadaro, A. (2006). Microsimulation as a tool for evaluating redistribution policies. *Journal of Economic Inequality*, *4*(1), 77–106. https://doi.org/10.1007/s10888-005-9012-6

Callan, T., Smeeding, T., & Tsakloglou, P. (2008). Short-run distributional effects of public

education transfers to tertiary education students in seven European countries. *Education Economics*, *16*(3), 275–288. https://doi.org/10.1080/09645290802338144

Cancho, C., & Bondarenko, E. (2017). The Distributional Impact of Fiscal Policy in Georgia. *CEQ Working Paper 42*.

Cano, L. (2017). Personal income tax and income inequality in Ecuador between 2007 and 2011. *CEPAL Review No. 123 , SSRN Electronic Journal*. https://doi.org/10.18356/F31C2017-EN

Capéau, B., Decoster, A., & Phillips, D. (2014). Consumption and indirect tax models. *Handbook of Microsimulation Modelling (Contributions to Economic Analysis, Vol. 293), Emerald Group Publishing Limited, Bingley*, *293*, 223–273. https://doi.org/10.1108/S0573-855520140000293007

Caracciolo, F., & Santeramo, F. G. (2013). Price trends and income inequalities: Will Sub-Saharan Africa reduce the gap? *African Development Review*, *25*(1), 42–54. https://doi.org/10.1111/j.1467-8268.2013.12012.x

Carrasco, H., Jawara, H., & Meyer, M. (2022). The Effects of Fiscal Policy on Inequality and Poverty in The Gambia. *World Bank Document*.

Coibion, O., Gorodnichenko, Y., Kueng, L., & Silvia, J. (2012). Innocent Bystanders? Monetary policy and inequality in U.S. *National Bureau of Economic Research Working Paper 18170*. https://doi.org/10.1016/j.jmoneco.2017.05.005

Cornia, G. A., & Martorano, B. (2019). Inequality and growth in an agricultural-led development model: The case of Ethiopia over 1995-2011. *UNDP E-Library*, 294–315. https://doi.org/10.18356/35f604e7-en

CSA, & LSMS-ISA. (2018). *Ethiopia - Rural Socioeconomic Survey 2011-2012*.

CSA, & LSMS-ISA. (2020a). *Ethiopia - Socioeconomic Survey 2013-2014*.

CSA, & LSMS-ISA. (2020b). *Ethiopia - Socioeconomic Survey 2015-2016, Wave 3*.

CSA, & LSMS-ISA. (2023). *Ethiopia - Socioeconomic Survey 2018-2019*.

Dabla-Norris, E., Kochhar, K., Suphaphiphat, N., Ricka, F., & Tsounta, E. (2015). Causes and Consequences of Income Inequality: A Global Perspective. *IMF Staff Discussion Notes*, *15*(13), 1. https://doi.org/10.5089/9781513555188.006

Damgaard, C., & Weiner, J. (2000). Describing Inequality in Plant Size or Fecundity. *Ecology*, *81*(4), 1139–1142. https://doi.org/10.2307/177185

De Agostini, P., Capéau, B., Decoster, A., Figari, F., Kneeshaw, J., Leventi, C., Manios, K., Paulus, A., Sutherland, H., & Vanheukelom, T. (2017). EUROMOD extension to indirect taxation: final report. *EUROMOD Extension to Indirect Taxation: Final Report. EUROMOD Technical Note EMTN 3.0. Colchester: Colchester: Institute for Social and Economic Research, University of Essex.*

De Freitas, J. (2012). Inequality, the politics of redistribution and the tax mix. *Public Choice*, *151*(3–4), 611–630. https://doi.org/10.1007/s11127-010-9761-z

Debebe, S., & Zekarias, E. H. (2020). Analysis of poverty, income inequality and their effects on food insecurity in southern Ethiopia. *Agriculture and Food Security*, *9*(16), 1–12. https://doi.org/10.1186/s40066-020-00269-3

Devereux, S., Teshome, A., & Sabates-Wheeler, R. (2005). Too much inequality or too little? Inequality and stagnation in Ethiopian agriculture. *IDS Bulletin, Institute of Development Studies*, *36*(2).

Dixon, P. M., Weiner, J., Mitchell-olds, T., & Woodley, R. (1987). Bootstrapping the Gini Coefficient of Inequality. *Wiley on Behalf of the Ecological Society of America*, *68*(5), 1548–1551.

Doepke, M., & Schneider, M. (2006). Inflation and the Redistribution of Nominal Wealth. *Journal of Political Economy*, *114*(6), 1069–1097. https://doi.org/10.1108/eb001157

Dorfman, R. (1979). A Formula for the Gini Coefficient. *The Review of Economics and Statistics, The MIT Press*, *61*(1), 146–149.

Emran, M. S., & Stiglitz, J. E. (2005). On selective indirect tax reform in developing countries. *Journal of Public Economics*, *89*(4), 599–623. https://doi.org/10.1016/j.jpubeco.2004.04.007

Enami, A., Larroulet, P., & Lustig, N. (2022). How Accurate is the Kakwani Index in Predicting Whether a Tax or a Transfer is Equalizing? *ECINEQ Working Paper Series 601*. https://doi.org/10.25071/1874-6322.40543

European Union. (2013). The distributional impact of public services in European. *Eurostat Methodologies and Working Papers*. https://doi.org/10.2785/41678

FDRE. (2002a). Federal Excise Tax Proclamation No. 307/2002. *Federal Negarit Gazette*.

FDRE. (2002b). Federal Turnover Tax Proclamation No. 308/2002. *Federal Negarit Gazette*.

FDRE. (2016). Federal income tax proclamation No. 979/2016. *Federal Negarit Gazette*.

FDRE. (2019). Federal Value Add Tax (Amendment) Proclamation No.1157/2019. *Federal Negarit Gazette*.

FDRE. (2020). Federal Excise Tax Proclamation No. 1186/2020. *Federal Negarit Gazette*.

FDRE, & Unicef. (2018). *Research Agenda on Fiscal Policy Reform in Ethiopia*.

Furceri, D., Loungani, P., & Zdzienicka, A. (2016). The effects of monetary policy shocks on inequality. *IMF Working Paper*, *WP/16/245*, 1–43. https://doi.org/10.1016/j.jimonfin.2017.11.004

Gasior, K., Leventi, C., Noble, M., Wright, G., & Barnes, H. (2018). The distributional impact of tax and benefit systems in six African countries. *WIDER Working Paper 2018/155*. https://doi.org/10.35188/UNU-WIDER/2018/597-8

Gebeyehu, B., Feleke, S., Tufa, A., Lemma, T., Tefera, T., & Manyong, V. (2018). Patterns and structure of household income inequality in rural Ethiopia. *World Development Perspectives*, *10–12*, 80–82. https://doi.org/10.1016/j.wdp.2018.09.007

Gerber, C., Klemm, A., Liu, L., & Mylonas, V. (2018). Income Tax Progressivity: Trends and Implications. *IMF Working Paper, WP/18/246*. https://doi.org/10.1111/obes.12331

Goldman, M., Woolard, I., & Jellema, J. (2021). The Impact of Taxes and Transfers on Poverty and Income Distribution in South Africa 2014/2015. *ACEIR Working Paper Series No. 7*. https://doi.org/10.1086/298187

Hanni, M., Martner, R., & Podestá, A. (2015). The redistributive potential of taxation in Latin America. *CEPAL Review*, *116*, 7–26. https://doi.org/https://doi.org/10.18356/4bfdcb5d-en

Harris, T., & Seid, E. (2021). 2019/20 survey of the Ethiopian tax system. *The Institute for Fiscal Studies Report R187*. http://www.ifs.org.uk

Hill, R., Inchauste, G., Lustig, N., Tsehaye, E., & Woldehanna, T. (2017). A Fiscal Incidence Analysis For Ethiopia. *The CEQ Working Paper*, *41*, 41. http://repec.tulane.edu/RePEc/ceq/ceq41.pdf

IMF. (2023). *World Economic Outlook: Real GDP growth (Annual percent change)*.

Inchauste, G., Lustig, N., Maboshe, M., Purfield, C., & Woolard, I. (2017). The distributional Impact of Fiscal Policy in South Africa. *CEQ Working Paper 29*.

Inui, M., Sudo, N., & Yamada, T. (2017). The effects of monetary policy shocks on inequality in Japan. *BIS Working Papers, No 642*. https://doi.org/10.1016/j.jimonfin.2017.11.004

Itriago, D. (2011). Owning Development: Taxation to Fight Poverty. *Oxfam Research Report*.

https://www-cdn.oxfam.org/s3fs-public/file_attachments/rr-owning-development-domestic-resources-tax-260911-en_3.pdf

Jebessa, J., Melles, F., Gagel, D., & Quincke, G. (2005). Taxation in Ethiopia. *ECC and EBDSN*.

Jellema, J., Wai-Poi, M., & Afkar, R. (2017). The Distributional Impact of Fiscal Policy in Indonesia. *CEQ Working Paper 40*.

Jouini, N., Lustig, N., Moummi, A., & Shimeles, A. (2018). Fiscal Policy, Income Redistribution, and Poverty Reduction: Evidence from Tunisia. *Review of Income and Wealth*, *64*(s1), S225–S248. https://doi.org/10.1111/roiw.12372

Kakwani, N. C. (1977). Measurement of Tax Progressivity : An International Comparison Published by : Oxford University Press on behalf of the Royal Economic Society MEASUREMENT OF TAX PROGRESSIVITY : *The Economic Journal*, *87*(345), 71–80.

Keen, M. (2007). Vat Attacks! *IMF Working Paper, WP/07/142*. https://doi.org/10.2139/ssrn.1007891

Kneeshaw, J., Agostini, P. De, Chatsiou, K., Gasior, K., Tamayo, H. X. J., Leventi, C., Manios, K., Paulus, A., Popova, D., & Tasseva, I. (2020). Baseline results from the EU28 EUROMOD : 2016-2019. In *EUROMOD Working Paper, No. EM 20/20, University of Essex, Institute for Social and Economic Research (ISER), Colchester*.

Lara Ibarra, G., Sinha, N., Fayez, R., & Jellema, J. (2019). Impact of Fiscal Policy on Inequality and Poverty in the arab Republic of Egypt. *World Bank Policy Research, Working Paper 8824*. https://doi.org/10.1596/1813-9450-8824

Luebker, M. (2011). The impact of taxes and transfers on inequality. *TRAVAIL Policy Brief No . 4 , International Labour Office, Geneva*.

Lustig, N. (2022). The Commitment to Equity Handbook: Estimating the Impact of Fiscal Policy on Inequality and Poverty. *Washington, DC: Brookings Institution Press and CEQ Institute, Tulane University.*, *1*, 1–23. https://commitmentoequity.org/wp-content/uploads/2023/04/CEQ-Handbook-Volume-1-.pdf

Lustig, N., & Higgins, S. (2022). The CEQ Assessment: Measuring the Impact of Fiscal Policy on Inequality and Poverty. *Book Chapter -1 of Lustig 2012. Commitment to Equity Handbook: Estimating the Impact of Fiscal Policy on Inequality and Poverty.Washington, DC: Brookings Institution Press and CEQ Institute, Tulane University.*

Mantovani, D. (2018). Comparing redistributive efficiency of tax-benefit systems in Europe. *EUROMOD Working Paper Series, EM 12/18.* http://155.185.68.2/campusone/web_dep/CappPaper/Capp_p155.pdf

Marical, F., D'Ercole, M. M., Vaalavuo, M., & Verbist, G. (2008). Publicly Provided Services and the Distribution of Households' Economic Resources. *OECD Economic Studies No. 44, 2008/1*. https://doi.org/10.1787/eco

Martorano, B. (2018). Taxation and Inequality in Developing Countries: Lessons from the Recent Experience of Latin America. *Journal of International Development*, *30*(2), 256–273. https://doi.org/10.1002/jid.3350

Mascagni, G., & Molla, K. G. (2018). Business taxation in Ethiopia : Exploring administrative data to understand taxpayers ' responses to tax thresholds. *Institute for Fiscal Studies Report R189*.

Matthias, D., & Schneider, M. (2006). Inflation and the Redistribution of Wealth. *Journal of Political Economy*, *114*(6), 1069–1097, The University of Chicago. https://doi.org/10.1108/eb001157

McKay, A., & Wolf, C. K. (2023). Monetary Policy and Inequality. *Journal of Economic*

Perspectives, *37*(1), 121–144. https://doi.org/10.26509/frbc-ec-201701

Mengistu, A. T., Molla, K. G., & Woldeyes, F. B. (2017). UNU-WIDER SOUTHMOD Country Report: ETMOD v1.0, 2014-2016. *UNU-WIDER SOUTHMOD Country Report Series. Helsinki: UNU-WIDER*. https://doi.org/10.23987/sts.55159

MOFED. (2002). Ethiopia: Sustainable Development and Poverty Reduction Program. *Addis Ababa: Ministry of Finance and Economic Development*.

Muñoz, S., & Cho, S. S.-W. (2003). Social Impact of a Tax Reform: The Case of Ethiopia. *IMF Working Paper, WP/03/232*. https://doi.org/10.5089/9781451875584.001

Odusola, A. (2006). Tax policy reforms in Nigeria. *UNU-WIDER Research Paper No. 2006/03*, 1–43. https://www.wider.unu.edu/sites/default/files/rp2006-03.pdf

OECD. (2022). *Revenue Statistics in Africa 1990-2020*.

Ogden, K., & Phillips, D. (2023). The distribution of public service spending. *IFS Deaton Review of Inequalities*. https://ifs.org.uk/inequality/the-distribution-of-public-service-spending/

Paulus, A., & Sutherland, H. (2016). EUROMOD, CEQ, LIS and TAXSIM: a note on overlaps, differences and complementarities. *EUROMOD Technical Note Series, EMTN 2.0, Colchester: Institute for Social and Economic Research, University of Essex*.

PDC. (2018). Poverty and Economic Growth in Ethiopia (1995/96-2015/16). In *Planning and Development Commission(PDC), Federal Democratic Republic of Ethiopia,Addis Ababa.*

Piketty, T. (2015). Putting distribution back at the center of economics: Reflections on capital in the twenty-first century. *Journal of Economic Perspectives*, *29*(1), 67–88. https://doi.org/10.1257/jep.29.1.67

Poterba, J. M. (2007). Income inequality and income taxation. *Journal of Policy Modeling*, *29*(4), 623–633. https://doi.org/10.1016/j.jpolmod.2007.05.010

Salotti, S., & Trecroci, C. (2018). Cross-country evidence on the distributional impact of fiscal policy. *Applied Economics*, *50*(51), 5521–5542. https://doi.org/10.1080/00036846.2018.1487001

Salti, N., & Chaaban, J. (2010). On the Poverty and Equity Implications of a Rise in the Value Added Tax. *Middle East Development Journal*, *2*(1), 121–138. https://doi.org/10.1142/s1793812010000174

Sen, A. (1973). *On economic inequality. Clarendon Press, Oxford, UK.*

Shahir, A. A., & Figari, F. (2023). UNU-WIDER SOUTHMOD Country Report: ETMOD v3.0, 2017–22. *UNU-WIDER SOUTHMOD Country Report Series. Helsinki: UNU-WIDER*. https://doi.org/10.23987/sts.55159

Stiglitz, J. E. (2015). The Great Divide: Unequal Societies and What We Can Do About Them. *W.W. Norton Company, New York London*. https://doi.org/10.1111/j.1564-9148.2015.00261.x

Taghizadeh-Hesary, F., Yoshino, N., & Shimizu, S. (2018). The impact of monetary and tax policy on income inequality in Japan. *Asian Development Bank Institute Working Paper, No. 837*. https://doi.org/10.1111/twec.12782

UNDP. (2019). *Income Inequality Trends in Sub-Saharan Africa: Divergence, Determinants, and Consequences*. United Nations. https://doi.org/10.18356/542cba95-en

United Nations. (2018). Classification of Individual Consumption According to Purpose (COICOP) 2018. *Statistical Papers,ST/ESA/STAT/SER.M/99 Series, Department of Economic and Social Affairs Statistics Division, United Nations, New York*. https://unstats.un.org/unsd/classifications/unsdclassifications/COICOP_2018_-_pre-

edited_white_cover_version_-_2018-12-26.pdf
UNU-WINDER. (2022). SOUTHMOD Modelling Conventions: EUROMOD Modelling Conventions adjusted for tax- benefit microsimulation in developing countries. *Helsinki: UNU-WIDER.*
UNU-WINDER. (2023). SOUTHMOD User Manual: A manual for the harmonized SOUTHMOD model bundle. *Helsinki: UNU-WIDER.*
Verbist, G., & Förster, M. (2020). Accounting for public services in distributive analysis. *Research on Economic Inequality*, *27*, 69–87. https://doi.org/10.1108/S1049-258520190000027006
World Bank. (2010). Ethiopia : Re-Igniting Poverty Reduction in Urban Ethiopia through Inclusive Growth. *World Banlk, Africa Region REPORT NO. 52848-ET*. https://openknowledge.worldbank.org/handle/10986/2921
World Bank. (2015). Ethiopia Poverty Assessment 2014. In *Poverty Global Practice Africa Region, Report No. AUS6744*. https://doi.org/10.1596/34617
World Bank. (2017). The Distributional Impact of Taxes and Transfers: Evidence from Eight Low- and Middle-Income Countries. *World Bank Publications*. https://doi.org/10.1596/1813-9450-7787
World Bank. (2020). Ethiopia Poverty Assessment: Harnessing Continued Growth for Accelerated Poverty. *The World Bank 1818 H Street NW, Washington*.
World Bank. (2022). *Poverty and Shared Prosperity Report 2022: Correcting Course*. https://doi.org/doi:10.1596/978-1-4648-1893-6
World Bank. (2023). *World Development Indicators, Gini Index*.
World Bank Group. (2020). *Ethiopia: Poverty and Equity Brief of April 2020*. https://databankfiles.worldbank.org/public/ddpext_download/poverty/33EF03BB-9722-4AE2-ABC7-AA2972D68AFE/Global_POVEQ_ETH.pdf
Younger, S. D., Myamba, F., & Mdadila, K. (2016). Fiscal Incidence in Tanzania. *CEQ Working Paper 36*.
Younger, S. D., Osei-Assibey, E., & Oppong, F. (2017). Fiscal Incidence in Ghana. *Review of Development Economics*, *21*(4), e47–e66. https://doi.org/10.1111/rode.12299

Appendixes

A) Personal Income Tax Reform

Table A gives detailed information on the current applicable personal income tax rate in Ethiopia and the hypothetical personal income tax reform scenarios considered in the microsimulation of the analysis. However, for reform-1d, I constructed a hypothetical personal income bracket to exempt the 1st and 2nd quintiles of the households from PIT to make the personal income tax more pro-poor.

Table A: The real and hypothetical personal income tax rates in Ethiopia

Employment income (per month, ETB)	Existing (Real) Applicable rate (in %)	Reform - 1b (in %)	Reform – 1c (in %)	Employment income (per month, ETB) *Applied for reform-1d*	Reform – 1d (in %)
0-600	0	0	0	0-600	0
601-1,650	10	15	5	601-4,033	0
1,651-3,200	15	20	25	4,034-5,250	30
3,201-5,250	20	25	30	5,251-6,500	35
5,251-7,800	25	30	35	6,501-7,800	40
7,801-10,900	30	35	45	7,801-10,900	45
Over 10,900	35	40	50	Over 10,900	50

B) Age distribution across deciles who receive an old-age pension

Deciles	No of Observations	Mean Age	min	max	sd	p50
1	13	54.05	32	90	19.38	56
2	13	55.66	45	98	13.30	46
3	9	51.65	40	83	15.00	50
4	11	65.99	28	80	10.25	68
5	27	57.52	32	90	10.94	58
6	18	56.86	30	93	12.94	56
7	27	65.28	30	88	12.35	69
8	25	64.58	38	79	13.05	65
9	34	59.68	37	90	13.31	62
10	35	66.74	25	85	13.01	68
Total	**212**	**60.59**	**25**	**98**	**13.95**	**63**

Source: Authors' calculations

Note: the deciles of the currently attending pupil in public school are constructed by the equivalized household expenditure.

C) Budget Summary of FDRE , 2018/19 budget year

C-1) Summary of FDRE government revenue & external funds (in ETB), 2018/19 budget year

S.No	Revenue & External Funds	Revenue In ETB	Sub Total In ETB
1	**Domestic Revenue**		
	Tax Revenue	211,111,400,001	
	Non-Tax Revenue	24,472,309,090	
	Capital Revenue	148,820,538	
	Total Domestic Revenue		**235,732,529,629**
2	**External Assistance**		
	Multilateral Institutions	10,565,324,876	
	Bilateral Assistance	6,207,281,076	
	Protection of Basic Services	2,334,449,872	
	Total External Assistance		**19,107,055,824**
3	**External Loan**		
	Multilateral Institutions	16,630,766,212	
	Bilateral Loan	8,272,867,000	
	Protection of Basic Services	7,865,775,743	
	Total External Loan		**32,769,408,955**
4	**Domestic Loan**	59,306,457,540	
	Total Domestic loan		**59,306,457,540**
5	**Total Revenue & External Funds**		**346,915,451,948**

Source: MoF, 2020

C-2) Summary of FDRE government Expenditure (in ETB), 2018/19 budget year

S.No	DESCRIPTION	RECURRENT	CAPITAL	SUBSIDIES	TOTAL
1	**Administration & General Services**				
	Organs of State	1,663,361,442	1,662,071,900		3,325,433,342
	Justice and Security	5,591,774,884	1,182,497,950		6,774,272,834
	National Defence	15,000,000,000			15,000,000,000
	General Services	6,635,641,071	3,747,511,640		10,383,152,711
	Sub Total	**28,890,777,397**	**6,592,081,490**	**-**	**35,482,858,887**
2	**Economic Service**				
	Agricultural and Rural Development	2,235,867,610	11,746,221,510		13,982,089,120
	Water & Energy	338,043,060	12,004,768,000		12,342,811,060
	Trade and Industry	882,757,560	408,909,700		1,291,667,260
	Mining	168,999,100	45,468,000		214,467,100
	Transport and Communication	905,390,790	1,637,483,900		2,542,874,690
	Urban Development & Construction	794,817,271	44,533,800,520		45,328,617,791
	Sub Total	**5,325,875,391**	**70,376,651,630**	**-**	**75,702,527,021**
3	**Social Service**				
	Education	24,518,043,030	18,796,498,500		43,314,541,530
	Culture and Sport	688,713,760	2,787,731,000		3,476,444,760
	Health	1,780,000,780	9,062,716,750		10,842,717,530
	Labour and Social Affairs	107,088,300			107,088,300
	Prevention and Rehabilitation	166,928,930	549,149,110		716,078,040
	Sub Total	**27,260,774,800**	**31,196,095,360**	**-**	**58,456,870,160**
4	**Others**				
	Transfer	167,000,000	5,470,731,500		5,637,731,500
	Regional Subsidy			135,604,731,380	135,604,731,380
	Public Debts	22,512,300,000			22,512,300,000
	Provisions	7,518,433,000			7,518,433,000
	Support for Achievement of Sustainable Development Goals			6,000,000,000	6,000,000,000
	Sub Total	**30,197,733,000**	**5,470,731,500**	**141,604,731,380**	**177,273,195,880**
5	**Total Expenditure**	**91,675,160,588**	**113,635,559,980**	**141,604,731,380**	**346,915,451,948**

Source: MoF, 2020

D) Nutritional (calorie-based) equivalence scales used for distributional analysis

Age groups	Male	Female
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60+	0.84	0.74

Source: PDC (2018)