Social impact of VAT based tax-transition: The case of Togo

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Abstract

Does the tax system of developing countries absorb tax transition reforms based on VAT? This paper attempts to answer the question by assessing the distributional and poverty consequences of VAT based tax-tariff reforms stationed on the case of Togo. Building on a computable general equilibrium model of tax changes coupled with microsimulation framework, the paper evidences that, VAT based tax-tariff reform implemented at the country level is poverty and inequality increasing. A point for point increase in VAT to compensate for trade tax revenues with the actual VAT rate of 18% enlarges poverty at this country level. Nonetheless, a low VAT rate of 15%, with exemption of agricultural goods from VAT coverage is found to have preferred poverty consequences. Notwithstanding, the analysis reveals that, non-farmers' households are the ones that encounter the greatest increase in poverty incidence following the reform, as compare to farmers. Yet, disaggregating households according to their residence place also reveals the interesting result that, poverty is urban based within the group of farmers, while at the same time is rural based within the group of non-farmers. The paper also points out that, targeted social transfers to households with revenue brought by the reform, may counteract the poverty rising effect of the reform, while dealing with inequality to some extent.

Keywords: VAT-trade tax reform, Distributional impact, Poverty impact, Togo.

1 Introduction

Tax reforms have been promoted by international financial institutions as an important component of general economic reforms in many developing countries. One of the advocated reforms includes a shift[1] from border taxes, to domestic sale taxes especially value added tax (VAT). VAT has been the main trade tax revenue recovery instrument following trade liberalization, and is widely used in a majority of countries. Part of research has been carried out to provide evidence on the revenue compensating effect of VAT and if the revenue replacement strategy is well functioning (Baunsgaard & Keen, 2010; Waglé, 2011; Crivelli, de Mooij, & Keen, 2016; Adandohoin, 2018). However little research has been done to identify social impact of more reliance on VAT as a tax-tariff reform device.

A major concern about more extensive use of VAT in national tax systems often arises from its regressivity over income (Gastaldi et al., 2017). This statement is based on the fact that, the share of income that households spend in consumption, is decreasing in income (Carlson & Patrick, 1989). Poorest households spend a greater proportion of their income in consumption as compared to high income households. In such circumstance, VAT would most affect the poor than the rich because of the ability to save for the latter (Poh, 2003). VAT is a revenue mobilization tool in favour of economic efficiency but underperforming in terms of equity (Poh, 2002).

Nonetheless, studies that emphasized the regressivity of VAT are inconclusive. According to Jenkins et al. (2006), the claim has not taken into account the fact that, in many developing countries, the commodities on which poor households spend most of their income, even if included in the legal tax base, are administratively impractical to tax. In such context, the effective VAT rate borne by each household, would be naturally progressive over quintiles of household expenditures. Other authors emphasized more discourses about the regressivity of VAT by highlighting the fact that, border taxes that VAT has replaced could have been more regressive[2] (Clarete & Whalley, 1986; Gemmell & Morrissey, 2005). And yet, studies that emphasized coordinated VAT-tariff reforms, come to the evidence of a welfare increasing effect of the revenue replacement strategy (Michael et al., 1993; Hatzipanayotou et al., 1994; Abe, 1995; Keen & Ligthart, 2002; Naito, 2006; Keen, 2008).

In theory, direct taxation should best preserve equity, but its revenue raising power is limited in many developing countries. As stated in Bird and Zolt (2005), personal income tax has done little to reduce inequality in many developing countries given that, in these countries, this tax

[1] This phenomenon is called tax transition, or tax-tariff reform, and VAT-trade tax reform in this case. The aim is to offset revenue losses on international trade due to trade liberalization, with domestic revenues most times VAT based.

[2] Tariffs have larger distorting effects. They distort both production and consumption decisions, whereas an imperfect VAT would distort only consumption decisions.

is neither comprehensive nor very progressive. It often amounts to little more than withholding tax on wages in the formal sector. So, given the dominance of consumption taxes in the tax system of developing countries, concerns about fairness and social justice fall back on VAT, that must ensure both revenue and preserve equity. In this rationale, distributional and poverty consequences of consumption taxes (VAT) become a major interest in social analysis. Yet, addressing the social impact of VAT reforms, including VAT-trade tax reform, comes to asking the question about the best pro-poor VAT design compatible with a revenue neutral VAT-tariff reform that increases social outcomes.

In general pioneers of the optimal taxation theory carried out frameworks that emphasize the structure of domestic indirect taxes welfare maximising and revenue increasing. In Ramsey (1927), consumption taxes should be levied at the same rate on all commodities, if labor supply is fixed. But if this assumption no longer holds, it is better to tax goods on a differentiated[3] rate basis. Diamond (1975) gets a generalized formulation of the Ramsey (1927)'s law in many persons framework by introducing distributive[4] considerations in the social utility function. The welfare maximising effect is also achieved through differentiated rate basis, where tax rates should be levied at high rates on goods consumed by agents with less marginal utility of income. Even through these theories provide us with frameworks on the structure of indirect taxation that helps minimize the impact of indirect taxes on social welfare, poverty and inequalities, the well-known administrative challenges faced by developing countries is in favour of uniform VAT rate, and uniform rate also avoid introducing competition between goods (Ebrill, 2001). But uniform VAT rate although economically efficient, would also put aside the envelope of equity (Poh, 2002; Poh, 2003).

By far, there is no consensus in the empirical literature about the best pro-poor VAT design. Ahmad and Stern (1984); and Ahmad and Stern (1991) concluded that a multiple VAT rate or a uniform VAT system with exemptions is more progressive than uniform rate system based on the case of India. Sahn and Younger (1999) found that a broad based VAT is progressive in eight[5] African countries. Muñoz and Cho (2003) established in the case of Ethiopia that, the uniform VAT rate is progressive but less progressive than the sale taxes it replaced, because the exempted goods under the VAT system is disproportionately consumed by richest households. Jenkins et al. (2006) show that, the uniform VAT rate system is progressive over all quintiles of households' expenditures based on the Dominican Republic case, whereas Hossain (2003) carried out that, a revenue-neutral uniform VAT reform is regressive in Bangladesh compare to

[3] In Ramsey (1927) this rule is known as "inverse elasticity rule of taxation". To avoid the loss of economic efficiency and the loss of the representative agent's welfare due to plausible substitution between labor supply and leisure, it is better that commodities should be taxed most which have the least elasticity of demand.

[4] Author weighted social utility function by agents' marginal utility of income.

[5] Cote d'Ivoire, Ghana, Guinea, Madagascar, Mauritania, South Africa, Tanzania, Uganda

the pre-reform situation in its impact on income of different households. However, a basic rate of VAT with exemptions for certain commodity groups, has the superior distributional effect.

Taking stock of the above discussions, this paper aims to fit into the debate, by analyzing the equity impacts and poverty implications of VAT based tax-tariff reform for the case of Togo. It will contribute with a relatively advanced methodology to the tax incidence literature by linking a macro computable general equilibrium (CGE) model, to a microsimulation framework, allowing to deal with general equilibrium effects of tax changes at the macro level, together with heterogeneities in the distributional effects of these tax policy changes at the household level (sequential top-down approach). As said, the induced price changes due to the reform, as well as income effects at the macro level, are used as connectors, to conduct distributive analyses after the reform, on household survey data.

The rest of this paper is organized as follows: Section 2 provides summaries of the literature review on the social incidence of VAT in developing countries, while section 3 emphasizes the economic situation of Togo and its VAT and trade tax design. In section 4, we present our data, followed by section 5 that deals with the model. Our simulations consistent with VAT based tax-tariff reform (VAT-trade tax reform) are carried out in section 6. Then we analyze their macro and micro results in section 7. Finally, section 8 is about some sensitivity analyses.

2.Social incidence of VAT in the literature.

Studies that address tax incidence analyses use various techniques. Some use simple macro models (see for example Alavuotunki et al. (2019); Martinez-Vazquez et al. (2012)) that address inequality effect of VAT introduction in a subset of country and found out that, inequality has increased due to VAT introduction, or that VAT has a negative effect on income distribution. Nonetheless, studies based on macro level analysis, miss to capture important facets of the phenomenon, allowable by micro-data. They couldn't exploit heterogeneities in households composition for example, or exploit richest information in the structure of their income and expenditure to properly deal with social analysis. So, they are incomplete and misleading. Therefore, most of the literature that aimed at assessing the regressivity of VAT or VAT incidence to some extent, comes back to survey data that are more suitable to rigorously gauge social incidence parameters. While referring to these types of data, tools used are wide and encompass microsimulation analyses, computable general equilibrium model analyses, or linked macro-micro computable equilibrium models, to better assess effects of tax policy changes on social outcomes.

Microsimulation models enable researchers to simulate the effects of a policy on a sample of agents at the individual level. They offer the possibility to account for observed heterogeneities in socio-economic parameters, where a simulated policy may consist of evaluating the consequences of a change in the economic environment induced by a policy reform on a vector of indicators of individuals in a sample of observations(Bourguignon & Spadaro, 2006). Within this framework, Hossain (2003) investigated the distributional implication of introducing VAT in Bangladesh and established the result that, a revenue-neutral uniform VAT is regressive in its impact on different households. In order to mitigate the adverse impact, author explores the distributional impact of an alternative policy package consisting of a basic rate of VAT with exemptions for certain commodity groups chosen on the basis of their distributional characteristics. The distributional consequence of the alternative package was found to be superior to those of the uniform VAT. Younger et al. (1999) addressed tax incidence in Madagascar using a nationally representative survey data and found out that the movement away from trade taxes, toward broadly based value added taxes is more equitable and economically efficient. Consumption taxes are progressive and more progressive than import duties (Younger et al., 1999). Essama-Nssah (2007) assessed the social incidence of commodity taxes, based on survey data from Guinea and relies on the price elasticity of the poverty measure, and on the consumption patterns of each commodity. Author shows that, many components of food expenditure (particularly cereals, grains and roots) would be good candidates for VAT exemption. Arsić and Altiparmakov (2013) based on microsimulation exercises assessed the equity impact of VAT in the case of Serbia and found that, the significant presence of own-source farming production of food in this country presents an important progressivity enhancing effect compared to VAT incidence in developed countries. They conclude their paper by highlighting the fact that, the common belief of inherently inequitable VAT taxation are vastly overstated and poorly understood in the economic reality of less developed countries, where VAT can be described as being mostly mildly progressive. Similar result based on a rich dataset of households' incomes and expenditures for the Dominican Republic's case is also discovered by Jenkins et al. (2006) that brought the powerful result that, the effective VAT rate paid on each item by households is naturally progressive over quintiles of households' expenditures. They explain their results by the fact that, commodities on which poor households spend most of their income, are often impractical to tax due most times to exemptions encountered on these types of goods. As a consequence, the purchase prices of these items will have a lower proportion of VAT content than goods and services consumed by richest households. Engel et al. (1999) quantified the direct impact of taxes including VAT on income distribution at the household level and found that the after-tax distributional effect of raising VAT from 18% to 25% in Chile is very similar to the pre-reform situation. Muñoz and Cho (2003) provided an assessment of the poverty and social

impact of replacing Ethiopia's sales tax with a value-added tax (VAT). Results indicate that this reform has not had a major adverse effect on the poorest 40 percent of the population. The VAT is progressive in its incidence, and the higher revenue brought by VAT can provide additional funds for poverty-reducing spendings. Roy et al. (2010) focused on the poverty implication of introducing VAT in six major India's states in place of sale taxes, and carried out the result that, there are scope of improvements in the design of VAT reform with respect to some items predominantly consumed by the relatively poorer groups. Household data available in India from the National Sample Survey on consumption expenditures for the 55th round was used for this study. Newhouse and Zakharova (2007) assessed a VAT reform that consists in extending VAT base to energy products and professional services, as well as increasing the rate from 10 to 12% in Philippines, and found that the reform was progressive and relatively well targeted. Salti and Chaaban (2010) examined the impact of a rise in the Value Added Tax (VAT) on poverty and inequality in Lebanon. The simulation results using own and cross price demand elasticities estimated with an Almost Ideal Demand System show that, the projected VAT rate increases will have a non-negligible impact on poverty and inequality in Lebanon, despite current VAT exemptions. Alderman and Del Ninno (1999) explored the implication of VAT exemption in South Africa on the expenditure of the poor, and establish that maize currently exempted from VAT is a best choice for low tax rates from equity point and the impact on the food consumption of the poor. In contrast, lower tax rates on milk and meat which are currently exempted are not good candidates for assisting the poor.

Nevertheless, these studies based on microsimulation approaches miss to capture indirect effect of tax policies on prices and cannot fulfill all types of reforms. We need general equilibrium models to fully address tax incidence analyses. They enable researchers to appraise multiple interactions between economy's sectors and to model tax policies with accuracies. Computable general equilibrium models (CGE[6]) are more suitable to address feedback effects of economic policies on a range of indicators including income and expenditure outlooks of various agents.

Such a CGE model was used by Devarajan and Hossain (1999) to analyse the incidence of taxes in Philippines. They found that indirect taxes are broadly neutral in their incidence because of general equilibrium effects. Rutherford et al. (2003) examined the Colombian tax system to evaluate the welfare cost of raising additional government revenue using CGE model. Their model includes several income classes allowing to consider both efficiency and equity considerations. They found that value added taxes are equitable source of government revenue both in the short and long run, and economic efficiency is also reached in Colombia using uniform value

[6]Computable general equilibrium model afterwards.

added taxes. Emini (2000) built a computable general equilibrium (CGE) model to assess the impact of the imperfect value added tax (VAT) applied in Cameroon. Part of the impact is appreciated through households' welfare indicators. Author found that, the VAT implemented in Cameroon is beneficial to state's revenue, but this success is somewhat mitigated, for the households' welfare worsens.

Beyond all, a major drawback of CGE models is the representative agent condition. For this reason, they cannot address within-group changes following economic reforms. The solution is to link a CGE model with microsimulation framework, to enable dealing both with general equilibrium effect of economic policy changes, together with heterogeneities within the microsimulation analysis. They are called macro-micro computable general equilibrium. Within macro-micro CGE models, we have two approaches: integrated multi-households' approach in a CGE model, or sequential approaches, that distinguish a macro module separate from a micro module but tend to reconcile them. Sequential approaches can be "top-down", "bottom-up", "top-down-bottom-up". In the top-down approach, linking variables can be prices, wages or other linking variables, obtained from the CGE model (Chen & Ravallion, 2004). In the bottom-up approach, survey data are used to calibrate parameters for the CGE model (Cogneau, Robilliard, et al., 2007). Finally, the top-down-bottom-up approach links in two-ways the macro model and the micro model until they converge (Bourguignon & Savard, 2008). Building on a sequential top-down approach, Boccanfuso, De Quatrebarbes, and Savard (2011) assessed the best pro-poor VAT design in Niger and found that, broadening the tax base while maintaining high VAT rate will lead to an important increase in poverty. Nonetheless, lowering the rate or maintaining exemptions on agricultural goods have at least superior impact on poverty.

3. Economic situation of Togo and its VAT and trade tax design.

Togo is an African country that belongs to West African Economic and Monetary Union (WAEMU) community. According to its human development index (0.48), country is ranked 162nd. Its poverty indicators reveal that in 2015, poverty incidence is at 55.1%, and the extreme poverty ratio 28.7% (Institute-Statistics, 2015). Like many other developing countries, the country undertakes during the 2000s, its tax transition reform, that consists in offsetting reduced revenue from international trade liberalization through increased revenue from domestic taxation. Under the decision 10/2006/CM/WAEMU, country takes precedence over the tax transition agenda, by reinforcing domestic revenue mobilization.

Concerning trade taxes, country's tariff lines basically follow the ones of WAEMU that consist in implementing a common external tariff of four rates: 0% on basic products, 5% on equipment and materials, 10% on inputs and 20% on final consumption goods. Export taxes have almost

disappeared in the trade policies of the country, and the effective rate borne by agricultural goods is 0.3% and 0.5% for manufactured goods. The average weighted tariff rate decreases from 14.99% in 1999 to 9.73% in 2015 that corresponds to a revenue loss about 2 percentage points of trade tax to GDP or 16.5 percentage points of trade tax to total tax revenue.

VAT was introduced in 1995. In order to increase revenue contribution from VAT, the VAT system was standardized to a uniform VAT rate of 18% following the WAEMU directives 02/98/CM/UEMOA, and 02/2009/CM/UEMOA. Reduced VAT rates that were applied to a list of products are no longer in effect[7]. Exports are zero rated. But some imperfections remain in the VAT system. Agricultural goods as well as medical care, medical services supplied by hospitals, clinics and other similar establishments are exempted from VAT charge[8]. Even imperfectly implemented, VAT constitutes by far, the major source of government revenue accounting for 9% of country's GDP, 42% of total tax revenue and by near 60% of domestic tax revenue in 2015. But a question still remains: does the VAT revenue collection in the VAT based tax transition agenda of this country reconcilable with poverty and inequality at this country level?

4. Data.

This study exploits two types of data. The macro model uses data originating from the 2015 social accounting matrix of the country (SAM[9] 2015), and the micro model is based on the "Unified Well Being" survey data conducted the same year at the country level (QUIBB 2015) .

4.1 The SAM data.

The original social accounting matrix comprises 40 branches of activity, each with specific goods that we aggregate to distinguish 4 sectors of production : agricultural sector, industry sector, private services, and public services (table 1).

[7]The decision 02/2009/CM/UEMOA allows countries to implement a reduced VAT rate between 5% to 10%.

[8]This list is not exhaustive. Exemptions also cover teaching activities carried out by educational establishments, universities, and professional establishments.

[9]Social accounting matrix

Table 1: Sectors of production

	Activities
Agriculture	subsistence farming; breeding and hunting; forestry and forest exploitation; fishing; livestock.
Industry	phosphate extraction; other mining activities; slaughtering; meat processing; fish conservation; manufacture of fatty substances; tobacco products; beverage manufacturing; animal feed manufacturing; manufacture of other food products; cotton gin; manufacture of other textile articles; woodcraft; manufacture of paper and cardboard; manufacture of machines and various materials; manufacture of paper and cardboard; printing and reproduction; chemical manufacturing; manufacture of building materials; manufacture of metallurgical products; manufacture of machines and various materials; other manufacturing and recovery activities; electricity; production of water and gas; construction.
Private services	trade; repairs; catering and accommodation; road transport; air transport; production of auxiliary transport services; post and telecommunication; real estate activities; financial activities; services to companies.
Public services	Public administration; education; health; social protection; other collective activities.

Source: Author with SAM data

We can also distinguish four categories of agents (households, firms, government, and the rest of the world), and two kinds of production factors (labor and capital). Households in the SAM are categorized in two main parts: farmers and non-farmers. The agricultural sector participates for 28.3% to the creation of economy's total value added. Its contribution to total production is 15.2%. Production in the agricultural sector is made of 83,5% of added value and 16.48% of intermediate inputs. Agricultural activities are granted subsidies in the initial situation. Sector's production uses 42.3% of labor and 41.1% of capital. Agricultural goods are produced locally (94.3% of total production), imported (5.2% of composite demand) 94.8% of domestic demand, and exported (5.7% of total production).

The industry sector commits to 22% of total production and 10.6% of value added. Value added in the industry sector represents 21.7% of its total production. The sector makes use of intermediate inputs more than the use of value added (77.1% versus 21.7%). This drives the little use of workers in the sector as compare to agricultural sector (10.8% versus 42.3%). But this sector exports more goods than the agricultural sector (58.8% versus 5.7%). Its imports account for 82.4% of economy's total imports.

For services, private services stand for 41.4% of total economy's value added, and 49.9% of total production. This sector also makes more use of intermediate inputs than value added (61.8% versus 37.1%). Private services are mostly imported than exported. In addition to private services, public services sector contributes to 19.5% of economy's total value added, 12.8% of total

production.

Regarding public finance, the major source of government revenue is concentrated on indirect taxes especially VAT (32.2% of government revenue; 50.3% of total tax revenue) and custom duties (15.2% of government revenue; 23.7% of total tax revenue). VAT is almost levied on manufactured goods (74.3%) and private services (22.2%). The contribution from agricultural goods and public services is quietly limited (0.86% and 2.4% respectively). With reference to custom duties, they are also essentially borne by industrial goods (97.2%) and meagerly by agricultural goods (2.7%). While export taxes are mostly levied on manufactured and agricultural goods, their contributions to total tax revenue are negligible (0.4%).
Table 2 provides effective rates borne by these goods calculated from the SAM [10]

Table 2: Effective tax rates

	Custom duties	Export taxes	VAT
Agriculture	9.6	0.3	1.3
Industry	11.4	0.5	16.5
Private services	0.2	-	10.2
Public services	-	-	7.8

Source: Author with SAM data
This confirms the fact that, industrial goods are the ones mostly covered by indirect taxation in this country.

4.2 The QUIBB data.
In addition to the SAM data, this study capitalizes on the "Unified Well Being Survey Data" conducted at the country level in 2015 for the microsimulation framework (sequential top-down approach). The survey covers urban and rural areas of the country and consists of a random sample of 2326 households. The database includes households' income, consumption and expenditure indicators and is published by country's National Statistical Institute. It also comprises basic demographic characteristics such as the educational level of the household head, its age, sex, the branch of activity, the socio-professional status, and its residence place (urban versus rural). Data from the QUIBB were harmonized with data from the SAM to distinguish two

[10]Except VAT effective rate that was calibrated differently.

types of households: farmers and non-farmers, based on the main activity of the household head.

Table 3 and 4 provide some descriptive statistics about households' income and expenditure in the survey. These statistics overall show that, farmers earn much less income than do the non-farmers. Non-farmers also spend more than do the farmers. Note that, these patterns of expenditures are carried out in absolute nor relative terms. But one thing more important to note is that, the amount of expenditures in the survey, is well above the one of incomes. This is due to the "under-reporting bias of incomes" in survey data. Thus, this study, will focus more on expenditures data in place of incomes, to address distributional and poverty analyses. This problem of under-reporting bias of incomes in survey data is largely pointed out by several studies (Moore & Welniak, 2000; Hurst et al., 2014; Meyer et al., 2009; Bound et al., 2001; Cruces et al., 2013).

Table 3: Descriptive statistics : incomes

	Obs	Mean	Std.Dev	e(Min)	e(Max)
Farmers	538	362388.1	689232.4	1000	1.04e+07
Non-farmers	1304	425975	1022797	1000	1.50e+07

Table 4: Descriptive statistics : expenditures

	Obs	Mean	Std. Dev.	e(Min)	e(Max)
Farmers	586	919349.4	782197.9	13440	5945940
Non-farmers	1740	1375913	1213804	23800	1.41e+07

Source: Author with QUIBB data

5. The model.

5.1 Macro model.

This study builds on the small open country general equilibrium model of (Decaluwé, Martens, & Savard, 2001). The model encompasses a system of six blocks: production, incomes and savings, the block of expenditures, international trade, prices and equilibriums.

5.1.1 The production block.

Production in production branches, derives from a production technology nested in two steps: at the higher step, production is obtained following a Leontief connection between value added and total intermediate consumption. The Leontief formula at this step is based on the fact that, we both need value added and intermediate consumption to produce goods. They are complements. At the lower step, value added is made of labor and capital. We suppose that labor and capital are imperfect substitutes and we model this through a CES[11] production technology. Total intermediate input consumption results from a combination in a fixed proportion (Leontief formula) of intermediate demand of products through the technical coefficient matrix. The producer's problem consists in maximising total production with respect to production costs. We then derive the relative demand of factors according to their relative prices.

In the model, labor is adaptable across sectors but capital is specific to each sector. This means, there exist unique labor remuneration that corresponds to economy's equilibrium global wage. But it exists as many capital remunerations as production sectors.

5.1.2 The block of incomes and savings.

The model distinguishes incomes and savings of households, firms, government and the rest of the world.

5.1.2.1 Households' incomes and savings.

Households derive their incomes from the remuneration of labor and capital, dividends paid by firms, transfers from the rest of agents (government, rest of the world), as well as incomes from self-employment. Transfers are exogenous. Their disposable income is designed as the difference between gross income minus direct taxes (personal income taxes) and transfers they paid to other agents. Their saving is modelled as a residual, which implies the difference between their disposable income and consumption expenditures they made. The level of direct taxes is endogenous, calculated through the effective income tax rates calibrated with the SAM data. These rates are supposed to be exogenous.

5.1.2.2 Government revenue and saving.

Government derives its revenue from various sources involving direct and indirect taxes, part of economy's total capital remuneration [12], and exogenous transfers from the rest of agents (firms, households, and the rest of world). Direct taxes consist of taxes levied on incomes of individuals and firms. Part of direct taxes also includes taxes on production in the production branches. Indirect taxes levied on goods and services, cover value added taxes, import duties, as well as

[11] Constant elasticity of substitution.

[12] This comes from usage of public equipment and materials as production factors.

export taxes. These taxes are endogenous and connected to their tax bases through exogenous effective tax rates computed from the SAM, except the effective tax rate of VAT.

The modelling of VAT revenue receives particular attention to take into account its imperfection in developing countries. We distinguish two kinds of taxpayers (producers): liable and non-liable. Liable producers face two types of dilemmas: the non-refunded VAT from tax authorities and VAT finally borne on their intermediate consumption due to VAT exemptions on final goods. Non-liable producers also bear VAT on their intermediate consumption since they cannot charge VAT on final goods. Thus, VAT revenue collected by the government is the total of VAT collected on final consumption of non-exempted goods and services marketed by liable producers, plus VAT they indirectly borne due to non-refunded VAT and exemptions, and VAT borne on intermediate consumption by non-liable producers. This distinction (liable and non-liable) is reliable due to the fact that, in these countries, we often encounter sizeable part of informality alongside with the formal sector. The effective VAT rate is then, the result of this form of modelling that takes into account VAT imperfections in developing countries including Togo. The proportion of liable and non-liable producers (formal versus informal producers) as well as the proportion of non-refunded VAT and exempted goods, are considered as parameters in the model but can be simulated.

Lastly, government saving is the difference between government revenue and transfers it made in direction of firms, households, and the rest of the world, minus government spending on final consumption goods. While government total spending is exogenous, government spendings on consumption goods are endogenous and related to total spending in a fixed proportion.

5.1.2.3 Firms' incomes and savings.

Firms perceive the rest of economy's total capital compensation that was not committed to remunerate households and government. They also derive incomes from exogenous transfers made by other agents (households, government, the rest of the world). Their savings consist of their gross incomes net of income taxes (corporate income taxes), minus dividends they paid to households, and transfers to government and the rest of the world.

5.1.2.4 Revenue and saving of the rest of the world.

The revenue of the rest of the world consists of country's imports in foreign currency and transfers received from domestic agents also in foreign currency. Their saving is obtained by subtracting country's exports and transfers the rest of the world made in direction of domestic agents (valuated in foreign currency). Note that, their saving is nothing else than the opposite of country's current account balance.

5.1.3 The block of expenditures.

Expenditures in goods and services in the economy are made up of three types of expenditures: final consumption expenditures (households, government), intermediate consumption expenditures in production branches, and investment expenditures on goods and services. Intermediate consumption expenditures in production branches are already described in the production block through a Leontief formula of sectors' total production (fixed proportion). Households final consumption expenditures is a LES[13] function, derived from the maximization of a Stone Geary utility function under budget constraint. Overall, this system of demand (LES) supposes that, households' consumptions depend on an endogenous consumption budget [14], a marginal propensity to consume goods, an incompressible part (not related to income) and good prices. Government final consumption expenditures on goods and services are related to exogenous total government spending in a fixed proportion and depend also on good prices. The same pattern is used in modelling investment expenditures in goods and services. They are related to country's total investment through a fixed proportion and depending on good prices. These proportions were calibrated through the SAM data. Note that, country's total investment is drained by its total saving which is obtained by summing agents' total saving.

5.1.4 The block of international trade.

Two hypotheses govern the modelling of foreign trade: the "small open country assumption" and the Armington (1969) hypothesis. The first implies that, a small country is a price taker in international trade: its economy is not large enough to influence world prices of imported and exported goods. These prices are determined exogenously. For the Armington (1969) hypothesis, it stipulates that a good produced in a country and the same good produced abroad are imperfectly substitutable. To model Armington (1969)'s hypothesis, demand of goods in domestic market is a composite demand that is made of local products and their imported substitutes. Consumers tend to maximize the Armington (1969) function under their budget constraint that leads to choose the relative share of domestic demand and imported goods according to their relative prices and the elasticity of substitution between domestic and imported goods (CES based elasticity of substitution function). Note that, the price of imported goods only includes tariffs nor VAT. VAT is applied on the composite price of goods.

Symmetrically, the repartition of total production between local and external market is performed through a constant elasticity of transformation (CET) function. This function captures the ease with which the producer switches its production between domestic market and exports.

[13] Linear expenditure system of demand.

[14] Total consumption budget is related to household's disposable income through average propensity to consume goods.

Producers choose the relative share of production marketable on domestic and export retail sources, taking into account the relative price of domestic supply and exports, as well as the ease to relocate their production on these two markets.

5.1.5 The block of prices.

The price system is made of supply side prices, and prices around demand. A system of tax ensures the connection between the two. The producer price reflects the "per-unit" cost of production which is the weighted average between the value-added price and the intermediate consumption price, reduced of any subsidies. The value-added price is made of per-unit labor and capital remuneration costs, while intermediate consumption price reflects the per-unit cost of intermediate goods demand. Normally, VAT would be neutral vis-a-vis of production costs. But due to imperfections in the VAT system (non-refunded VAT, exemptions), VAT finally enters the per-unit cost of production through intermediate consumption price of goods. According to distinctions made in previous sections, the liable producer may bear VAT charge on its intermediate consumption through non-refunded VAT and exemptions of final goods. Non-liable producers may also support VAT on their intermediate consumption since they cannot charge VAT.

Once the producer price determined, the price of local supply of goods is obtained as the difference between total producer's price and export price, taking into account the relative part of domestic supply and exports in total production. Export prices are valuated at international prices, and the small open country assumption implies that, if the country wants to impose a tax on exports, this tax comes to reduce the price of exportable goods to maintain the international price constant. In the presence of tax on production, this tax would rather enter the domestic demand price of goods.

Consumers for their part, ask for a composite basket of goods. The composite basket is made of domestic demand and imports. The composite price is obtained as a weighted average of domestic demand prices and import prices. Import prices take into account tariff rates. Lastly, final consumption price of goods includes VAT and is obtained by applying VAT on the composite price of goods.

5.1.6 Equilibriums and model closure.

A certain number of equilibriums must be satisfied. The goods and services market equilibrium is obtained by imposing perfect equality between total domestic absorption of goods and its components. The walras law was imposed. If equilibrium is reached on a subsequent number of markets, then equilibrium must be reached even on the last market.

Labor market equilibrium is obtained by imposing the absolute equality between economy's total labor supply and the sum of sectorial labor demands. In the capital market, the equilibrium is that, in each sector, capital supply corresponds to its demand. These equilibriums are obtained through price adjustments.

The model closure is that, economy's total saving serves to finance its total investment. A number of additional assumptions are made. Public deficit and current external account balance are endogenous. These mean that government can carry out external debt to finance investments. The nominal exchange rate is exogenous and is considered as numeraire.

5.2 The micro model.

As emphasized in previous sections, this paper uses a "sequential top-down approach" to address distributional and poverty implications of VAT based tax-tariff reform. As said, the induced price changes at the macro level due to the reform, are used to compute new vectors of households' incomes and expenditures at the micro level. We both carry income (expenditure) and price effects simulated at the macro level, to household level, to assess poverty and inequality after the reform. We rely on the GINI index to measure inequality (Gini, 1912; Gini, 1921; Jasso, 1979) , and Foster et al. (1984) decomposable poverty index to address poverty.

The GINI index on a random sample consisting of income values indexed in non-decreasing order is based on the formula:

$$GINI = 1 - \frac{2}{n-1} * [n - \frac{\sum_{i=1}^{n} r_i y_i}{\sum_{i=1}^{n} y_i}] \tag{1}$$

where n is the population size;

r_i is the individual's rank when incomes are indexed in non-decreasing order;

y_i is individual's income.

For the Foster et al. (1984) poverty index, we use the formula:

$$FGT(\alpha) = \frac{1}{n} * \sum_{i=1}^{q} (\frac{z - y_i}{z})^{\alpha} \tag{2}$$

where n is the population size;

z is the poverty line;

q is the number of individuals under the poverty line;

y_i is individual's income.

and α the individual's aversion to poverty.

α can take values between 0 and 2. If α takes the value 0 (FGT0); we have the poverty incidence ratio or headcount ratio. If it takes the value 1 (FGT1), we obtain the poverty gap ratio, and if α is close to 2 (FGT2), we have the extreme poverty ratio or the distance in poverty.

6. Simulations.

Our first simulation consistent with VAT based tax-tariff reform, or VAT trade-tax reform (simulation 1) consists in offsetting trade tax revenue losses through VAT increases. We simulate a point decrease in trade taxes (both tariff rates and export tax rates) concomitantly with a point increase in VAT revenue (VAT effective rates). Note that, by its nature, the model predicts VAT effective rates for each commodity. So, we are concerned in this simulation with differentiated VAT rates (multiple rates). In other words, a cut in trade tax rates is compensated through a point for point increase in VAT revenue (VAT effective rates). This is an alternative to address multiple VAT rate design as a tax-tariff reform device.

In simulation 2, we maintain the same framework of multiple VAT rates, but we also exempt agricultural goods from VAT coverage. In this simulation, challenges that could arise from VAT refunds, are kept constant to the initial situation level. We carry out this simulation to address an option of VAT design pro-poor oriented and look at its macro effects to further assess inequality and poverty distributions at the micro level after the reform.

Simulation 3 lays basis for uniform VAT rate as a tax-tariff reform tool. Now, we compensate a point decrease in trade tax revenue with a point increase in VAT revenue, through uniform VAT rate of 18%.[15] To complement our analysis on the uniform VAT rate framework, and in order to address pro-poor VAT design compatible with revenue, we also calibrate the uniform VAT rate that just maintains government revenue unchanged, following the decrease in trade taxes. This was done by exogenizing the VAT revenue to the level that compensates for the decrease in government revenue, and by endogenizing VAT rate (simulation 4). Then we undertake a simulation based on this rate and provide its macro and micro results (simulation 4).

In addition to simulation 4, simulation 5 maintains the uniform VAT rate system of simulation 4 but authorizes a reduced rate of 5% on agricultural goods.

Finally, the latest simulation (simulation 6) exempts agricultural goods from VAT coverage under the uniform VAT rate system of simulation 4. This means, agricultural goods are fully exempted, but the rest of commodities bear uniform VAT rate of simulation 4. We also kept constant VAT refund challenges to the initial situation level in both simulation 5 and 6.

In all the above simulations, we are interested about the induced price changes as well as income(expenditure) effects of the reform at the macro level, to conduct microsimulation exercises at the household level based on the poverty and inequality indicators previously outlined.

[15] This is the uniform VAT rate adopted by the country.

7. Results.

7.1 Macro results.

-Implications of compensating a point decrease in trade tax revenue through a point increase in VAT revenue (simulation 1).

Table 13 in appendix provides results of VAT based tax transition concerns consistent with simulation 1. A point decrease in trade tax is offset through a point increase in VAT. This policy orientation (multiple VAT rates) was sufficient to compensate for government revenue, and even slightly increases it by +1.9%. Industrial goods and services are the ones that bring more VAT revenue (+14.4% for industry; +13.1% for private services; +10.8% for public services). This was sufficient to offset decreased revenue from trade taxes (-12.9% of custom duties and -12.3% of export taxes in the industry sector, -11.8% of custom duties for private services). In the agricultural sector, the increased in VAT revenue (+10.7%) was insufficient[16] to offset the decline observed in the sector's trade tax revenue(-16.7% of custom duties; -1.3% on export taxes).

Note that, following the trade liberalization framework, prices of imported goods decreased by (-0.8%; -1%; -0.02%) respectively for agricultural goods, industrial goods and private services, while prices of exported goods increased by (+0.02% and +0.05%) for agricultural and industrial goods, as direct effects. The decrease observed in import prices of agricultural and industrial goods, was enough to induce a decrease in the composite price[17] of these goods (-7.1% and -0.9%), while the composite price of services increased by 12.2% due to increases in their domestic prices (+13.5%). Lastly, only final consumption prices of agricultural goods decreased (-7%) while responding to cuts in trade taxes with increases in VAT. This is simply due to the fact that, agricultural goods are practically exempted from VAT charge in the initial situation. The revenue replacement strategy by VAT however increases final consumption prices of industrial goods, private services, and public services (+1.6% and +14.1%; +0.5%).

Turning back to the government revenue effect of the reform, we noticed that government revenue typically increased by (+1.9%). Under the assumption of fixed government total spending, the expansion in government revenue leads to an increase in its total saving (+19.7%). But economy's total investment decreases by (-1.4%) due to a fall in households' savings (-7.4% for non-farmers, -5.6% for farmers) and in firms' savings (-72%). The fall observed in households and firms' savings is an indirect effect, that need detailed explanations based on labor and capital market outlooks following the reform. Subsequently, the cut in total investment was enough to induce a fall in manufactured goods' investments (-3%) and in private services' investments (-13%), while investments in agricultural goods increase by (+5.9%) due to the cut in final consumption prices of agricultural goods. These patterns of investments may shape demand

[16] Agricultural goods are mostly exempted in the initial situation.

[17] The composite price of goods, is the weighted average of domestic demand price and import price.

behaviours of goods and services.

In the agricultural sector, the absorption of agricultural goods decreases by (-0.6%) even though investments have increased in the sector. This is due to fall in final consumption of agricultural goods by non-farmers (-0.4%) that was enough to counteract increases in farmers consumption in the same goods (+1.2%) and increases in agricultural goods' investments. While farmers' consumption in agricultural goods were price sensitive, it seems like consumption of non-farmers in the same goods were price inelastic[18]. In the industry sector, the cut in the sector's investments on manufactured goods was enough to induce a decline in domestic absorption of these goods (-3.3%). Nevertheless, in the private services sector, the cut in its investments doesn't cause a fall in the domestic absorption of these goods (+4.3%), due to increases in intermediate demands of the sector (+0.4%). Domestic absorption of public services however decreased by (-1.5%). The rise however in industrial, public and private services prices due to VAT, lowers households' consumptions in industrial goods, public and private services (-8.3%; -17.6%; -7.1% respectively for non-farmers and -6.7%; -15.9%; -5.5% respectively for farmers).

To sum, concerning demand, the composite demand of agricultural and manufactured goods, as well as public services decreased following the reform by (-0.6% and -3.3%, -1.5%), while the composite demand of private services increases by (4.3%). The cut in composite demand of agricultural, industrial goods, and public services is driven both by cuts in imports (-7.4%; -3.2%; -2%) and in domestic demand (-0.1%; -3.5%; -1.5%) of these goods. Imports of these goods were price inelastic following the trade liberalization policy[19]. But imports of private services as well as their domestic demands increase. Private services imports increase (+19.9%) due to the fall in tariff rate of this good.[20]. Then, the observed demand behaviours would shape production behaviours.

Production of manufactured goods as well as public services decrease by (-3.1%; -1.52%), as a reaction to fall in domestic demand of these goods, while production of private services increases (+1.2%) also due to raises in domestic demand of these goods. In the agricultural sector, total production increased (+0.4%) mostly drained by exports (+9.6%). So, following the reform, production in agricultural sector and private services increase, while production in the industrial sector and public services decrease. These production behaviours are sufficient to explain value added reactions in all branches. Value added of agricultural and private services increase, while value added in the industry and public services decrease. Agricultural and private services sectors attract part of the workforce from the industrial and public services sectors, providing a drop in the economy's labor remuneration (-10%). The fall in value added of industrial goods

[18]Non- farmers households also have less propensity to consume agricultural goods as compare to farmers.

[19]Imports of these goods were price inelastic since it is found that the price of imported goods have almost decreased in all goods.

[20]Imports of private services for their part, were price sensitive.

and public services also lead to a fall in capital remuneration in these sectors (-16.3%; -13.1%), while the cut in wages in the agricultural and private services sectors lead to a cut in the relative demand of capital as compare to labor, that further decreases capital remuneration prices in these sectors also (-9% and -7.4%). As households' incomes depend on wage remunerations and firms' incomes mostly on capital market remunerations, these help understand the fall in their savings previously encountered. Farmers' incomes fell by (-5%) while non-farmers' incomes by (-6.9%). These fall in households' incomes coupled with raises in good prices, may support the fall in final consumption of households previously encountered. Consumption in all goods fell except consumption in agricultural goods by farmers, that benefits from cuts in agricultural good prices previously justified. Here, the price effect was sufficient to counteract the income effect.

-Implications of compensating a point decrease in trade tax revenue through a point increase in VAT revenue while exempting the agricultural sector (simulation 2).

Simulation 2 produces the ongoing results (table 14): government revenue is compensated and increases as well. The increase is nearly the one obtained in simulation 1 (+1.9%). VAT revenue was brought by industrial goods (+14.9%) as well as services (+14.3% for private services and +11.8% for public services). Agricultural goods are fully exempted in this scenario (+0%). We also notice an increase in government saving consistent with exogenous total government spending's hypothesis. There are no major changes in economy's total investment that decreases at nearly rate (-1.4%) as compare to simulation 1, due to decreases previously highlighted in households' savings (-6.5% for non-farmers, -4.9% for farmers) and in firms' savings (-62%). Nonetheless, the decrease in firms' savings was less than in simulation 1 (-62% versus -72%). Investments in agricultural goods increase at nearly rate as for simulation 1 (+5.6%) due to decreases in final consumption prices of agricultural goods. The cut observed in investment of manufactured goods was less than in simulation 1's scenario (-2.6% versus -3%), and investment in services always keeps its trend (-13.5%). Next, domestic absorption of agricultural goods increases this time due to a combined increasing effect in the sector's investment with a much higher increase in the consumption of farmers households (+1.4% versus +1.2% in simulation 1). Consumption of non-farmers still decreases but at a much lower rate (-0.02% versus -0.4% in simulation 1). Domestic absorption of private services still increases as in simulation 1 (+3.4%). In this simulation, industry sector and public services continue to suffer from the reform. The absorption of industrial goods still decreases by (-2.6%) less than in simulation 1 (-3.3%). For public services, their domestic absorption decreases by (-1.8%). The increases in absorption of agricultural goods and private services are drained by increases in their domestic demand

(+0.5% and +2%) respectively. Domestic demand of industrial goods decreases (-1.7%) but less than in simulation 1 (-3.5%). Finally, production increases in both agricultural sector and private services sector. Production in agricultural sector increases more than in simulation 1 (1% versus 0.4%), and production in private services by (+0.3%). Production still remains lower in the industry sector (-0.8% versus -3.1% in simulation 1) and in public services, due to decreases in domestic demand of these goods. Hence, value added increases in agricultural sector and private services sector. They continue to attract workers from the industry and public services sector and the decrease in wages is much lower (-8% versus -10%). As labor becomes much higher in value added than capital, this puts capital remunerations much lower in all sectors (-6% in agricultural sector, -10% in the industry sector, -8% in private services and -12.6% in public services). This helps understand cuts in households' incomes and in firms' incomes previously outlined. The cut observed in income combined with raises in prices due to VAT (+1.1% in industry, +13.9% in private services, +0.9% in public services), consistently decrease households' final consumption in industrial goods, private and public services (-7.1%, -16.8%, -6.7% for non-farmers); (-5.6%, -15.2%, -5.2% for farmers). These cuts were less pronounced than in simulation 1. Final consumption price of agricultural goods decreases following the reform and explain the increase in farmers consumption of agricultural goods, while the one of non-farmers was price insensitive.

-Implications of compensating a point decrease in trade tax revenue through a point increase in VAT revenue with uniform VAT rate of 18% (simulation 3).

We now start from the standard VAT framework implemented in the country (VAT rate 18%), and we respond to a cut in trade taxes with an increase in VAT revenue. Simulation 3 (table 15) provides the following results: government revenue is fully compensated and even increases more (+12.5%). Such a scenario puts all sectors to VAT contribution at the same 18% level. VAT revenue was brought by all sectors and was much enough to compensate decreases observed in trade taxes. For example, while custom duties decrease by (-13.4%) and export taxes by (-11.8%) in the industry sector, VAT revenue quietly increases by (22.7%) in the sector. At the same time, the increase was by (+81%) in private services sector for an analogously decrease of custom duties of (-19.1%). The contribution requested from the agricultural sector in this scenario, is very huge (+1250%), since this sector was mostly exempted in the initial situation (VAT effective rate of 1.3%). So, government revenue increases a lot. This increase causes a huge increase in government saving (+131%), that resulted in an increase of economy's total investment this time (+4.5%). The increase in total investment ended with an increase in agricultural and industry sectors good investments (+13.1% in agricultural sector; +1.6% in industry sector) where total

investment increased much faster than rises in these sectors good prices. Prices of major goods increase (+2.8% in industry, +23.8% in private services, +4.7% in public services), but prices of private services increase much faster (+23.8%) than the increase in total investment(+4.5%) that conversely leads to a decrease in private services goods' investments (-15.5%).

Concerning demand, domestic absorption of agricultural goods decreases this time (-3.2%) as well as domestic absorption of industrial goods (-3.7%). This is due to the fact that, the increase in investment in these goods was less enough to counteract the fall in final consumption of all households and in all goods, resulting from major rises in good prices. Final consumption of industrial goods decreases by -14.2% for non-farmers, -11.4% for farmers. This drop is -27.6% for non-farmers, -24.7% for farmers in private services, and -15.2%, -12.3% in public services respectively for these two types of households. These cuts in consumption, are more pronounced than in simulation 1 and 2, and even consumption of farmers decreases for the first time in agricultural goods following this simulation (-1.8%). Consumption of non-farmers also decreases in agricultural goods much faster than in previous simulations.

The cut in domestic absorption of agricultural and industry sectors' goods is drained by cuts in domestic demand of these goods (-2.3%; -3.5%), but also cuts in imports of these goods following the reform (-17.7%; -3.8%). Only absorption of private services increases (+7.5%), due to raises in total intermediate demand of these goods (+2.1%), while domestic absorption of public services decreased by (-6.1%).

Production in agricultural, industry, and public services sectors decrease (-1%; -3%; -6%), due to falls in demand of these goods, while production of private services increases (+4.1%). While the fall in agricultural goods production comes from falls in domestic supply of these goods (-2.3%), falls in production of industrial goods are driven both by falls in their domestic supply (-3.5%) and falls in exports of these goods (-2.1%[21]). Further, the increase observed in total production of private services results from increases in domestic supply of these goods rather than in exports (+6% versus -11.2%). The cut in agricultural, industry and public services production can also be explained by falls in producer's price, itself driven by falls in the value added price of these sectors (-18.4%; -20%, -20.3%). These sectors, in order to cope with decreased value- added price, are recruiting fewer and fewer workers and less capital, which lowered wages (-17.3%) very huge than in simulation 1 and 2, and capital remuneration (-19.6% ,-22.6%, -28.2%) also very importantly. Farmers and non-farmers' incomes decrease and much faster than in simulation 1 and 2 (-8.5%; -11.9%).

-Unique VAT rate of 15% simulation results (simulation 4).

We now carried out the coming simulation. Regardless of the decrease in government revenue

[21]Exports of manufactured goods were not sensitive to cut in export tax rates.

following the trade liberalization policy, we just make sure that, the fall in government revenue is exactly compensated by VAT revenue with no extensive possibility for government to reach additional revenue. We ensure that government revenue is kept unchanged following the global reform, by calibrating the uniform rate of VAT that preserves government revenue. As said in above sections, we exogenize VAT revenue to the level that just compensates for government revenue losses, and endogenize VAT rate. The underlined uniform VAT rate found is 15%. We conduct a simulation based on this rate structure. It produces the following results (table 16): government revenue remains unchanged (+0%). In the context where government saving is not affected, economy's total investment decreases by (-7.5%) as a result of cuts in households and firms' savings.

Simulation 4 also leads to decreases in final consumption price of agricultural and industry goods as direct effects (-4.9%; -2.7%) but increases final consumption price of services (+14.9% for private services; +2.3% for public services). For the industry sector's price, this is not surprising since industrial goods bear high effective VAT rate at the initial situation as compare to this simulation scenario, that could explain the decrease this time in industry final consumption prices. But the effective rate of simulation 4 is above the initial situation rate of services that leads to increases in their prices. The decrease in final consumption price of agricultural goods is explained by a more decrease in their composite price due to cut in tariff rates, that was much enough than the increase in VAT rate from a low initial situation level(+1.3%).

The decrease in investment was sufficient to induce a decrease in domestic absorption of agricultural and industrial goods (-1.9%; -2%) also shaped by a combined decrease in domestic demand of these goods and in imports[22]. Note that, cuts in domestic demand of agricultural and industrial goods were however, less than cuts observed in their demand from simulation 3 (-1.3% versus -2.3%; -0.6% versus -3.5%). In the private services sector, we notice an increase in domestic demand of these goods (+3.3%). Indeed, something more important to note is that even if production decreases in agricultural sector, it increases the first time in industry, and also in private services (+0.6%; +1.7%). The increase in production in industry sector is drained by increases in exports (+2.4%) of these goods nor in domestic supply. Exports of these goods were sensitive to cuts in exports tax rates. Conversely, the increase in total production of private services is more guided by increases in domestic supply of these goods (+3.3%) nor in exports. In the agricultural sector, the fall observed in their production is driven by fall in domestic supply of these goods.

Even through consumption prices of agricultural and industry goods decreased as previously highlighted, final consumption of households decreases in both the two goods, because the income effect of the reform was more important than the price effect. Indeed, households' incomes

[22]Imports of these goods were not sensitive to cuts in tariff rates

fell by (-5.9% for farmers and -8.3% for non-farmers), always explained by falls in wages and capital remunerations. The decrease in households' incomes was, however, less important than in simulation 3 (-5.9% versus -8.5%; and -8.3% versus -11.9%).

By far, simulation 4 is based on a strong hypothesis that, government observes the decline in trade taxes before setting up the unique VAT rate that offsets for the observed revenue drop. Government may not have this capability to adapt. So, the best to do, is to start from this reference low rate situation, and to compensate any future drop in trade tax by an equal increase (point for point) in VAT revenue.

-Unique VAT rate of 15% with reduced rate of 5% on agricultural goods (simulation 5).

In simulation 5, we maintain the uniform VAT rate of 15% of simulation 4 but authorize a reduced rate of 5% on agricultural goods. In this simulation, government reacts to a point decrease in trade tax with a point increase in VAT revenue. Results (table 17) are compatible with a revenue neutral VAT-trade tax reform, where a point decrease in trade tax is offset by a point increase in VAT revenue. The price of consumption goods drops as in simulation 4 for agricultural and manufactured goods but increases for services. We observe the same trend for investment as in simulation 4 (decreases) which is due to the fall in households and firms' savings. But production increases in the agricultural sector this time (+0.6%) because of decreased production costs in the sector (-9.7%). Production also increases in private services sector (+2.1%). Only the industry sector is negatively impacted by the reform, but the decrease in their production is lower than in simulation 3 (-0.9 versus -3%). Labor demand increases in agricultural (+1.3%) and services (+4%) sectors and is allowed by a shift of workers from industry to the rest of sectors. In addition, consumption of farmers in agricultural goods increases (+0.7%) because the price effect outweighs the income effect (-8.1% versus -6.5%).

-Maintaining unique VAT rate of 15% while exempting the agricultural sector (simulation 6).

This policy orientation is also compatible with revenue. The same argument is maintained: starting from the rate structure of simulation 4, government reacts to a point decrease in trade tax with a point increase in VAT. We have nearly results as in simulation 5 (consumption prices decreased in agricultural and industry sector, and farmers' consumption increases more (+1.8%). Yet, one additional important aspect to note is that, production increases in major sectors including in the industry sector this time (+1.7%; +1.4%; +0.9%). Labor demand also increases in all sectors (+3.5%; +3%; +1.8%), and agricultural sector drives more workers than the rest

of sector (+3.5%). These results are provided in table 18.

7.2 Micro results.

In this section we aim at providing micro results of our simulations (distributional and poverty impact of the reforms). As previously outlined, we carry price and income effects of the reform to household level and analyse poverty and inequality distributions. The poverty line used, is the one defined in the survey which is based on expenditure per capita for that year. It is valuated at 344408 local currency per capita and per year in 2015 which is below the poverty line of the world bank (1.90 dollars per day and per capita).

At the initial situation, poverty incidence (FGT0) is at 64.7%, more pronounced among farmers (83.6%) than non-farmers (58.4%). Poverty gap (FGT1) is at 31.2% also wide between farmers (49.6%) than non-farmers (25.1%). The extreme poverty ratio (FGT2) for the population is close to (18.8%), more pronounced between farmers (33.2%) than non-farmers (13.9%). Poverty conditions are therefore linked to the branch of activity of the household head (farmer versus non-farmer).

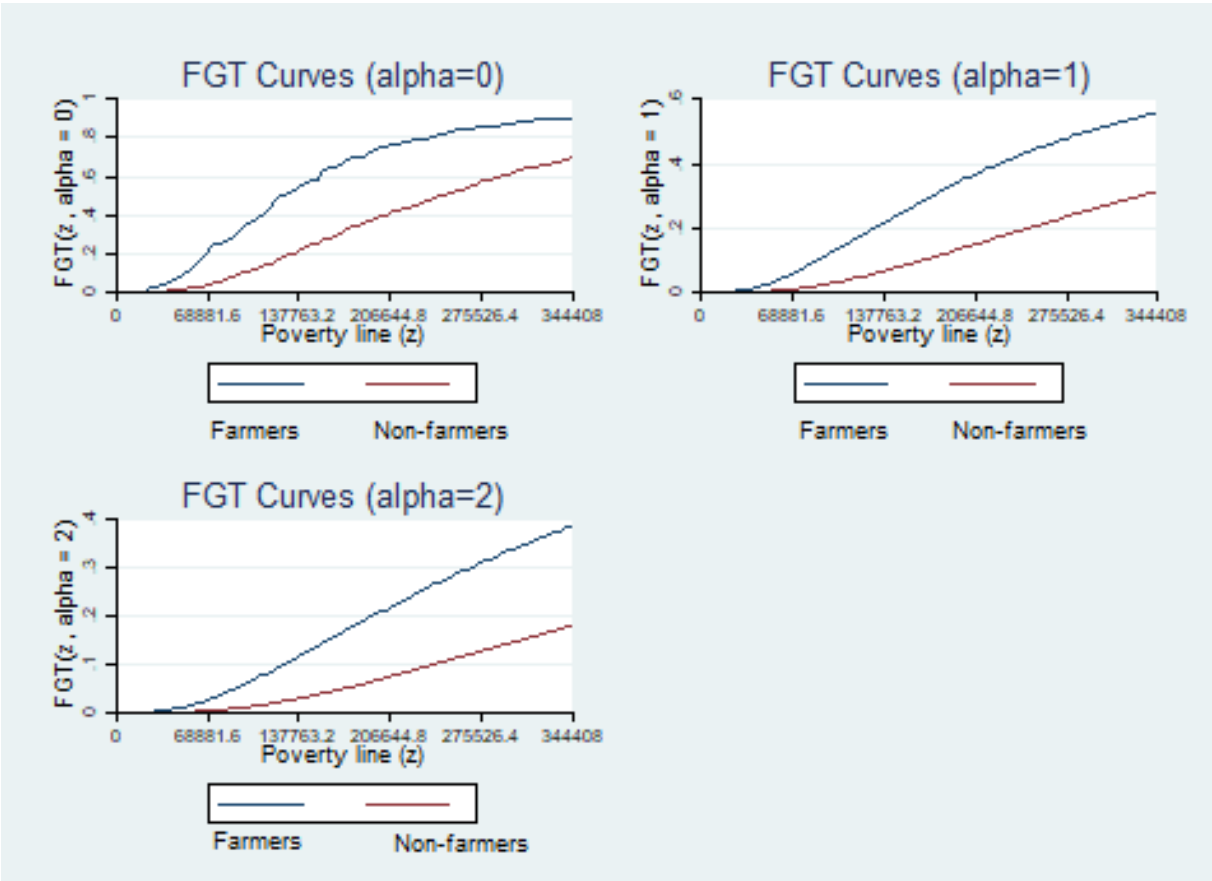
For the inequality measure, the Gini index at the initial situation is 44.6%, more pronounced between non-farmers (42.6%) than between farmers (41.6%).

Table 5 provides summaries of the initial situation poverty and inequality measures.

Table 5: Basic initial situation's indicators (%).

	Population	Farmers	Non-farmers
GINI	44.6	41.6	42.6
Poverty rate	64.7	83.6	58.4
Poverty gap	31.2	49.6	25.1
Extreme poverty	18.8	33.2	13.9

Source :Author with DASP package in Stata.



Source : Author with DASP package in Stata.

We compute new vectors of expenditures at the household level. Since expenditures in the survey are tax included, we compute expenditures excluding tax by the formula:

$$Expenditure\_ext = \frac{Expenditure\_int}{1+t} \tag{3}$$

Where *expenditure_ext* represents expenditure excluding tax, and *expenditure_int*, the one including tax. t is the standard VAT rate at the country level.

We bring the price induced tax changes from simulations, to individual level to compute new patterns of expenditures tax included based on expenditures excluding tax. Note that, in initial situation, prices were initialized to one. Then, it is easy to take the induced new prices originating from tax policy changes, to calculate new vectors of expenditures. We also make sure to bring expenditure effects of the reforms to individual level. It represents such a way to bring both income and price effects of the reform, to household level after the reform, and analyse their social incidence properties.

Table 6 provides results of the concerned reforms. Note that, in all simulations, inequality increased after the reform, as well as poverty parameters. A general constatation is that, uniform VAT rate systems brought smallest increase in inequality than multiple rates, but multiple rate systems increased poverty less fast than uniform rate systems. Nonetheless, result obtained from simulation 3 suggests that, single rate system actually implemented in the country (+18%), serves just to smooth inequalities, but consistently increases all dimensions of poverty in the country at a higher level. Thus, a VAT based tax-tariff reform stationed on this rate structure could not address poverty challenges. It only increases government saving with no gainful impact on poverty. Poverty started by falling from a single rate of 15% (simulation 4) as compare to simulation 3.

In addition, simulation 2 and simulation 6 have interesting rival properties. Admittedly, they increase poverty, but contribute to increase poverty at very nearly rates. If we stick to extreme poverty (distance in poverty), they have equal poverty distribution. But simulation 6, has additional property that, it increases less inequality as compare to simulation 2. Further, we can also note that, simulation 6, has better macro outcomes than simulation 2 in macro-analysis (production increases in major sectors, as well as labor demand, which is not the case in simulation 2 where industry and public services sectors continue to suffer from the reform).

Even though, no reform has contributed to reducing poverty and inequality, the best to do, is to adopt low uniform rate of 15% while exempting agricultural sector from VAT. It is consistent with a revenue neutral VAT-tariff reform, that increases less inequality and spreads less poverty at the country level.

Table 6: Changes across simulations: Total population (percentage points)

	Reference	Sim1	Sim2	Sim3	Sim4	Sim5	Sim6
GINI	44.6(+0%)	+0.54***	+0.54***	+0.45***	+0.5***	+0.5***	+0.5***
Poverty rate	64.7(+0%)	+7.95***	+7.44***	+9.89***	+8.38***	+8.25***	+7.47***
Poverty gap	31.2(+0%)	+6.77***	+6.49***	+8.42***	+7.2***	+7***	+6.5***
Extreme poverty	18.8(+0%)	+5.34***	+5.11***	+6.63***	+5.66***	+5.52***	+5.11***

Source :Author with DASP package in Stata.

An intragroup analysis (table 7 and 8) reveals that, while poverty increases in total population, this masks disparities across households. Poverty rate increases more in the non-farmers' group than in the farmers (8.78 versus 4.45 percentage points increase). The fact that, poverty headcount ratio increases more in non-farmers' group than in farmers is due to a "composition effect in spending". Non-farmers spend more on services items where prices have increased a lot due to VAT raises, than do the farmers which main spendings are based on agricultural goods.[23] So, one could state that the reform was globally painless for the poor (farmers) than for the rich (non-farmers). Yet, despite the fact that distance in poverty increases in the farmers' group (6.11) than in the non-farmers (4.98), this does not put many agricultural households in poverty as compare to non-farmers. For intragroup inequalities, they are also found to be more pronounced within the non-farmers'group than within the farmers. But, as the reform overall increases poverty and inequality in the two groups, we further document this challenge by providing targeted transfers with revenue brought by simulation 6's reform to households in an additional simulation (simulation 7). Targeted transfers are carried out by the tax-benefit literature, as complementary tools to deal with poverty and unequal income distributions (Levine et al., 2009; Decoster et al., 2019).

[23]Farmers spend more on agricultural goods as compare to services, and quietly benefit from exemptions in agricultural products in simulation 6's scenario. We provide in appendix table 19 the composition in spendings.

Table 7: Changes across simulations: Farmers (percentage points)

	Reference	Sim1	Sim2	Sim3	Sim4	Sim5	Sim6
GINI	41.6(+0%)	+0.62***	+0.62***	+0.63***	+0.61***	+0.61***	+0.61***
Poverty rate	83.6(+0%)	+4.96***	+4.28***	+6.16***	+5.3***	+5.3***	+4.45***
Poverty gap	49.6(+0%)	+6.29***	+6***	+7.39***	+6.55***	+6.39***	+6***
Extreme poverty	33.2(+0%)	+6.33***	+6***	+7.42***	+6.58***	+6.43***	+6.11***

Source : Author with DASP package in Stata.

Table 8: Changes across simulations: Non-farmers (percentage points)

	Reference	Sim1	Sim2	Sim3	Sim4	Sim5	Sim6
GINI	42.6(+0%)	+0.65***	+0.65***	+0.66***	+0.64***	+0.65***	+0.64***
Poverty rate	58.4(+0%)	+8.89***	+8.43***	+11***	+9.35***	+9.18***	+8.78***
Poverty gap	25.1(+0%)	+6.84***	+6.54***	+8.67***	+7.32***	+7.13***	+6.74***
Extreme poverty	13.9(+0%)	+5***	+4.83***	+6.41***	+5.41***	+5.27***	+4.98***

Source : Author with DASP package in Stata.

8. Sensitivity analyses.

8.1 Is there any residence place effect, that shapes our results?

We maintain the simulation 6's framework and split households according to their residence place. Poverty and inequality parameters may look differently depending on the residence place of the household head (urban versus rural). For example, while income or expenditure levels

would be higher in urban areas than in rural, the share of in-kind expenditures would also be much larger in rural areas than in urban (Muñoz & Cho, 2003). So, it becomes interesting to look at the incidence profile of the reform in rural versus urban areas. Results are given in table 9 and 10.

We found that, within the group of farmers, poverty and inequality increase more in urban areas than in rural areas. This is an interesting result that can be explained by the following: the main item of expenditure of farmers is agricultural goods, and rural farmers have greater ability to self-consume agricultural goods that escape market considerations, than do the urban ones. This is the plausible explanation to the result we found. But within the non-farmers' group, poverty and inequality are however rural phenomenon. This study finds out heterogeneous residence place effects, depending on (1) the household branch of activity, (2) the expenditure patterns within each group of households (composition effect in spending).

Table 9: Urban versus rural: simulation 6 (percentage points)

	Urban-farmers	Rural-farmers
GINI	39.7 (+0.6***)	39.5(+0.3***)
Poverty rate	82.3 (+7.4***)	89.4 (+3.4***)
Poverty gap	43.5 (+7.9***)	54.6 (+6.1***)
Extreme poverty	27.2 (+7***)	37.3 (+6.3***)

Source: Author with DASP package in Stata.

Table 10: Urban versus rural: simulation 6 (percentage points)

	Urban non-farmers	Rural non-farmers
GINI	41 (+0.5***)	39.7(+0.8***)
Poverty rate	52.4 (+9***)	67.1 (+9.2***)
Poverty gap	20.4 (+6.4***)	35.4 (6.8***)
Extreme poverty	10.6 (+4.3***)	21.7 (+5.2***)

Source : Author with DASP package in Stata.

Note: The first number represents the value of the indicator at the initial situation. The second number is the point increase.

8.2 The role of social transfers in mitigating poverty and inequality.

There is a growing focus in developing countries on the role of social transfers, towards reducing poverty and inequality (Levine et al., 2009; Barrientos, 2012; Ferrarini et al., 2016; Devereux et al., 2017). The tax-benefit literature suggests that government raises taxes and spends more in social programs to straighten the inequality curve after taxation (Immervoll et al., 2006; Immervoll et al., 2007; Decoster et al., 2019). Social transfers have a much stronger redistributive impact than taxes (Wang et al., 2012). Effective social transfers reduce poverty and inequality, and these social effects generate social development in many developing countries (Barrientos, 2012). According to Prasad (2008) inequality can be addressed through a combination of social services and taxation. Brady and Bostic (2015) found that, universal social policies would better reduce poverty and inequality than social policies targeted only on the poor, while Levine et al. (2009), based on Namibia's case, show that targeted social cash transfers have large effects on poverty reduction and that the effects are particularly positive for the poorest of the poor.

This paper provides additional simulation (simulation 7), in the following rationale : one third of the additional revenue generated by the reform is allocated to non-farmers households, and the two-third to farmers households[24]. Table 11 presents results of this policy orientation on poverty and inequality after the reform. We found that, even though poverty and inequality still remain, they decreased in total population and within groups. Inequality in the population decreased by 0.2 points, as compared to simulation 6 (0.5 versus 0.3 percentage points), and extreme poverty decreased by 0.41 points (5.11 versus 4.7 percentage points) with reference to the same simulation. Yet, extreme poverty (distance in poverty) decreased more in farmers' group (6.11 versus 4.8 percentage points) than within the non-farmers (4.98 versus 4.80). Remarquably, there is no more difference in extreme poverty over these two groups (4.8 all over). Nonetheless, results of this study consistently support the fact that, we need sound policy instruments to deal with poverty as a matter of concern at this country level. Improving market conditions, that best boost wages and capital compensations in the reform agenda, would certainly contribute to increase more income and deal with poverty, if also guided by redistributive tools such as transfers at this country level.

[24]This repartition is debatable. But the rationale behind, is to provide transfers on universal basis, with differentiation in amounts, quick to deal both with inequality but also poverty at the same time.

Table 11: Taking into account social transfers: simulation 7 (percentage points)

	Population	Farmers	Non-farmers
GINI	44.6 (+0.3***)	41.6(+0.6***)	42.6(+0.6***)
Poverty rate	64.7 (+7***)	83.6 (+3.2***)	58.4(+8.2***)
Poverty gap	31.2 (+6***)	49.6 (+4.7)	25.1(+6.4***)
Extreme poverty	18.8(+4.7***)	33.2 (+4.8***)	13.9(+4.8***)

Source : Author with DASP package in Stata.

Note: The first number represents the value of the indicator at the initial situation. The second number is the point increase.

Conclusion

This paper addresses the poverty and distributional consequences of VAT based tax-tariff reform (VAT-trade tax reform) for the case of Togo. It is in light with tax policies that overall recommend a revenue replacement strategy of trade taxes with value added tax (VAT). We found that, VAT based tax transition agenda in Togo is globally unfair and poverty increasing. A VAT-tariff reform based on the actual uniform rate of 18% is poverty expanding. A low VAT rate of 15% raises poverty much less than the actual uniform rate, and is also revenue increasing, meaning consistent with a revenue neutral VAT-trade tax reform. Exempting agricultural sector from VAT coverage from the 15%'s rate situation, is also consistent with a revenue neutral reform that has the property to increase less poverty, with superior distributional effect. Nonetheless, the paper found a major interesting result that, according to patterns of spendings, the incidence of poverty is much larger supported by the non-farmers than the farmers, and also that, urban farmers are more affected by the reform than rural farmers. Yet, it also found that, granting transfers to households with revenue brought by the reform proves remarkable poverty reducing effect, but also helps deal with inequality to some extent.

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Appendix 1: CGE: List of equations

A. Production and employment.

i=goods, j=branches, h= households.

1. VA(j)=v(j)*XS(j)

2. CI(j)=io(j)*XS(j)

3. VA(j)= A(j)*$[\beta(j) * KD(j)^{-\rho(j)} + (1 - \beta(j)) * LD(j)^{-\rho(j)}]^{\frac{-1}{\rho(j)}}$

4.$\frac{KD(j)}{LD(j)} = [\frac{W}{R(j)} * \frac{\beta(j)}{1-\beta(j)}]^{\sigma(j)}$

5.$DI(i,j) = aij(i,j) * CI(j)$

6.$DIT(i) = \sum_j DI(i,j)$

B. Incomes and savings.

7.YH(h)=$\lambda^l(h) * \sum_j W * LD(j) + \lambda^k(h) * \sum_j R(j) * KD(j) + DIVE^e(h) + TRH(h) + AUTOE(h) + TGH(h) + TRMH(h) * E$

8.$YDH(h) = YH(h) - TDH(h) - THE(h) - THG(h) - THRM(h) - TVH(h)$

9.$SH(h) = YDH(h) - CTH(h)$

10.$YE = (1 - \sum_h \lambda^k(h) - \lambda^k g) * \sum_j R(j) * KD(j) + TEE + \sum_h THE(h) + TGE + TRME * E$

11.$SE = YE - TDE - \sum_h DIVE^e(h) - TEE - TEG - TERM$

12.$YG = \lambda^k g * \sum_j R(j) * KD(j) + \sum_h TDH(h) + TDE + TDRM * E + \sum_i TI(i) + \sum_i TM(i) + \sum_j TXP(j) + \sum_i TE(i) + TEG + \sum_h THG(h) + TRMG * E$

13.$TDH(h = tyh(h) * YH(h)$

14.$TDE = tye * YE$

15.$TDRM = tyrm * YRM$

16.$TI(i) = tcn(i) * (1 - exon(i)) * [PQ(i) * \sum_h C(i,h) + nass(i) * PQ(i) * DIT(i) + (1 - nass(i)) * exon(i) * PQ(i) * DIT(i) + (1 - nass(i)) * credit(i) * PQ(i) * DIT(i)]$

17.$TM(i) = tmm(i) * PWM(i) * M(i) * E$

18.$TE(i) = tex(i) * PE(i) * EX(i)$

19.$TXP(j) = tx(j) * PP(j) * XS(j)$

20.$SG = YG - TGE - \sum_h TGH(h) - TGRM - G$

21.$YRM = [TERM + \sum_h THRM(h) + TGRM] * \frac{1}{E} + \sum_i PWM(i) * M(i)$

22.$SRM = YRM - [TRME + \sum_h TRMH(h) + TRMG] - \sum_i PWE(i) * EX(i) - TDRM$

C. Expenditures.

23.PC(i)*C(i,h)=PC(i)*Cmin(i,h)+B(i,h)*[CTH(h)-PC(i)*Cmin(i,h)]

24.CTH(h)=PMC(h)*YDH(h)

25.PC(i)*CG(i)=$\alpha(i) * G$

26.$PC(i) * INV(i) = \mu(i) * IT$

D. Prices.

27.PP(j)*XS(j)=PVA(j)*VA(j)+PCI(j)*CI(j)+TXP(j)

28.PVA(j)*VA(j)=W*LD(j)+R(j)*KD(j)

29.PCI(j)*CI(j)=$\sum_i[DI(i,j)*PQ(i)*(1-nass(i))*(1-exon(i))*(1+tcn(i))*credit(i)]+\sum_i[DI(i,j)*PQ(i)*(1-nass(i))*(1-exon(i))*(1-credit(i))]+\sum_i[DI(i,j)*PQ(i)*(1-nass(i))*(1-exon(i))*(1+tcn(i))*exon(i)]+\sum_i[DI(i,j)*PQ(i)*(1-nass(i))*exon(i)]+\sum_i[DI(i,j)*PQ(i)*nass(i)*(1-exon(i))*(1+tcn(i))]+\sum_i[DI(i,j)*PQ(i)*nass(i)]$

30.$PE(i)*(1+tex(i))=PWE(i)*E$

31.$PL(i)*DS(i)=PP(i)*XS(i)-PE(i)*EX(i)$

32.$PD(i)=PL(i)*(1+tx(i))$

33.$PM(i)=PWM(i)*E*(1+tmm(i))$

34.$PQ(i)*Q(i)=PD(i)*DD(i)+PM(i)*M(i)$

35.$PC(i)=PQ(i)*[1+tcn(i)*(1-exon(i))]$

E. International trade.

36.XS(j)=$A^e(j)*[\beta^e(j)*EX(j)^{\rho^e(j)}+(1-\beta^e(j))*DS(j)^{\rho^e(j)}]^{\frac{1}{\rho^e(j)}}$

37.$EX(i)=DS(i)*[\frac{PE(i)}{PL(i)}*\frac{1-\beta^e(i)}{\beta^e(i)}]^{\sigma^e(i)}$

38.$Q(i)=A^m(i)*[\beta^m(i)*M(i)^{-\rho^m(i)}+(1-\beta^m(i))*DD(i)^{-\rho^m(i)}]^{\frac{-1}{\rho^m(i)}}$

39.$M(i)=DD(i)*[\frac{PD(i)}{PM(i)}*\frac{\beta^m(i)}{1-\beta^m(i)}]^{\sigma^m(i)}$

F. Equilibriums.

40.Q(bns)=$\sum_h C(bns,h)+DIT(bns)+INV(bns)+CG(bns)$

41.$LEON=Q(ser)-\sum_h C(ser,h))-DIT(ser)-INV(ser)-CG(ser)$

42.$LS=\sum_j LD(j)$

43.$KS(j)=KD(j)$

44.$DS(i)=DD(i)$

45$EXS(i)=EX(i)$

46.$IT=\sum_h SH(h)+SE+SG+SRM*E$

Appendix 2.

Parametres.

v(j) Leontief coefficient of value added

io(j) Leontief coefficient of intermediate consumption

A(j) CES value added scale parameter

$\beta(j)$ CES value added distribution parameter

$\rho(j)$ Exponent of the CES value added function

$\sigma(j)$ Elasticity of substitution of the CES value added function

aij(i,j) Technical coefficients

$\lambda^l(h)$ Share of total household labor compensation

$\lambda^k(h)$ Share of total household capital compensation

$\lambda^k g$ Share of total government capital compensation

PMC(h) Average household propensity to consume

Cmin(i,h) Incompressible consumption of good i by household h

B(i,h) Marginal propensity to consume good i by household h

$\alpha(i)$ Share of government expenditure allocated to good i

$\mu(i)$ Share of investment of good i in total investment

$A^e(j)$ Scale parameter of the CET transformation function

$\beta^e(j)$ Distribution parameter of the CET transformation function

$\rho^e(j)$ Exponent of the CET transformation function

$\sigma^e(j)$ CET transformation elasticity

$A^m(i)$ CES composite demand function scale parameter

$\beta^m(i)$ Distribution parameter of the CES composite demand function

$\rho^m(i)$ Exponent of the CES composite demand function

$\sigma^m(i)$ Elasticity of substitution of CES composite demand function

tyh(h) Effective personal income tax rate on households

tye Effective corporate income tax rate

tyrm Effective personal income tax rate on the rest of the world

tcn(i) Effective VAT rate on good i

tmm(i) Effective tariff rate on good i

tex(i) Effective export tax rate on good i

tx(j) Effective production tax rate in each branch j

exon(j) Share of exempted goods in each branch j

nass(j) Share of non-liable producers in each branch j

credit(j) Share of non-refunded VAT by tax administration in each branch j.

Endogenous variables.

VA(j) Value added of branch j

XS(j) Total production of branch j

CI(j) Intermediate consumption of branch j

LD(j) Labor demand per branch

KD(j) Capital demand per branch

W Wage rate

R(j) Capital compensation rate per branch

DI(i,j) Intermediate good demand per branch

DIT(i) Total intermediate good demand of product i

YH(h) Household gross income

YDH(h) Household disposable income

SH(h) Household savings

YE Firms gross income

SE Firms savings

YG Government revenue

SG Government savings

SRM Savings of the the rest of the world

TDH(h) Personal income taxes

TDE Corporate income taxes

TDRM Rest of the world income taxes

TI(i) VAT on good i

TM(i) Custom duties on good i

TXP(j) Production taxes in branch j

TE(i) Export taxes on good i

C(i,h) Household consumption on good i

CTH(h) Household total consumption budget

CG(i) Public expenditure on good i

INV(i) Investment in good i

IT Total investment

PP(j) Per-unit cost of production

PVA(j) Value added price

PCI(j) Intermediate consumption price

PL(j) Local producer price in branch j

PE(i) Export price in branch j

DS(i) Domestic supply of good i

EXS(i) Export supply

EX(i) Export demand

PD(i) Domestic price of good i

PQ(i) Composite price of good i

DD(i) Domestic demand of good i

PM(i) Import price of good i

M(i) Import of good i

Q(i) Composite demand of good i

PC(i) Final consumption price of good i

Exogenous variables.

E Nominal exchange rate (numeraire)

LS Total labor supply

KS (j) Capital supply per branch

TRH(h) Received transfers by households

TVH(h) Paid transfers by households

AUTOE(h) Income of self-employment

TGH(h) Transfers of government to households

TRMH(h) Transfers of the rest of the world to households

TEE Between firms transfers

THE(h) Transfers of households to firms

TGE Transfers of government to firms

TRME Transfers of the rest of the world to firms

TEG Transfers of firms to government

THG(h) Transfers of households to government

TRMG Transfers of the rest of the world to government

TERM Transfers of firms to the rest of the world

THRM(h) Transfers of households to the rest of the world

TGRM Transfers of government to the rest of the world

YRM Income of the the rest of the world

G Total government spending

PWE(i) World export price of good i

PWM(i) World import price of good i

Appendix 3. Elasticities (table 12).

Table 12

	Agriculture	Industry	Private services	Public services
σ	0.7	0.9	0.8	0.6
σ^m	1.1	1.3	1.2	0.7
σ^e	1.2	1.1	1.3	0.7

Appendix 4. Simulation results

Table 13

	Sim1 changes in (%)
VA	AGR 0.407, IND -3.187, SER 1.232, PUB -1.516
XS	AGR 0.407, IND -3.187, SER 1.232, PUB -1.516
CI	AGR 0.407, IND -3.187, SER 1.232, PUB -1.516
LD	AGR 0.806, IND -6.302, SER 2.341, PUB -2.068
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000
W	AGR -10.04, IND -10.04, SER -10.04, PUB - 10.04
R	AGR -9.010, IND -16.323, SER -7.407, PUB -13.127
DIT	AGR -1.865, IND -0.754, SER 0.394, PUB 0.480
TI	AGR 10.708, IND 14.485, SER 13.190, PUB 10.884
TM	AGR -16.721, IND -12.966, SER -11.856
TE	AGR -1.306, IND -12.338
TXP	AGR -6.657, IND -3.626, SER 13.460, PUB -2.306
CG	SER -12.429, PUB -0.500
INV	AGR 5.963, IND -3.035, SER -13.722
PP	AGR -7.035, IND -0.454, SER 12.080, PUB -0.80
PVA	AGR -9.537, IND -13.257, SER -8.813, PUB -10.886
PCI	AGR 5.631, IND 3.153, SER 24.634, PUB 21.325
PL	AGR -7.484, IND -0.807, SER 13.562, PUB -0.807
PE	AGR 0.028, IND 0.051
DS	AGR -0.173, IND -3.565, SER 2.975, PUB -1.520
EX	AGR 9.630, IND -2.647, SER -12.717, PUB -0.960
DD	AGR -0.173, IND -3.565, SER 2.975, PUB -1.520
PD	AGR -7.484, IND -0.807, SER 13.562, PUB -0.807
PQ	AGR -7.118, IND -0.950, SER 12.297, PUB -0.803
PM	AGR -0.876, IND -1.021, SER -0.021
M	AGR -7.468, IND -3.295, SER 19.953, PUB -2.062
Q	AGR -0.605, IND -3.384, SER 4.368, PUB -1.522
PC	AGR -7.020, IND 1.608, SER 14.194, PUB 0.502
YH	Non-farmers -6.975, Farmers -5.047
YDH	Non-farmers -7.460, Farmers -5.650
SH	Non-farmers -7.460, Farmers -5.650
TDH	Non-farmers -6.975, Farmers -5.047
CTH	Non-farmers -7.460, Farmers -5.650
C (Non-farmers)	AGR -0.418 IND -8.328 SER -17.680 PUB -7.175
C (Farmers)	AGR 1.192 IND -6.729 SER -15.939 PUB -5.535
YE -5.664	SE -72.083 YG 1.935 TDE -5.664 TDRM 1.7E-14
SG 19.704	SRM 15.384 IT -1.476

Table 14

	Sim2 changes in (%)
VA	AGR 0.979, IND -0.809, SER 0.392, PUB -1.829
XS	AGR 0.979, IND -0.809, SER 0.392, PUB -1.829
CI	AGR 0.979, IND -0.809, SER 0.392, PUB -1.829
LD	AGR 1.944, IND -1.622, SER 0.742, PUB -2.492
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000
W	AGR -8.902, IND -8.902, SER -8.902, PUB -8.902
R	AGR -6.361, IND -10.542, SER -8.055, PUB -12.654
DIT	AGR -0.362, IND -0.221, SER 0.057, PUB -0.075
TI	AGR -100.000, IND 14.919, SER 14.306, PUB 11.840
TM	AGR -15.060, IND -12.811, SER -11.858
TE	AGR -2.063, IND -9.448
TXP	AGR -5.073, IND -1.990, SER 12.313, PUB -2.182
CG	SER -12.268, PUB -0.942
INV	AGR 5.459, IND -2.609, SER -13.548
PP	AGR -5.994, IND -1.190, SER 11.874, PUB -0.359
PVA	AGR -7.655, IND -9.730, SER -8.504, PUB -9.925
PCI	AGR 2.423, IND 1.216, SER 24.119, PUB 20.630
PL	AGR -6.373, IND -2.067, SER 13.333, PUB -0.362
PE	AGR 0.028, IND 0.051
DS	AGR 0.490, IND -1.776, SER 2.097, PUB -1.830
EX	AGR 8.789, IND 0.562, SER -13.233, PUB -1.581
DD	AGR 0.490, IND -1.776, SER 2.097, PUB -1.830
PD	AGR -6.373, IND -2.067, SER 13.333, PUB -0.36
PQ	AGR -6.067, IND -1.367, SER 12.091, PUB -0.360
PM	AGR -0.876, IND -1.021, SER -0.021
M	AGR -5.622, IND -3.124, SER 18.642, PUB -2.064
Q	AGR 0.130, IND -2.681, SER 3.456, PUB -1.831
PC	AGR -6.560, IND 1.181, SER 13.983, PUB 0.951
YH	Non-farmers -6.158, Farmers -4.392
YDH	Non-farmers -6.586, Farmers -4.917
SH	Non-farmers -6.586, Farmers -4.917
TDH	Non-farmers -6.158, Farmers -4.392
CTH	Non-farmers -6.586, Farmers -4.917
C (Non-farmers)	AGR -0.025 IND -7.162 SER -16.826 PUB -6.762
C (Farmers)	AGR 1.421 IND -5.677 SER -15.210 PUB -5.256
YE -4.896	SE -62.316 YG 1.960 TDE -4.896 TDRM 1.7E-14
SG 22.112	SRM 11.068 IT -1.459

Table 15

	Sim3 changes in (%)
VA	AGR -0.997, IND -2.932, SER 4.138, PUB -6.059
XS	AGR -0.997, IND -2.932, SER 4.138, PUB -6.059
CI	AGR -0.997, IND -2.932, SER 4.138, PUB -6.059
LD	AGR -1.953, IND -5.807, SER 7.994, PUB -8.150
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000
W	AGR -17.317, IND -17.317, SER -17.317, PUB -17.317
R	AGR -19.615, IND -22.634, SER -8.974, PUB -28.240
DIT	AGR -1.689, IND 0.427, SER 2.193, PUB 1.655
TI	AGR 1250.920, IND 22.777, SER 81.280, PUB 121.810
TM	AGR -25.949, IND -13.441, SER -19.120
TE	AGR 7.198, IND -11.847
TXP	AGR -15.091, IND -3.632, SER 17.731, PUB -11.777
CG	SER -19.270, PUB -4.558
INV	AGR 13.103, IND 1.668, SER -15.568
PP	AGR -14.236, IND -0.721, SER 13.053, PUB -6.087
PVA	AGR -18.456, IND -20.033, SER -13.473, PUB -20.362
PCI	AGR 7.136, IND 4.720, SER 28.991, PUB 25.235
PL	AGR -15.192, IND -1.264, SER 14.645, PUB -6.123
PE	AGR 0.028, IND 0.051
DS	AGR -2.320, IND -3.516, SER 6.049, PUB -6.084
EX	AGR 19.076, IND -2.102, SER -11.214, PUB -1.837
DD	AGR -2.320, IND -3.516, SER 6.049, PUB -6.084
PD	AGR -15.192, IND -1.264, SER 14.645, PUB -6.123
PQ	AGR -14.435, IND -1.101, SER 13.272, PUB -6.099
PM	AGR -0.876, IND -1.021, SER -0.021
M	AGR -17.721, IND -3.824, SER 24.949, PUB -10.134
Q	AGR -3.270, IND -3.722, SER 7.593, PUB -6.101
PC	AGR -7.531, IND 2.869, SER 23.869, PUB 4.776
YH	Non-farmers -11.983, Farmers -8.557
YDH	Non-farmers-12.816, Farmers -9.579
SH	Non-farmers -12.816, Farmers -9.579
TDH	Non-farmers-11.983, Farmers -8.557
CTH	Non-farmers-12.816, Farmers -9.579
C (Non-farmers)	AGR -5.052 IND -14.228 SER -27.613 PUB -15.206
C (Farmers)	AGR -1.792 IND -11.400 SER -24.769 PUB -12.389
YE -9.543	SE -121.456 YG 12.542 TDE -9.543 TDRM 1.7E-14
SG 131.136	SRM 11.648 IT 4.585

Table 16

	Sim4 changes in (%)			
VA	AGR -0.472, IND 0.643, SER 1.756, PUB -3.454			
XS	AGR -0.472, IND 0.643, SER 1.756, PUB -3.454			
CI	AGR -0.472, IND 0.643, SER 1.756, PUB -3.454			
LD	AGR -0.929, IND 1.300, SER 3.348, PUB -4.683			
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000			
W	AGR -12.043 , IND -12.043 , SER -12.043 , PUB -12.043			
R	AGR -13.208, IND -10.772, SER -8.347, PUB -18.800			
DIT	AGR 0.462, IND 0.873, SER 1.099, PUB 0.602			
TI	AGR 903.950, IND -11.916, SER 34.912, PUB 67.464			
TM	AGR -20.499, IND -12.523, SER -15.215			
TE	AGR 1.366, IND -7.750			
TXP	AGR -10.173, IND -0.919, SER 12.380, PUB -6.761			
CG	SER -13.031, PUB -2.337			
INV	AGR -2.743, IND -4.982, SER -19.608			
PP	AGR -9.747, IND -1.552, SER 10.440, PUB -3.426			
PVA	AGR -12.619, IND -11.405, SER -10.320, PUB -13.902			
PCI	AGR 4.801, IND 1.224, SER 22.915, PUB 19.562			
PL	AGR -10.379, IND -2.688, SER 11.734, PUB -3.446			
PE	AGR 0.028, IND 0.051			
DS	AGR -1.309, IND -0.633, SER 3.308, PUB -3.468			
EX	AGR 12.598, IND 2.448, SER -10.568, PUB -1.069			
DD	AGR -1.309, IND -0.633, SER 3.308, PUB -3.468			
PD	AGR -10.379, IND -2.688, SER 11.734, PUB -3.446			
PQ	AGR -9.862, IND -1.575, SER 10.650, PUB -3.432			
PM	AGR -0.876, IND -1.021, SER -0.021			
M	AGR -11.665, IND -2.803, SER 18.021, PUB -5.794			
Q	AGR -1.932, IND -2.091, SER 4.525, PUB -3.47			
PC	AGR -4.955, IND -2.715, SER 14.984, PUB 2.393			
YH	Non-farmers-8.343, Farmers -5.984			
YDH	Non-farmers -8.923, Farmers -6.699			
SH	Non-farmers -8.923, Farmers -6.699			
TDH	Non-farmers -8.343, Farmers -5.984			
CTH	Non-farmers -8.923, Farmers -6.699			
C (Non-farmers)	AGR -3.690	IND -5.954	SER -19.385	PUB -10.009
C (Farmers)	AGR -1.484	IND -3.858	SER -17.297	PUB -8.029
YE -6.688	SE -85.121	TDE -6.688	TDRM 1.7E-14	SG 0.000
SRM 4.917	IT -7.562			

Table 17

	Sim5 changes in (%)
VA	AGR 0.661, IND -0.911, SER 2.107, PUB -5.050
XS	AGR 0.661, IND -0.911, SER 2.107, PUB -5.050
CI	AGR 0.661, IND -0.911, SER 2.107, PUB -5.050
LD	AGR 1.310, IND -1.824, SER 4.025, PUB -6.814
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000
W	AGR -13.490 , IND -13.490 , SER -13.490 , PUB -13.490
R	AGR -11.867, IND -15.242, SER -9.117, PUB -23.090
DIT	AGR -0.351, IND 0.356, SER 1.051, PUB 0.518
TI	AGR 306.060, IND 4.206, SER 57.794, PUB 94.938
TM	AGR -19.570, IND -12.948, SER -17.068
TE	AGR 2.493, IND -9.523
TXP	AGR -9.129, IND -2.108, SER 14.127, PUB -9.003
CG	SER -16.067, PUB -3.872
INV	AGR 6.478, IND -2.016, SER -17.924
PP	AGR -9.726, IND -1.208, SER 11.772, PUB -4.16
PVA	AGR -12.693, IND -14.376, SER -11.455, PUB -16.152
PCI	AGR 5.298, IND 2.502, SER 25.728, PUB 22.146
PL	AGR -10.357, IND -2.097, SER 13.219, PUB -4.187
PE	AGR 0.028, IND 0.051
DS	AGR -0.183, IND -1.891, SER 3.829, PUB -5.067
EX	AGR 13.849, IND 0.479, SER -11.647, PUB -2.182
DD	AGR -0.183, IND -1.891, SER 3.829, PUB -5.067
PD	AGR -10.357, IND -2.097, SER 13.219, PUB -4.187
PQ	AGR -9.841, IND -1.377, SER 11.988, PUB -4.170
PM	AGR -0.876, IND -1.021, SER -0.021
M	AGR -10.633, IND -3.276, SER 20.509, PUB -7.854
Q	AGR -0.811, IND -2.821, SER 5.199, PUB -5.079
PC	AGR -8.162, IND -0.201, SER 19.143, PUB 4.027
YH	Non-farmers -9.303, Farmers -6.551
YDH	Non-farmers -9.949, Farmers -7.334
SH	Non-farmers -9.949, Farmers -7.334
TDH	Non-farmers -9.303, Farmers -6.551
CTH	Non-farmers -9.949, Farmers -7.334
C (Non-farmers)	AGR -1.720 IND -9.115 SER -22.767 PUB -12.168
C (Farmers)	AGR 0.729 IND -6.733 SER -20.384 PUB -9.876
YE -7.257	SE -92.365 YG 3.921 TDE -7.257 TDRM 1.7E-14
SG 53.678	SRM 8.868 IT -2.213.

Table 18

	Sim6 changes in (%)
VA	AGR 1.754, IND 1.491, SER 0.955, PUB -5.507
XS	AGR 1.754, IND 1.491, SER 0.955, PUB -5.507
CI	AGR 1.754, IND 1.491, SER 0.955, PUB -5.507
LD	AGR 3.502, IND 3.027, SER 1.812, PUB -7.420
KD	AGR 0.000, IND 0.000, SER 0.000, PUB 0.000
W	AGR -11.985, IND -11.985, SER -11.985 , PUB -11.985
R	AGR -7.549, IND -9.020, SER -9.987, PUB -22.597
DIT	AGR 1.208, IND 0.752, SER 0.482, PUB -0.274
TI	AGR -100.000, IND 4.636, SER 59.739, PUB 97.227
TM	AGR -16.569, IND -12.794, SER -17.085
TE	AGR 1.113, IND -6.592
TXP	AGR -6.259, IND -0.456, SER 12.691, PUB -8.848
CG	SER -15.957, PUB -4.498
INV	AGR 6.719, IND -1.694, SER -17.889
PP	AGR -7.875, IND -1.918, SER 11.626, PUB -3.536
PVA	AGR -9.817, IND -10.504, SER -11.050, PUB -14.934
PCI	AGR 1.960, IND 0.501, SER 25.250, PUB 21.477
PL	AGR -8.380, IND -3.318, SER 13.056, PUB -3.556
PE	AGR 0.028, IND 0.051
DS	AGR 1.086, IND -0.101, SER 2.640, PUB -5.521
EX	AGR 12.316, IND 3.734, SER -12.495, PUB -3.095
DD	AGR 1.086, IND -0.101, SER 2.640, PUB -5.521
PD	AGR -8.380, IND -3.318, SER 13.056, PUB -3.556
PQ	AGR -7.966, IND -1.786, SER 11.841, PUB -3.54
PM	AGR -0.876, IND -1.021, SER -0.021
M	AGR -7.299, IND -3.105, SER 18.923, PUB -7.872
Q	AGR 0.587, IND -2.122, SER 3.979, PUB -5.530
PC	AGR -8.450, IND -0.615, SER 18.987, PUB 4.709
YH	Non-farmers -8.221, Farmers -5.663
YDH	Non-farmers -8.793, Farmers -6.340
SH	Non-farmers -8.793, Farmers -6.340
TDH	Non-farmers -8.221, Farmers -5.663
CTH	Non-farmers -8.793, Farmers -6.340
C (Non-farmers)	AGR -0.331 IND -7.678 SER -21.768 PUB -11.678
C (Farmers)	AGR 1.863 IND -5.427 SER -19.524 PUB -9.542
YE -6.205	SE -78.973 YG 3.226 TDE -6.205 TDRM 1.7E-14
SG 50.827	SRM 4.920 IT -2.298

Appendix 5. Microsimulation equation.

PC(i)*C(i,h)=PC(i)*Cmin(i,h)+B(i,h)*[CTH(h)-PC(i)*Cmin(i,h)].

PC(i) Final consumption price of good i

C(i,h) Household consumption on good i

Cmin(i,h) Incompressible consumption of good i by household h

B(i,h) Marginal propensity to consume good i by household h

CTH(h) Household total consumption budget

Appendix 6. Structure of expenditures (% total expenditure, table 19).

Table 19

	Agriculture	Industry	Private services	Public services
Population	31.3%	29.3%	32.9%	6.5%
Farmers	35.7%	26.1%	29.7%	8.5%
Non-farmers	30.6%	29.8%	33.5%	6.1%

Appendix 7. Structure of expenditures rural-urban (% total expenditure, table 20)

Table 20

	Agriculture	Industry	Private services	Public services
Rural farmers	36.6%	25.8%	28.6%	9%
Urban farmers	39.4%	25%	29.3%	6.3%
Rural non-farmers	34.5%	26.5%	31%	8%
Urban non-farmers	29.5%	30.3%	34%	6.2%