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POVERTY, INEQUALITY AND WELFARE EFFECTS OF TRADE LIBERALIZATION IN CÔTE D'IVOIRE: A COMPUTABLE GENERAL EQUILIBRIUM MODEL ANALYSIS

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Poverty, inequality and welfare effects of trade liberalization in Côte d'Ivoire: A computable general equilibrium model analysis

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Abstract

This paper attempts to quantify the effects of removing trade taxes and instituting some necessary fiscal reform on poverty and income distribution in Côte d'Ivoire. It first analyses income distribution for various homogenous socioeconomic groups using an absolute poverty line based on the constant basic needs approach. Next it simulates and analyses in a computable general equilibrium (CGE) model the impact on poverty, inequality and welfare of the elimination of taxes on agricultural exports and imports combined with a change in the domestic tax rate. The results show that poverty increases for all households, but depending on the simulations the situation is diversified among socioeconomic groups. Liberalizing trade by removing tax on exports leads to an increase in domestic prices of agricultural and industrial goods, resulting in an increase in the consumer price index and a decrease in households' disposable income and thus in their consumption. Public employees are identified as the most affected by poverty following trade tax reform.

JEL classification: C68; F15; I31; I32; O15

Keywords: Trade liberalization, Regional integration, Fiscal policy, Poverty, Inequality, Welfare, CGE.

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1. Introduction

At the peak of its relatively long period of growth during 1960–1979, Côte d'Ivoire's GDP grew at an average annual rate of 5.7%. Some observers qualified this period of sustained growth the "Ivorian Miracle". The performance of the economy, based on growth in agricultural exports, led to an increase in the country's revenues then managed by CAISTAB[1] (a public marketing board). By the end of 1979 the growth process slowed due to the decline in the international prices of agricultural products and exacerbated by both the 1973 and 1978 oil crises coupled with the deterioration of terms of trade. Since the early 1980s the macroeconomic situation has worsened, and the emergence of persistent budget deficits has constrained the government's investment in development programmes previously initiated in several sectors.

The economic policy choice during the period 1970–1979 was the diversification and modernization of the agricultural sector in order to diversify the export revenue base. Unfortunately, the end of the decade was marked by economic crisis and more deterioration of the terms of trade. Faced with a persistent decline in the international prices of agricultural products, the government engaged in structural adjustment programmes (SAPs) that lasted throughout the 1980s and were financed by the World Bank (WB) and International Monetary Fund (IMF) in an attempt to restore macroeconomic equilibrium, improve the efficiency of the economy and foster growth. These programmes failed to restore the health of the economy and instead worsened the economic situation of the country.

In the beginning of the 1990s, the international institutions and partners in development suggested the privatization of several public enterprises and a freeze on the public wage bill. In addition, they suggested the liberalization of the agricultural sector, mainly cocoa and coffee, which represented the heart of the country's finances. In the meantime, the CFA franc was devalued by 50% in 1994, followed by the suppression of the CAISTAB in January 1999, just four months before the first coup.

In recent years several studies, including Grootaert (1994, 1995, 1997) have analysed the impact of macroeconomic chocks, as reduction of public expenditures, increase of export taxes and devaluation, on poverty and income distribution in Côte d'Ivoire. To our knowledge this paper is the first to address the impact of trade tax reform on poverty, inequality and welfare in this country since the reform induced by the trade liberalization programme, mainly the reform of CAISTAB and West African Monetary and Economic Union (WAMEU[2]) launched in 1994.

Like those of most developing countries, Côte d'Ivoire's government is tied to custom receipts, which accounted for more than 40% of its total fiscal receipts during the period 1960–1998. Although trade liberalization and regional integration offer economic growth opportunities in the long run, in the short run they will result in a cut in the revenue of the country and worsen an already high budgetary deficit. Furthermore, for Côte d'Ivoire and other WAEMU member countries engaged in this process, the union offers indisputable advantages but insists that these countries adopt a common external tariff (CET) and modify intra-zone custom duties through maximum limit tax rates. For Côte d'Ivoire, the tariff union is realized in the new context known as "Open Regionalism", i.e., a within-zone liberalization along with an absence of protection vis-à-vis third countries[3] (Bergsten, 1997; Srinivasan, 1995).

The importance of custom duties in GDP requires the government to coordinate intra zone and external trade liberalization with domestic fiscal reform by finding receipts to compensate the diminished resources. One of the major instruments for this is domestic taxation within the limit fixed by the zone, as it is no longer possible to manipulate export taxes in the new context. The government can mainly adjust domestic direct and indirect taxes by a uniform increase of existing taxes, or a unique tax rate replacing all existing ones or specific taxes. In a context of reduction of economic growth, because trade liberalization and tax reform will affect income distribution among households, government has to pay careful attention to these changes as they can affect income distribution and poverty. The main focus of this paper is precisely to examine the impact of combined external trade tax and domestic tax reform on poverty and income distribution in Côte d'Ivoire.

Several methodological approaches have been used in the literature to measure the effects of trade liberalization and fiscal reforms on income distribution along with several related criticisms in favour of or against these methods (Gale, Houser and Scholz, 1996). Some authors (Bernheim, 1994; Attanasio and Browning, 1995) focus on lifetime income, an approach that is questioned because of the availability of data, while others use CGE models - which themselves are attacked for their hypotheses on household preference functions and for their aggregative level, which doesn't allow capturing the details of changes in trade and fiscal policy. A third approach uses microsimulations (e.g., Dickert, Houser and Scholz, 1994; Gale, Houser and Scholz, 1996) and completes the previous two, but is also criticized because it doesn't take into account all the interdependencies. Despite these criticisms, several CGE models have been developed during the past ten years to analyse the impacts of structural adjustment programmes on income distribution and poverty. Bourguignon, Branson and de Melo (1989b) have developed a macroeconomic model used by Bourguignon, de Melo and Suwa (1989) to simulate adjustment of two archetype economies (an African low income country and a Latin American intermediate income country).

In developing countries, the works on the effects of tax reform have followed two approaches. First is the CGE approach of Dahl, Devarajan and Wijnberg (1986), Mitra (1992), and Dahl and Mitra (1989), who examine the impacts of macroeconomic tax reform, without sector details. A second, disaggregated, approach is taken by Ahmad and Stern (1987) and Jha and Srinivasan (1989) who make strong macroeconomic hypotheses, mainly on factor price fixity. Combining the two approaches, Delfin and

Mitra (1998) derive macroeconomic and sectoral impacts of trade liberalization in India, with a disaggregation of production. Several other studies illustrate the use of CGE models in developing countries: Benjamin (1996), Rimmer (1995), Dervis, De Melo and Robinson (1982), Sadoulet and de Janvry (1990, 1995), Bourguignon, Branson and de Melo (1989a), and Keuning and Thorbecke (1989).

A project by the Organization for Economic Cooperation and Development (OECD) developed a common CGE model structure that has been applied to various countries to study the impacts of adjustment policies on income distribution (Morrisson, 1991, for Morocco; Meller, 1991, for Chile; Demery and Demery, 1991, for Malaysia). De Janvry et al. (1991) used a CGE model for Ecuador and found that reduction of current expenditures is the main way to restore growth and protect the poor in rural zones. Thorbecke (1991) used a much-disaggregated CGE model to analyse the impacts of stabilization and structural adjustment programmes in Indonesia. Using several scenarios Thorbecke concluded that adjustment programmes lead to restored equilibrium and improved income distribution. Lambert et al. (1991) used this model structure for Côte d'Ivoire and found that reducing public expenditures by cutting wages of employees in public sector reduced inequality but was unable to efficiently reduce poverty. For Côte d'Ivoire an increase of export taxes is regressive in terms of income distribution; only devaluation has reduced both inequality and poverty. Because our main objective in this study is to examine the impact of trade and tax reform on income distribution in Côte d'Ivoire, all the interdependences have to be considered, and that requires a CGE model.

In the next section, we present the methodology of the paper including the various tools used to measure and compare poverty, inequality and welfare. The link between poverty analysis and the CGE model is discussed in Section 3. Section 4 presents the statistical results and Section 5 the simulation results. Finally, the conclusions of the work are given in Section 6.

2. Methodology

Our approach follows the recent method for income distribution analysis in a CGE framework with trade shocks proposed by Decaluwé, Patry, Savard and Thorbecke (1999), Azis and Thorbecke (2001), Thorbecke (2001), and Decaluwé et al. (2005). While these authors use fictive data, here we estimate the distribution function for groups of households using real data from Côte d'Ivoire. First we analyse household survey data and construct an absolute poverty line following Ravallion and Bidani (1994), which then permits us to analyse inequality and poverty. Second, we build a CGE model based on a social accounting matrix (SAM) containing homogeneous socioeconomic groups, in order to perform economic policy simulations (fiscal shocks). Finally, we analyse and compare poverty, inequality and welfare before and after shocks, and measure the progressivity of the new fiscal system emerging from the simulations.

Measuring and comparing poverty profile and income distribution

Before studying poverty and inequality we must define welfare, or standard of living. The living standard for individuals is measured as their level of utility, obtained by maximization of their utility function for a given income and a price system. Given the difficulties for income measurement, surveys in Côte d'Ivoire rely on consumption criteria, and expenditure per capita is therefore retained as a welfare indicator. This method follows the utilitarian paradigm derived from modern microeconomic theory, where welfare is the sum of consumption expenditures on all goods and services. This concept is based on the capacity of individuals to obtain goods, thus on their preferences. The use of per capita consumption allows the identification of several arbitrary poverty lines in Côte d'Ivoire.[4] A concept using the basic needs approach has been proposed by Sen (1976, 1981, 1985, 1987), but the utilitarian view is still the main basic approach in welfare analysis.

Social welfare indexes

To measure social welfare, various indexes are used –Atkinson, S-Gini, Theil–but one of the most used is the Atkinson index (1987), defined by:

$$W = \int_0^1 U(Q(p))\omega(p;\rho)dp \qquad (1)$$

where $\omega(p;\rho)$ is the density of poor and $U(Q(p))$ is the living standards utility function $Q(p)$. The social welfare function is then the expected utility for the poorest individual in a sample of ρ individuals, $1<\rho<2$. In this index, the parameter (indicates the weight given to the gap from the mean of living standards. It is an ethical parameter indicating aversion to inequality.

But equivalent variation (EV) and compensatory variation (CV) are also used to measure social welfare, by comparing the utility of households at price and income in a reference situation to the utility in the new situation (Varian, 1992; Decaluwé et al., 2001). In this study we use equivalent variation (EV) defined as:

$$EV = \left[\frac{P_1^0}{P_1^1}\right]^{\gamma}\left[\frac{P_2^0}{P_2^1}\right]^{1-\gamma} YM_1 - YM_0 \qquad (2)$$

where P_1^0 = price of good 1 at base year (before simulation)
P_1^1 = price of good 1 at year 1 (after simulation)
P_2^0 = price of good 2 at base year (before simulation)
P_2^1 = price of good 2 at year 1 (after simulation)
and: YM_0 = household income at base year (before simulation)
YM_1 = household income at year 1 (after simulation)
If: $EV>0$ = increase in household welfare
$EV<0$ = decrease in household welfare

Inequality indexes

Again, there are several indexes for measuring inequality (Atkinson, S-Gini, generalized entropy). One of the most used is the Gini index, which is the ratio of the difference between the perfect equality line and the Lorenz curve (see Sen, 1997, for presentation). In this study, we use the Gini index, given by:

$$\frac{GINI}{2}\int_0^1 (p - L(p))dp \qquad (3)$$

Poverty indexes

The determination of a poverty line is controversial in studies of income distribution because of its important political implications (Sen, 1976, 1981; Ravallion, 1996). Two approaches are frequently used to determine the poverty line. The first uses the notion of living standard equivalent distributed equally (EDE), while the second combines the living standard and poverty line in a poverty gap. In this study we determine an absolute poverty line following the approach by Ravallion and Bidani (1994). When the poverty line has been determined, several indexes help to characterize poverty (FGT index, Watts's index, and Clark, Hemming and Ulph (CHU) index). The Foster, Greer and Thorbecke (FGT; 1984) approach will be used in this study, as it is a more general index. Given y., the income for individuals of a population, the FGT index is:

$$P(z;\alpha) = \int_0^q g(p,z)^\alpha dp \qquad (4)$$

where $\alpha \geq 0$ (see Ravallion, 1996). When $\alpha = 0$, the FGT index indicates the proportion P_0 of poor. When $\alpha = 1$, the index indicates the poverty gap index, also known as depth or intensity of poverty, i.e., the mean of the gap between poor people's living standard and the poverty line. When $\alpha = 2$ the index is the poverty severity index, which is sensitive to the distribution of living standard among the poor.

Decomposition of inequality and poverty indexes

The FGT indexes are decomposable and thus help in looking at the contributions of different groups of households to overall poverty level. The contribution of each socioeconomic group to overall poverty is given by:

$$C_j = {K_j P_x}/{P_\alpha} \qquad (5)$$

where $P_{x,j}$ is the poverty index for group j and K_j is the proportion of the population in group j. The Atkinson and the generalized entropy inequality indexes are also decomposable in within-group and between-group inequalities. In effect, the knowledge of the groups' contributions in the total index could be useful for formulating more precise economic policy towards vulnerable groups.

Curves and dominance

The study of poverty, inequality and welfare aims at comparing the computed indexes within a time period and between and within the groups of population. Comparisons of inequality and poverty indexes are usually made using dominance curves to see if inequality and poverty in a distribution are more or less than in another distribution (see

Duclos, 1999). These tests are often implemented using several curves to describe living standard distribution. The purpose of dominance curves (quintiles and normalized quintiles, poverty gap, Lorenz curve, concentration curve, CPG curve (cumulative Poverty Gap) is to test the robustness of results with respect to the choice of poverty line. One of the most used is the Lorenz curve, which is expressed as follows:

$$L(p) = \frac{1}{\mu}\int_0^p Q(p)dp \tag{6}$$

where $L(p)$ indicates the cumulated percentage of living standards $Q(p)$ reached by a proportion p of the population. Individuals are ranked in ascending order of living standards; if $L(0.5)=0.3$, it means that 50% of the poorest have reached 30% of the living standard of the population, with μ the mean of living standards, given by:

$$\mu = \int_0^1 Q(p)dp \tag{7}$$

The cumulative distribution curves are used to establish stochastic dominance among distributions and are used in this study.

Distributive effects and progressivity of fiscal system

The fiscal system in a country can be progressive, proportional or regressive. This gives an indication of the concentration of fiscal burden on the subgroups of the population. Two existing ratios are used to measure the progressivity of a fiscal system. First, there is the elasticity of taxes to gross income, which is the ratio of marginal tax to the mean tax rate. A high value of this ratio indicates a high concentration of taxes on the rich. The second ratio, which is used here, is the elasticity of net income to gross income. It is possible to characterize a fiscal system according to its level of progressivity by comparing the elasticity of net income to gross income (see Duclos, 1999, for details of presentation).

Integrating poverty analysis into the CGE model

The CGE model is built to simulate exogenous shocks on poverty, inequality and welfare. But how is poverty analysis incorporated into the CGE model? In the model, the impacts on poverty, inequality and welfare indexes result from the modification in consumer prices of a basket of goods that determines the poverty line. The poverty line is derived endogenously in the model (Decaluwé et al., 2005).

In effect, the modification of the distribution is linked to the variation in the mean income of each household category. A fundamental hypothesis in this model is that the variance in each group is exogenous to the model. Consequently, income distribution moves proportionally to the variation in the mean income, meaning that the increase or decrease in income for a group is identically distributed within the group. The method allows us to catch the inter group inequality but not the intra group one. This is a limitation

of this method, for which Savard (2005) presents an alternative micro simulation approach.

In order to analyse and derive a poverty profile for a group of households, it is useful to incorporate the characteristics of each household into the CGE model. This problem of integrating a poverty dimension into a CGE model has been clarified in the works by Decaluwé, Patry, Savard and Thorbecke (1999), Decaluwé, Martens and Savard (2001), Azis and Thorbecke (2001), Thorbecke (2001), and Decaluwé, Savard and Thorbecke (2005). For this purpose, these previous works estimated the beta distribution for various groups of households:

$$I(y;p,q)=\left[\frac{1}{B(p,q)}\right]\left[\frac{(y-mn)p^{-1}(mx-y)q^{-1}}{(mx-mn)p+q^{-1}}\right] \tag{8}$$

where:

$$B(p,q)=\int_{mn}^{mx}\frac{\left[(y-mn)p^{-1}(mx-y)q^{-1}\right]}{(mx-mn)p+q^{-1}} \tag{9}$$

with parameters *mx* and *mn* representing the maximum and the minimum income within each category of household, and q and p being the parameters of the beta distribution. When q and p are larger than unity, if $q > p$, the distribution becomes skewed to the right. If $q = p$, the function becomes symmetric. The poverty measure can be expressed in term of the beta distribution, giving:

$$P_{\alpha}=\left(\frac{z-y}{z}\right)^{\alpha} I(y,p,q)dy \tag{10}$$

where: P_{α} = FGT index

z = poverty line

y = income

$I(.)$ = beta function

Next Decaluwé, Patry, Savard and Thorbecke (1999) postulated that the poverty line is determined by a basket of goods reflecting the basic needs (BN) consistent with Ravallion and Bidani (1994) approach to estimating absolute poverty. If this basket is denoted by ((comp), it remains invariant from one simulation to another and applies to all households. The monetary poverty line is obtained by multiplying the basic needs commodity basket by their respective prices ($\varpi_{com}{}^{p}$) and aggregating across commodities:

$$Monetary\ poverty\ line = \sum \varpi_{com}^{p} P_{qcom} \tag{11}$$

Since commodity prices are endogenously determined within the model, so is the nominal value of this basket, i.e., the poverty line. If the commodity prices rise following an external shock, the poverty line will increase (shift to the right) and poverty will rise ceteris paribus. The demand system specified in the model is based on the linear expenditure system (LES):

$$C_{h,com} = \frac{Pq_{com}\varpi_{h,com} + \beta^{c}_{h,com}(CH_h - \sum \varpi_{com} Pq_{com})}{Pq_{com}} \qquad (12)$$

where $C_{h,com}$ is the demand for commodity by household group h; $\varpi_{h,com}$ is the basket of committed (minimum) consumption in volume terms for the commodities specific to household group h; Ch is disposable income of household group h; Pq_{com} is the price of a commodity; and $\sum \varpi_{h,com} Pq_{com}$ is the monetary value of the committed (minimum) consumption specific to household group h.

This demand system implies that each socioeconomic group has its own perception of the minimal commodity basket that it needs, consistent with the socioeconomic characteristics and the overall standard of living of the group. In fact, the minimum basket for the high-income socioeconomic group is bound to be different from that of the low-income households. Hence the first term on the right-hand side in the numerator of the equation represents the amount needed to satisfy this household-specific minimum consumption requirement. In turn, the second term in the numerator represents the proportions of marginal expenditure propensities $\beta_{h,com}$ of discretionary income $(CH_h - \sum \varpi_{h,com} Pq_{com})$ to be spent on each respective commodity.

It can be seen that if this last term is zero (i.e., there is no discretionary income), each household group consumes a quantity of each commodity corresponding exactly to its household-specific postulated minimum.

It is essential to clearly understand the distinction between the poverty basic needs basket, which applies to all households - regardless of group membership - and is defined at the level of the society, and the LES demand system, which specifies a group-specific consumption level for each commodity that is intractable downward. Each group is assumed to behave in such a way that it first satisfies its minimum consumption of the respective commodities (Decaluwé et al., 2005).

In this paper, instead of fictitious data as in Decaluwé, Patry, Savard and Thorbecke (1999) we use real data from the Côte d'Ivoire 1998 household survey data (ENV98). The empirical intra group distributions obtained are then used to evaluate the incidence of income distribution for each socioeconomic group in the CGE model. Following a shock on the economy, the intra group distribution will shift accordingly to change the mean income from the modification of the price of the basket of 20 goods reflecting the basic needs.

3. The CGE model for Côte d'Ivoire

The structure of the CGE model largely follows the framework of Decaluwé, Patry, Savard and Thorbecke (1999), and also by Azis and Thorbecke (2001), Thorbecke (2001), and Decaluwé et al. (2005). This model represents a small open economy without influence on international markets (international export and import prices), which are exogenous to the model. The model is described as four-sector model (agriculture, industry, tradeable services, non-tradeable services) with three goods (agriculture, industry, tradeable services) and nine groups of households.

Model parameters

The production of each sector is represented by a Leontief type function (Leontief, 1941, 1953) between the intermediate consumptions (IC) and the value added (VA). While the labour can be mobile between sectors, the capital is considered fixed, due to the short-term horizon. The values added are modelled by constant elasticity of substitution (CES) functions.

The labour market is represented by one type, according to the nine socioeconomic groups. The total supply is given exogenously and full employment is assumed so that total labour supply equates labour demand.

Households take their main resources from the wages paid by the firms and transfers from the government and from the rest of the world (ROW), and a part of capital remuneration. These resources are used to pay the taxes, buy goods and services, and save. The disposable income is obtained by subtracting the direct taxes from their resources. Savings and total consumption represent a fixed proportion of the disposable income. The firms gain their revenues from capital remuneration and from transfers from government and the ROW. Their savings represent their proper funds.

Government consumes non-tradeable services and makes transfers to households, firms and the rest of the world (ROW). Its main income comes from taxation (primarily from taxation on international trade).[5] The difference between government income and its expenditures represents its savings.

The demand system is a linear expenditure system (LES); the consumption function of households is obtained by maximization of utility function. The intermediate demand is the sum of intermediate consumptions of productive sectors. The demand for investment for a good is a fixed part of total investment.

An imperfect substitution between domestic and imported goods is assumed, following the Armington (1969) hypothesis. The current balance (difference between import and export value) represents the savings of the rest of the world (foreign savings).

Equilibrium conditions and closure of the model

Equilibrium conditions are realized on the different markets of employment, capital (between total investment and total saving) and goods (demand and supply of goods).

Tax reforms or liberalization initiatives are often analysed in "revenue neutral" terms so as to ensure that the results are not driven by the induced changes in the level and composition of investment if the experiment produces changes in government saving. In the model we assume that public investment, government saving and foreign savings are fixed. Following trade liberalization, government revenue decreases, resulting in the decrease of government savings as public investment is fixed. For the equilibrium between total investment and total savings to be realized, private investment must decrease and there will then be less supply than demand (excess demand). It follows that the consumer price index increases. Thus, a compensation of government revenue has to be made through domestic taxation to restore government income.

Calibration

The foundation database of the CGE model for income distribution analysis consists of a social accounting matrix (SAM) that includes several socioeconomic groups (see Decaluwe, Patry, Savard and Thorbecke, 1999; Azis and Thorbecke, 2001; Thorbecke, 2001). First we construct an aggregated SAM with one household but several sectors, using the available information in the Côte d'Ivoire 1997 input-output tables (TES: tableau entrees-sorties; TEE: tableau economique d'ensemble; and TOF: tableau des operations financieres). Second, we compute the income of the nine groups by origin from Côte d'Ivoire's 1998 household survey (ENV98). The obtained proportions are imputed in the input-output table (TES) to derive the households' incomes for the SAM. The expenditures for each group are estimated from the 1998 survey in the same way.[6]

The complete SAM includes nine socioeconomic groups and as many activities as in the input-output table of Côte d'Ivoire containing 44 sectors. But in this work, our objective being to describe the impacts on households, we use an aggregated version of the SAM with three tradeable sectors and a non-tradeable sector. The aggregation of the SAM follows Côte d'Ivoire's 1993 national accounts (SCN93) where sectors 1 to 6 are agricultural, sectors 7 to 30 are industrial and sectors 31 to 44 are services. The SAM of this study is provided in Appendix A and includes 26 accounts:

- Factors: Labour and capital.
- Sectors: agriculture, industry, tradeable services, non-tradeable services.
- Domestic goods: Agriculture, industry, tradeable services, non-tradeable services.
- Export goods: Agriculture, industry, tradeable services.

4. Statistical results

This paper is based on two databases. The first one is the household survey ENV98[7] from Institute National de la Statistique (INS, 1998a), including 4,200 households organized in five strata (Abidjan, other cities, East forest, West forest, Savannah). The second database is the SAM including the initial socioeconomic groups reflecting Côte d'Ivoire's economic structure. The full list of equations and their notations is included in Appendix B.

Determination of socioeconomic groups

There are several approaches to determine homogeneous socioeconomic groups. Here, using the hierarchical classification method[8] (statistical criterion; see Anderberg, 1973), we have constructed nine groups of households from Côte d'Ivoire ENV98 individual survey data (see Table 1). These groups have been constructed taking into account weights in the survey.

Table 1: Demographic characteristics

	Hosuseholds		Percentage below the poverty line		Population share (%)	Income share (%)	
Socioeconomic group	Freq.	Perc.	Freq.	Perc.	Cum.		
1 Coffee-cocoa farmers	774	18.43	279	21.53	21.53	19.90	20.20
2 Other export crop farmers	203	4.83	65	5.02	26.54	5.48	3.38
3 Starch farmers	341	8.12	90	6.94	33.49	9.76	7.68
4 Other food crop framers	274	6.52	72	5.56	39.04	8.83	7.40
5 Public employee	216	5.14	77	5.94	44.98	4.39	2.97
6 Private employee (formal & non form)	844	20.10	251	19.37	64.35	15.90	17.42
7 Self-employed	846	20.14	252	19.44	83.80	19.65	20.31
8 Agricultural workers	350	8.33	92	7.10	90.90	8.63	10.89
9 Unemployed & non active	352	8.38	118	9.10	100.00	7.42	9.70
TOTAL	**4200**	**100**	**1296**	**100**			

The results in Table 1 show that the most important household group is the self-employed (formal and non formal), who comprise 20.14% of the population, followed by private employees (20.10%) and coffee and cocoa farmers (18.43%). The smallest groups are other export crop farmers and public employees with only 4.83% and 5.14% of households, respectively. These proportions characterize quite well the socioeconomic structure of Côte d'Ivoire, with a large part of the agricultural (coffee and cocoa farmers) households (37.90%), self-employed and private employees.

In terms of population share, Table 1 indicates that coffee and cocoa farmers are the most important group (19.90%), but this group receives only 20.20% of total income, while the self-employed with 19.65% of the population get 20.31% of total income. Public employees are the smallest group (4.39%) and receive the smallest part of income (2.97%).

Determination of an absolute poverty line

A key point of the paper is the determination of an absolute poverty line following Ravallion and Bidani (1994). Using the ENV98 survey, we choose a basket of 20 goods[9] from the survey[10] among the 37 items available. With the calories of these goods (daily needs fixed at 2,400 calories) and their respective prices (from INS, 2001), we evaluated the food poverty line in Côte d'Ivoire at CFAF292,030.04 per year (US$1.23 per day). Next, taking into account the regional price index (RPI) for the five strata of the ENV98 survey, this poverty line has been evaluated to CFAF288,816.58 per year (US$1.21 per day), which is used in the study. As we use weights in the survey to compute the poverty line, the poverty line is thus measured per adult equivalent.

Poverty and inequality analysis in the base year

For the whole population, we notice that 30.90% of households are consigned to poverty in 1998 (see Table 2). When we examine poverty by socioeconomic group the situation is more contrasted. We find, surprisingly, that with 46.06%, the public employees are the group most likely to be in poverty, followed by coffee and cocoa farmers (P_0=33.96), and private employees (P_0=32.79). Among the agricultural group, food crop farmers (starch and other food crop farmers) are less affected by poverty than others (see Table 2).

The result for public employees is a new phenomenon but consistent with Côte d'Ivoire's economic environment, which copes with declining public expenditure by reducing wages in the public sector. For coffee and cocoa farmers the poverty situation contrasts with their reputation in the economy of this country. This can be due to the drop in international prices of agricultural export products, making this group a vulnerable one as indicated by the highest P_2=9.17 (severity of poverty). Coffee and cocoa farmers, the self-employed, and private employees are the groups contributing the most in global poverty (see Table 2).

For the whole population (see Table 3), the Gini index indicates a high inequality between households (G=0.60). The results by subgroups show that inequality is high in

the unemployed and inactive group, followed by coffee and cocoa farmers. A high inequality also exists in the group of public employees and private employees (where the Gini index is higher than the Gini of the whole population). We observe higher intra group inequalities than inter group inequality for all households (see Table 4).

Table 2: Poverty indexes

Socioeconomic group	P_0	Contribution	P_1	Contribution	P_2	Contribution
1 Coffee-cocoa farmers	33.96	21.87	15.94	25.58	9.17	28.06
2 Other export crop farmers	30.09	5.34	15.12	6.68	9.09	7.66
3 Starch farmers	25.13	7.94	11.84	9.32	6.97	10.45
4 Other food crop framers	22.46	6.42	10.91	7.77	6.42	8.72
5 Public employee	46.06	6.54	13.70	4.85	5.35	3.61
6 Private employee (formal & non formal)	32.79	16.87	11.06	14.19	4.96	12.12
7 Self-employed (formal & non formal)	30.97	19.69	9.98	15.81	4.57	13.81
8 Agricultural workers	27.76	7.75	13.23	9.21	7.29	9.67
9 Unemployed & non active	31.41	7.54	10.95	6.55	5.13	5.85
All observations	**30.90**		**12.40**		**6.50**	

Note: P_0 indicates poverty incidence, P^1 indicates poverty gap and P^2 indicates extreme poverty; poverty is measured per adult equivalent using the weights of the survey.

Table 3: Atkinson indexes, A(e) and Gini

Socioeconomic group	A(0.5)	A(1)	A(2)	Gini
1 Coffee-cocoa farmers	0.4357	0.5742	0.7530	0.6509
2 Other export crop farmers	0.1906	0.3553	0.6055	0.4804
3 Starch farmers	0.1721	0.3435	0.6285	0.4502
4 Other food crop framers	0.1683	0.3352	0.6178	0.4398
5 Public employee	0.3789	0.5273	0.6389	0.6454
6 Private employee (formal & non formal)	0.3229	0.5356	0.7344	0.6259
7 Self-employed (formal & non formal)	0.2897	0.4934	0.7037	0.5964
8 Agricultural workers	0.2462	0.4671	0.7427	0.5421
9 Unemployed & non active	0.4415	0.6092	0.7686	0.6901
All observations				**0.6038**

Note: where $e > 0$ is the inequality aversion parameter.

Table 4: Intra and inter group inequality (generalized entropy, Atkinson)

		Generalized entropy					Atkinson		
		GE(-1)	GE(0)	GE(1)	GE(2)		A(0.5)	A(1)	A(2)
Within-group	GE_W(a)	1.234	0.683	1.040	42.557	A_W(e)	0.316	0.498	0.712
Between-group	GE_B(a)	0.019	0.018	0.017	0.017	A_B(e)	0.008	0.012	0.009
All observations		**1.254**	**0.702**	**1.058**	**42.575**		**0.321**	**0.504**	**0.715**

Notes: where a = income difference sensitivity parameter (Generalized Entropy); where $e > 0$ is the inequality aversion parameter (Atkinson).

5. Policy experiments

Before the common external tariff (CET) of WAEMU, the mean tax rate in Cote d'Ivoire was about 22%. Actually, the custom duties on imports aredecomposable as follows: a uniform custom duty of 5% (except the excluded products); a fiscal duty from 5 to 30%; a statistical tax of 0.5%; a deduction of 0.6% for seaway imports; a deduction of 0.75% on the free on board (FOB) value; the VAT of 20%, based on the CIF value plus the above taxes. Cumulatively, import duties reach 50% of the cost insurance and freight (CIF) value for the imported goods. In the following, we present the effects of the simulations (trade liberalization by removing external trade taxes) on the whole socioeconomic system and how they ultimately affect the household income distribution and poverty based on the poverty and inequality measures. The simulation results are presented in Table 5.

Table 5: Simulation results

Variables	Reference situation	Simulations			
	Sim 1: Te(Agri)=0 Sim 2: Te(Agri)=0 and Tx(TR)*0.20	*Percent change in consumer price*	Sim 3: Te(Agri)=0 and Tm(TR)=0 Sim 4: Te(Agri)=0, Tm(TR) and Tx(TR)*0.20		*Percent change in consumer price*
CPI					
Agriculture	1	1.054	(5.40)	0.984	(-8.60)
Industry	1	1.054	(5.41)	0.9840	(-0.50)
Services	1	1.054	(5.40)	0.984	(-10.2)
Poverty line	288,816.58	304 412.68	(5.40)	284,195.51	(-1.60)

Note: Te(.): taxes on (.) exports; Tm(.): Taxes on (.) imports.

Simulation 1 (elimination of taxes on agricultural exported goods) and simulation 2 (elimination of taxes on agricultural exported goods, combined with an increase of 20% in indirect taxes) lead to an expansion of the agricultural sector and non-tradeable services, while the industrial and service sectors contract. Both agricultural exports and export prices for agricultural goods increase. As the agricultural sector is labour intensive, it results in an increase in the return on labour relative to the return on capital. On the consumption side, there is a decrease for all household categories, which consume fewer agricultural goods and more industrial goods and services, whose relative prices fall. Simulations 3 (elimination of taxes on agricultural exported goods combined with

taxation of 20%) lead to similar results as the first ones in terms of production, households' disposable income and consumption, and exports and imports.

The first simulation, consisting of an elimination of taxes on agricultural exported goods without tax compensation, leads to a 3.8% increase in domestic price of agricultural goods, 5% of industrial goods and 4.4% of services, along with a 5.4% increase in the consumer price index.

The second simulation (the elimination of taxes on agricultural exported goods, combined with an increase of 20% in indirect taxes) leads to the same increase in domestic prices of all goods and services and in the consumer price index.

The third simulation (elimination of taxes on agricultural exported goods combined with elimination of taxes on imported goods) leads to a decrease of 0.5% in the domestic price of industrial goods, a decrease of 8.6% of agricultural goods and 10.2% of services, and a decrease of 1.6% in the consumer price index. The fourth simulation (third simulation combined with indirect taxation of 20%) leads to the same results as simulation 3.

Overall, following the elimination of export taxes, domestic prices of products and the consumer price index rise. Households' disposable income decreases in simulations 1 and 2 and the poverty line rises (see Table 5), while the poverty line decreases slightly in simulations 3 and 4.

The modification of prices of goods induces a change in the poverty line. Following a shock in the CGE model based on a SAM of three aggregate goods, a new poverty line is constructed consistent with the food poverty line computed with 20 disaggregated goods from the survey. (Refer to Appendix C for a description of the derivation of this new poverty line.) In effect, following the elimination of agricultural exports taxes the poverty line increases from CFAF288,816.58 to CFAF304,412.68 in simulation 1 and in simulation 2, but simulations 3 and 4 result in a decrease in the poverty line from CFAF288,816.58 to CFAF284,195.51 (see Table 5).

Poverty and inequality analysis

Using the various poverty lines from the simulations (Table 5), we notice that overall the elimination of agricultural export taxes (simulations 1 and 2) leads to more poor households (1,357) than simulations 3 and 4 (1,168) (see Table 6).

For socioeconomic groups, poverty changes with simulations (see Table 7). It is shown that poverty increases for all socioeconomic groups in simulations 1 and 2, with public employees by 48.66%, private employees by 33.61% and self-employed by 32.64%. In simulations 3 and 4, poverty decreases for all groups, except for other food crop farmers and agricultural workers. Public employees are the most affected by poverty in all cases. The figures in Appendix D present intra group distribution before and after shock for simulations, with vertical bars indicating poverty lines.

The Gini index (Table 8) indicates an increase of inequality from 0.60 to 0.72 for the three simulations. The results by subgroup show that inequality increases for all the socioeconomic groups, but is higher in the coffee and cocoa farmers group followed by the unemployed and nonactive and the public employees groups.

Table 6: Percentage below the poverty line (after shock)

Socioeconomic group	Reference situation			Simulations 1 and 2			Simulations 3 and 4		
	Freq	Perc	Cum	Freq	Perc	Cum	Freq	Perc	Cum
1 Coffee-cocoa farmers	279	21.53	21.53	291	21.44	21.44	251	21.49	21.49
2 Other export crop farmers	65	5.02	26.54	71	5.23	26.68	60	5.14	26.63
3 Starch farmers	90	6.94	33.49	91	6.71	33.38	77	6.59	33.22
4 Other food crop framers	72	5.56	39.04	77	5.67	39.06	60	5.14	38.36
5 Public employee	77	5.94	44.98	82	6.04	45.10	70	5.99	44.35
6 Private employee (formal & non formal)	251	19.37	64.35	259	19.09	64.19	232	19.86	64.21
7 Self-employed (formal & non formal)	252	19.44	83.80	266	19.60	83.79	229	19.61	83.82
8 Agricultural workers	92	7.10	90.90	95	7	90.79	82	7.02	90.84
9 Unemployed & non active	118	9.10	100.00	125	9.21	100	107	9.16	100
TOTAL	**1,296**	**100**		**1,357**	**100**		**1,168**	**100**	

Table 7: Poverty indexes (after shock)

Socioeconomic group	Reference situation			Simulations 1 and 2			Simulations 3 and 4		
	P0	P1	P2	P0	P1	P2	P0	P1	P2
1 Coffee-cocoa farmers	33.96	15.94	9.17	34.84	16.89	9.89	33.48	15.66	8.95
2 Other export crop farmers	30.09	15.12	9.09	34.14	15.94	9.73	29.54	14.88	8.90
3 Starch farmers	25.13	11.84	6.97	25.44	12.53	7.49	24.99	11.62	6.81
4 Other food crop framers	22.46	10.91	6.42	23.67	11.54	6.90	22.46	10.72	6.28
5 Public employee	46.06	13.70	5.35	48.66	15.39	6.27	46.05	13.17	5.08
6 Private employee (formal & non formal)	32.79	11.06	4.96	33.61	12.19	5.62	31.53	10.72	4.76
7 Self-employed (formal & non formal)	30.97	9.98	4.57	32.64	11.09	5.17	29.95	9.65	4.40
8 Agricultural workers	27.76	13.23	7.29	28.39	14.00	7.92	27.76	13.00	7.09
9 Unemployed & non active	31.41	10.95	5.13	32.96	12.05	5.77	29.93	10.63	4.94
All observations	**30.90**	**12.40**	**6.50**	**34.84**	**16.89**	**9.89**	**30.25**	**12.11**	**6.31**

Note: Simulation 1: No export taxes on agricultural products; Simulation 2: No import taxes on agricultural products; Simulation 3: No export taxes on industrial products. Poverty is measured per adult equivalent using the weights of the survey.

We notice here that intra group inequalities are higher than inter group inequality (Table 9). Once again this last result is mitigated, as the methodology does not allow catching intra group inequality (see Decaluwé et al., 2005).

Welfare and fiscal burden analysis

The measure of fiscal burden by the elasticity of net income over gross income for household groups is given in Table 10. It can be see that coffee and cocoa farmers, public employees, and the unemployed and nonactive bear more of the fiscal burden in simulations 1 and 2. Public employees, starch farmers, and coffee and cocoa farmers are those supporting the fiscal burden in simulations 3 and 4. Table 10 also gives equivalent variation (EV) for the various simulations. Simulations 1 and 2 lead to a slight increase in welfare for all households groups except for the self-employed and the unemployed and non active. There is also an increase in welfare in simulations 3 and 4.

Table 10: Welfare and fiscal burden analysis

Socioeconomic group	Equivalent variation (EV)		Fiscal burden	
	Simulations 1 and 2	Simulations 3 and 4	Simulations 1 and 2	Simulations 3 and 4
1 Coffee-cocoa farmers	0.190	0.188	1.002	1.015
2 Other export crop farmers	0.548	0.353	1.000	0.999
3 Starch farmers	0.068	0.046	0.997	1.027
4 Other food crop framers	0.013	0.056	1.001	0.976
5 Public employee	0.026	0.053	1.003	1.045
6 Private employee (formal & non formal)	0.004	0.106	0.995	0.972
7 Self-employed (formal & non formal)	-0.136	0.281	0.998	0.997
8 Agricultural workers	0.006	0.054	0.990	0.892
9 Unemployed & non active	-0.093	0.147	1.004	1.002

Table 8: Atkinson indexes, A(e) and Gini

	Reference situation				Simulations 1 and 2				Simulations 3 and 4			
Socioeconomic group	**A(0.5)**	**A(1)**	**A(2)**	**Gini**	**A(0.5)**	**A(1)**	**A(2)**	**Gini**	**A(0.5)**	**A(1)**	**A(2)**	**Gini**
1 Coffee-cocoa farmers	0.4357	0.5742	0.7530	0.6509	0.7958	0.8521	0.9144	0.8773	0.5824	0.6885	0.819	0.7437
2 Other export crop farmers	0.1906	0.3553	0.6055	0.4804	0.2186	0.3944	0.6416	0.5139	0.1964	0.3635	0.6131	0.4876
3 Starch farmers	0.1721	0.3435	0.6285	0.4502	0.1818	0.3587	0.6438	0.4634	0.1740	0.3466	0.6316	0.4528
4 Other food crop framers	0.1683	0.3352	0.6178	0.4398	0.1769	0.3476	0.6299	0.4507	0.1700	0.3377	0.6202	0.4419
5 Public employee	0.3789	0.5273	0.6389	0.6454	0.5591	0.6722	0.7509	0.7514	0.4247	0.5645	0.6677	0.6722
6 Private employee (formal & non formal)	0.3229	0.5356	0.7344	0.6259	0.3378	0.5481	0.7423	0.6357	0.3259	0.5381	0.7360	0.6278
7 Self-employed (formal & non formal)	0.2897	0.4934	0.7037	0.5964	0.2982	0.5017	0.7096	0.6029	0.2914	0.4950	0.7049	0.5976
8 Agricultural workers	0.2462	0.4671	0.7427	0.5421	0.2538	0.4777	0.7508	0.5508	0.2477	0.4692	0.7443	0.5439
9 Unemployed & non active	0.4415	0.6092	0.7686	0.6901	0.6024	0.7299	0.8408	0.7836	0.4823	0.6402	0.7872	0.7133
All observations				**0.6038**				**0.7259**				**0.6356**

Note: where e > 0 is the inequality aversion parameter.

Table 9: Inequality (generalized entropy; Atkinson)

Generalized entropy	Reference situation				Simulations 1 and 2				Simulations 3 and 4			
	GE(-1)	GE(0)	GE(1)	GE(2)	GE(-1)	GE(0)	GE(1)	GE(2)	GE(-1)	GE(0)	GE(1)	GE(2)
Within-group, GE_W(a)	1.234	0.683	1.040	42.557	1.942	0.954	2.994	903.71	1.382	0.759	1.521	158.50
Between-group, GE_B(a)	0.019	0.018	0.017	0.017	0.116	0.117	0.125	0.142	0.029	0.027	0.026	0.025
All observations	**1.254**	**0.702**	**1.058**	**42.575**	**2.059**	**1.072**	**3.120**	**904.074**	**1.411**	**0.786**	**1.547**	**158.56**
Atkinson	**Reference situation**				**Simulations 1 and 2**				**Simulations 3 and 4**			
	A(0.5)	A(1)	A(2)		A(0.5)	A(1)	A(2)		A(0.5)	A(1)	A(2)	
Within-group, A_W(a)	0.316	0.498	0.712		0.520	0.653	0.802		0.369	0.539	0.735	
Between-group, A_B(a)	0.008	0.012	0.009		0.007	0.012	0.009		0.007	0.012	0.009	
All observations	**0.321**	**0.504**	**0.715**		**0.523**	**0.657**	**0.804**		**0.374**	**0.544**	**0.738**	

Note: Where a = income difference sensitivity parameter; where e > 0 is the inequality aversion parameter.

6. Conclusions

In this work we have tried to quantify the poverty, inequality and welfare impacts of trade liberalization and tax reform in Côte d'Ivoire. The main findings are as follows: From the poverty analysis in the base year we find that for the whole population about 30.90% of households are affected by absolute poverty. But when we consider socioeconomic groups, the poverty situation is diversified among household groups. The most affected by poverty are public employees, followed by coffee and cocoa farmers and private employees. Furthermore, coffee and cocoa farmers, private employees, and the self-employed are those contributing the most in global poverty. While public employees were the group less affected by poverty in previous studies on Côte d'Ivoire, here we find using recent data and alternative methods that this group is actually the poorest. This finding about the mutation of poverty could arise from the recent social and political crises in the country.

For the whole population there is a high level of inequality. The results by subgroup show that inequality is high for all socioeconomic groups, but higher in the coffee and cocoa farmer group followed by the unemployed and nonactive and the public employees groups. We observe that intra group inequality is always higher than inter group inequality.

Using a CGE model, we simulated alternative tax reform policies. Overall, the elimination of agricultural export taxes (simulations 1 and 2) leads to more poor households than in the reference situation. On the other hand, simulations 3 and 4 result in fewer poor than the reference situation. All the simulations confirm that public employees are the most affected by poverty.

Following the policy simulation shocks, inequality rises in the population for the three simulations. Inequality increases for all the socioeconomic groups, but is higher in the coffee and cocoa farmers group, followed by the unemployed and non active and the public employees groups. Within-group inequality is always higher than that between groups because of the method used in this work, and that has to be kept in mind and addressed in further research.

The overall results suggest that poverty is no longer a phenomenon located only among coffee and cocoa farmers and other export crop farmers in Côte d'Ivoire. Even though extreme poverty is more severe in the coffee and cocoa farmers group, making this group more vulnerable than the others, the phenomenon spreads to socioeconomic groups in the modern sector with public employees now most affected. This work offers some insight into the identification of household groups, which should be taken into account in poverty reduction strategy programmes in Côte d'Ivoire in order to alleviate the negative effects of trade liberalization, regional integration and tax reform policies. Particularly, careful attention has to be given to public employees.

Notes

1. Caisse de Stabilisation et de Soutien du Prix des Produits Agricoles.

2. WAEMU is an additional step in the economic integration process of West African countries having the CFA franc as common currency. It includes: Benin, Burkina Faso, Cote d'Ivoire, Guinea Bissau, Mali, Niger, Senegal and Togo. WAEMU replaced the former WAMU, which was created in 1962.

3. The notion of open regionalism tries to reconcile the objectives of a regional union with those of the World Trade Organization (WTO).

4. The DSA (Dimension sociale de l'ajustement) survey (1993) has estimated the 1993's poverty line at CFAF101,340, and 32.3% of the population lived below this line. In 1995, the poverty line was estimated at CFAF144,000, and 36.8% of the population was below this relative poverty line (see INS, 1998b).

5. These taxes (import and export) will be eliminated in the simulation hypotheses.

6. This procedure introduces and insures concordance between the aggregate SAM and the survey data.

7. Enquete sur les Niveaux de Vie, 1998.

8. Which allows us to group observations having a high degree of statistical association between elements of a group and low between members from different groups.

9. 1- rice, 2- maize, 3- milo, 4- fresh cassava, 5- flour cassava, 6- yam, 7- banana plantain, 8- taro, 9- palm nut, 10- groundnuts butter, 11- acraw oignon tomato, 12- fruits, 13- tomato paste, 14- sugar, 15- attieke, 16- pasta, 17- biscuit, 18- fish and shellfish, 19- poultry, 20- cow sheep goat pig.

10. List of 37 foodstuffs from ENV98: 1- rice, 2- maize, 3- milo, 4- fresh cassava, 5- flour cassava, 6- gari and tapioca, 7- other cassava, 8- yam, 9- banana plantain, 10- taro, 11- palm nut, 12- groundnuts butter, 13- other nuts, 14- acraw oignon tomato, 15- palm oil, 16- fruits, 17- viande de brousse, 18- eggs, 19- alcohol drink, 20- sugar, 21- milk product, 22- bread, 23- attieke, 24- pasta, 25- biscuit, 26- fish and shellfish, 27- manufactured oil, 28- poultry, 29- cow sheep goat pig, 30- butter, 31- salt, 32- non alcohol drink, 33- bouillon cube, 34- tomato paste, 35- meal cooked outside, 36- meal consumed outside, 37- other food.

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Appendix A Côte d'Ivoire's social accounting matrix (SAM), 2003

SAM -Côte d'Ivoire - 2003

	Factor		Institutions											
Receipts	**Labour**	**Capital**	**ACC**	**AAPR**	**APF**	**AAPV**	**EPu**	**EPr**	**IND**	**OA**	**CHIN**	**Entrep**	**Gvt**	**ROW**
Expenditures														
1. Labour														
2. Capital														
3. Coffee/cacao farmers	544472	1110854										58678	38515	5816
4. Other export crop farmers	70270	143366										7573	4971	751
5. Starch farmers	64006	130587										6898	4528	684
6. Food crop farmers	64548	131694										6956	4566	689
7. Public employees	114244	233086										12312	8081	1220
8. Private employees (formal & non formal)	259220	528870										27936	18337	2769
9. Self-employed (formal & non formal)	259198	528825										27934	18335	2769
10. Agricultural workers	59025	120426										6361	4175	630
11. Non active & umemployed	128525	262221										13851	9092	1373
12. Firms		1008849											54300	71354
13. Government		228000	45595	6113	10165	9012	19974	58834	28332	9953	31525	374022		84000
14. Rest of the world			61120	8195	13626	12081	26775	78867	37979	13343	42260	308000	30600	
15. Agriculture														
16. Industry														
17. Tradeable services														
18. Non-tradeable services														
19. Dom: Agriculture			265611	35613	59214	52499	116359	342735	165047	57983	183651			
20. Industry			412195	55266	91891	81472	180574	531886	256133	89982	285003			
21. Tradeable services			215889	28947	48128	42674	94577	278579	134150	47128	149273			
22. Non-tradeable services													1153130	
23. Exp: Agriculture														1119920
24. Industry														1498996
25. Tradeable services														313201
26. ACCUMULATION			757925	92797	-16321	10715	-69316	-453769	215420	-27772	-276650	283982	413245	-134271
TOTAL	**s1563508**	**4426778**	**1758335**	**226931**	**206703**	**208453**	**368943**	**837132**	**837061**	**190617**	**415062**	**1134503**	**1761875**	**2969901**

SAM - Cote d'Ivoire - 2003 (contd.)

	Sectors				Domestic market				Export market				
Receipts	**Agri**	**Industry**	**Trad Serv**	**Non Trad Serv**	**Agri**	**Industry**	**Trad Serv**	**Non Trad Serv**	**Agri**	**Industry**	**Trdad Serv**	**ACCUM**	**TOTAL**
Expenditures	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	
1. Labour	112372	657447	309791	483898									1563508
2. Capital	1483939	1767686	809449	365704									4426778
3. Coffee/cacao farmers													1758335
4. Other export crops farmers													226931
5. Starch farmers													206703
6. Food crop farmers													208453
7. Public employees													368943
8. Private employees (formal & non formal)													837132
9. Self-employed (formal & non formal)													837061
10. Agricultural workers													190617
11. Non active & unemployed													415062
12. Firms													1134503
13. Government					7643	550962	19531		260900	17314			1761875
14. Rest of the world					244045	1552055	540955						2969901
15. Agriculture					1575933				859020				2434953
16. Industry						3662600				1481682			5144282
17. Tradeable services							1665970				313201		1979171
18. Non-tradeable services								1153130					1153130
19. Dom: Agriculture	108741	577771	15615									-153218	1827621
20. Industry	566097	1579224	367165	162306								1106423	5765617
21. Tradeable services	163804	562154	477151	141222								-157220	2226456
22. Non-tradeable services													1153130
23. Exp: Agriculture													1119920
24. Industry													1498996
25. Tradeable services													313201
26. ACCUMULATION													795985
TOTAL	**2434953**	**5144282**	**1979171**	**1153130**	**1827621**	**5765617**	**2226456**	**1153130**	**1119920**	**1498996**	**313201**	**795985**	

Appendix B List of equations and notations

Equations

Production

$$XS_j = \min\left[\frac{CI_j}{io_j}, \frac{VA_j}{v_j}\right]$$

$$VA_i = A_{kl,i}\left[\alpha_{kl,i} LD_i^{-\rho_{kl,i}} + (1-\alpha_{kl,i})\overline{KD_i}^{-\rho_{kl,i}}\right]^{-1/\rho_{kl,i}}$$

$$CI_j = io_j XS_j$$

$$DI_{ir,j} = aij_{ir,j} CI_j$$

$$LD_i = \left(\alpha_{kl,i}/(1-\alpha_{kl,i})\right)^{\sigma_{kl,i}} (r_i / w)^{\sigma_{kl,i}} \overline{KD_i}$$

Income and saving

$$YH_h = s\sum_j LD_j + \lambda\sum_j r_j \overline{KD_j} + TG_h + DIV_h + TW_h$$

$$YDH_h = YH_h - TD_h$$

$$SH_h = \eta\psi_h YDH_h$$

$$YF = (1-\lambda)\sum_i r_i \overline{KD_i} + TGF + TWF$$

$$SF = YF - \sum_h DIV_h - DTF - TFW$$

$$YG = \sum_{tr} TIM_{tr} + \sum_{tr} TIE_{tr} + \sum_{id} TI_{tr} + \sum_{h} DTH_{h} + DTF + TWG + \sum_{tr} TIP_{tr}$$
$$+ \lambda_{rg} \sum_{i} r_i \overline{KD_i} + CTC \sum_{tr} (PD_{tr} D_{tr} + PM_{tr} M_{tr})$$

Taxes

$$TI_{tr} = tx_{tr}(P_{tr} XS_{tr} - PE_{tr} EX_{tr}) + \frac{tx_{tr}}{(1 + tx_{tr})} PM_{tr} M$$

$$TIM_{tr} = tm_{tr} \bar{e} PWM_{tr} M_{tr}$$

$$TIE_{tr} = te_{tr} PE_{tr} EX_{tr}$$

$$DTH_h = ty_h YH_h$$

$$DTF = tyf YF$$

Demand

$$CTH_h = YDH_h - SH_h - THW_h$$

$$PC_{tr} C_{tr,h} = PC_{tr} C_{tr,h}^{MIN} + \gamma_{tr,h} \left(CTH_h - \sum_{trj} PC_{trj} C_{trj,h}^{MIN} \right)$$

$$\overline{G} = XS_{ntr} P_{ntr}$$

$$INV_{tr} = \frac{\mu_{tr} IT}{PC_{tr}}$$

$$ITVOL * PINV = IT$$

$$DIT_{tr} = \sum_{j} DI_{tr,j}$$

Prices

$$PV_j = \frac{P_j XS_j - \sum_{tr} PC_{tr} DI_{tr,j}}{VA_j}$$

$$r_i = \frac{PV_i VA_i - sLD_i}{KD_i}$$

$$PD_{tr} = (1 + tx_{tr}) PL_{tr}$$

$$PM_{tr} = (1 + tm_{tr}) ePWM_{tr}$$

$$PE_{tr} = \frac{\bar{e} PWE_{tr}}{(1 + te_{tr})}$$

$$PC_{tr} = \frac{(PD_{tr} D_{tr} + PM_{tr} M_{tr})}{Q_{tr}}$$

$$PX_{tr} = \frac{(PD_{tr} D_{tr} + PE_{tr} EX_{tr})}{XS_{tr}}$$

$$PINV = \sum_{tr} PC_{tr} \mu_{tr} / \mu_{TOT}$$

$$PINDEX = \sum_{j} \delta_j PV_j$$

International trade

$$XS_{tr} = B_{tr}^{E} \left[\beta_{tr}^{E} EX_{tr}^{K_{tr}^{E}} + (1 - \beta_{tr}^{E}) D_{tr}^{K_{tr}^{E}} \right]^{\frac{1}{K_{tr}^{E}}}$$

$$EX_{tr} = \left[\left(\frac{PE_{tr}}{PL_{tr}} \right) \left(\frac{1 - \beta_{tr}^{E}}{\beta_{tr}^{E}} \right) \right]^{\tau_{tr}^{E}} D_{tr}$$

$$Q_{tr} = A_{tr}^{M} \left[\alpha_{tr}^{M} M_{tr}^{-\rho_{tr}^{M}} + (1 - \alpha_{tr}^{M}) D_{tr}^{-\rho_{tr}^{M}} \right]^{\frac{-1}{\rho_{tr}^{M}}}$$

$$\overline{CAB} = \bar{e} \sum_{tr} PWM_{tr} M_{tr} + DIV\_ROW + \sum_{h} TWH_h$$
$$- TWF + TWG - \sum_{h} TW_h - \bar{e} \sum_{tr} PWE_{tr} EX_{tr}$$

$$M_{tr} = \left[\left(\frac{PD_{tr}}{PM_{tr}} \right) \left(\frac{\alpha_{tr}^{E}}{1-\alpha_{tr}^{E}} \right) \right]^{\tau_{tr}^{E}} D_{tr}$$

Equilibrium conditions

$$Q_{GOOD} = DIT_{GOOD} + \sum_{h} C_{GOOD,h} + INV_{GOOD}$$

$$\overline{LS} = \sum_{j} LD_{j}$$

$$T = \sum_{h} SH_{h} + SF + SG + \bar{e} * \overline{CAB}$$

$$EV_{h} = \left(CTH_{h} \sum_{trj} PC_{trj} C_{trj,rj}^{MIN} \right) \prod_{tr} \left[\frac{PCO_{tr}}{PC} \right]^{\gamma_{tr,h}} - \left(CTHQ_{h} - \sum_{trj} PCO_{trj} C_{trj,rj}^{MIN} \right)$$

Notations

Parameters

A_i^{KL}	Scale parameter (CES between capital and labour)
α_i^{KL}	Share parameter (CES between capital and labour)
σ_i^{KL}	Substitution elasticity (CES capital - labour)
ρ_i^{KL}	Substitution parameter (CES capital - labour)
io_i	Coefficient (Leontief total intermediate consumption)
v_i	Coefficient (Leontief value added)
$aij_{tr,j}$	Input-output coefficient
$\gamma_{tr,h}$	Marginal share of tradeable (tr) good in LES consumption function
$YELAS_{tr,h}$	Income elasticity of tradeable (tr) good
V_h^{MIN}	Minimum consumption value (temp variable)
$C_{tr,h}^{MIN}$	Minimum consumption of tradeable (tr) good (LES consumption function)
$FRISCH_h$	Frisch parameter (LES consumption function)
ψ_h	Propensity to save for household h

μ_{tr}	Share of the value of tradeable (tr) good in total investment
λ_h^r	Share of capital income received by household h
λ_f^r	Share of capital income received by firms
λ_{row}	Share of capital income received by foreigners
λ_h^w	Share of labour income received by household h
te_{tr}	Tax on exports on tradeable (tr) good
tm_{tr}	Import duties on tradeable (tr) good
tx_{tr}	Tax rate on tradeable (tr) good
tp_i	Tax rate on production
yh_h	Direct income tax rate for household h
tyf	Direct income tax rate for firms
B_{tr}^e	Scale parameter (CET function)
β_{tr}^e	Share parameter (CET function)
κ_{tr}^e	Transformation parameter (CET function)
τ_{tr}^e	Transformation elasticity (CET function)
A_{tr}^m	Scale parameter (CES function)
ρ_{tr}^m	Substitution parameter (CES function)
α_{tr}^m	Share parameter (CES function)
σ_{tr}^m	Substitution elasticity (CES function)
δ_i	Share of sector I in total value added
δk_i	deltak(I)

Prices

w	Wage rate
r_i	Rate of return to capital in sector TR
P_i	Producer price of good I
PX_i	Producer price of good I including tax
PD_{tr}	Domestic price of tradeable (tr) good including tax

PV_i	Value added price for sector I
PL_{tr}	Domestic price of tradeable (tr) good excluding tax
PC_{tr}	Price of composite tradeable (tr) good
PM_{tr}	Domestic price of imported tradeable (tr) good
PE_{tr}	Domestic price of exported tradeable (tr) good
PWM_{tr}	World price of import tradeable (tr) (foreign currency)
PWE_{tr}	World price of export tradeable (tr) (foreign currency)
$PINDEX$	Producer price index
$PINV$	Price index of investment
e	Exchange rate

Production

XS_i	Production of sector I
VA_i	Value added in sector I (volume)
$DI_{tr,j}$	Intermediate consumption of tradeable (tr) good in sector j
CI_i	Total intermediate consumption of sector I

Factors

KD_i	Tradeable (tr) Sector demand for capital
LD_i	Sector I demand for labour
LS	Total labour supply

Demand

$C_{tr,h}$	Household H consumption of tradeable (tr) good (volume)
CTH_h	Household H total consumption (value)
INV_{tr}	Investment in tradeable (tr) good (volume)
IT	Total investment (value)
$ITVOL$	Total investment (volume)
DIT_{tr}	Intermediate demand for tradeable (tr) good
G	Total public consumption (value)
D_{tr}	Demand for domestic tradeable (tr) good
Q_{tr}	Demand for composite tradeable (tr) good

International trade

M_{tr}	Imports of tradeable (tr) good
EX_{tr}	Exports of tradeable (tr) good
CAB	Current account balance

Income and savings

YH_h	Household h income
YDH_h	Household h disposable income
YF	Firms' income
YG	Government income
SH_h	Household h savings
SF	Firms' savings
SG	Government savings
DIV_h	Dividends paid to capitalist households
DIV_{row}	Dividends paid to foreigners
TWH_h	Transfers of ROW to households
TGF	Transfers of government to firms
TWF	Transfers of ROW to firms
TWG	Transfers of ROW to government
TGW	Transfers of government to ROW
THW_h	Transfers of households to ROW
TG_h	Public transfers to households
TI_{tr}	Receipts from indirect tax
TIP_{tr}	Receipts from tax on production tradeable (tr) sector
TIM_{tr}	Receipts from import duties
TIE_{tr}	Receipts from tax on exports
DTH_h	Receipts from direct taxation on household H income
DTF	Receipts from direct taxation on firms income
η	Adjustment variable for hh savings
adj	Adjustment variable for indirect taxes
EV_h	Equivalent variation for household H

LEON	Walras law verification variable
OMEGA	Objective variable
$trsh_h$	Parameter (saving function exogenous variable)
pms_h	Marginal propensity to save
CTC	Compensatory tax

Appendix C Constructing a new poverty line based on CGE simulations

We illustrate how to derive a new poverty line following a shock in the CGE model, which is based on aggregated goods in the SAM. The poverty analysis is based on a food poverty line computed with disaggregated items goods from the survey.

Suppose that the basic SAM of the CGE model contains 3 goods; meanwhile the poverty analysis has been done using 20 items goods (in our case) from the survey to compute the food poverty line. For each of the 20 goods in the survey, we have the prices per kg and the calories per 100 grams. To deal with this problem we proceed using the following steps. This procedure is easily implemented using Excel software (file available upon request).

Step 1: For each of these 20 goods, we compute corresponding calorific proportions.

Step 2: The calories are scaled to 2,400 (daily needs).

Step 3: The scaled calories multiplied by their corresponding prices gives **values** of calories.

Step 4: The sum of these values is the **official national poverty line**

Step 5: Next the retained 20 goods are grouped into **5 categories** (1- starchy food, 2-other food, 3-food industry, 4-fishing, 5-livestock).

Step 6: For each of the 5 categories, we compute a **mean calorific component**,

Step 7: **A mean value** and

Step 8: A **mean price**. These mean calorific values multiplied by their respective prices sum up to the **national official poverty line**.

Step 9: We compute **new scale parameters** by dividing the mean values by the official poverty line.

Step 10: The obtained **new scale parameters** multiply by the **poverty line** from our empirical analysis in the base year provide 5 **new mean values**, which sum up to the **empirical poverty line** of the base year.

Step 11: The 5 **new mean values** (from step 10) divided by the 5 mean calories obtained before give the **new mean prices** of the 5 goods.

Step 12: Next, the **new mean prices** are scaled to sum up to 100 or 1.

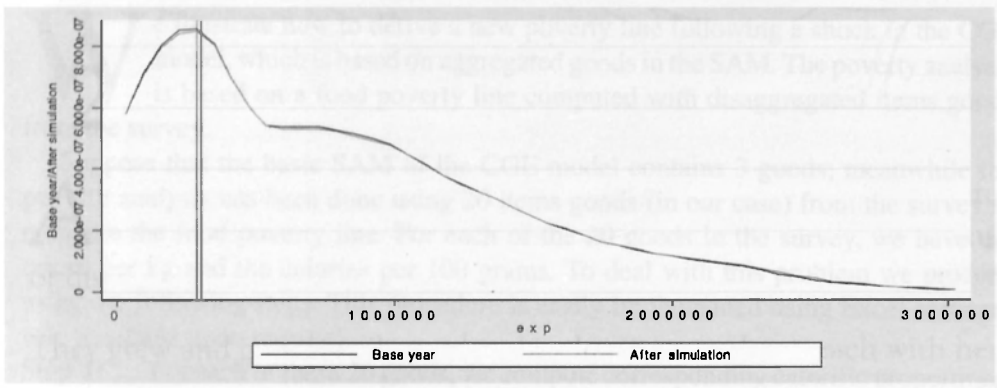
Step 13: As we are mainly interested in the food poverty line, the goods are grouped into 2 categories (1-**agriculture**: 1-feculent, 2-other food, 4-fishing, 5-livestock, and 2-**industry**: 3-food industry).

Step 14: For each of the 2 categories we compute **mean prices**.
Step 15: These 2 mean prices divided by **new mean price** from step 11 give **new scales**.
Step 16: Next we collect the **variations of prices** from the CGE simulations.
Step 17: These **variations of prices** from the CGE model are used for computing the after simulation 2 aggregate **new prices**.
Step 18: The 2 new prices from step 17 divided by the **new scale** from step 15 give 5 **new mean prices**.
Step 19: These last new mean prices multiply by the **mean calories** from step 6 provide **new mean values**.
Step 20: Which sum up to the after simulation **new poverty line**.

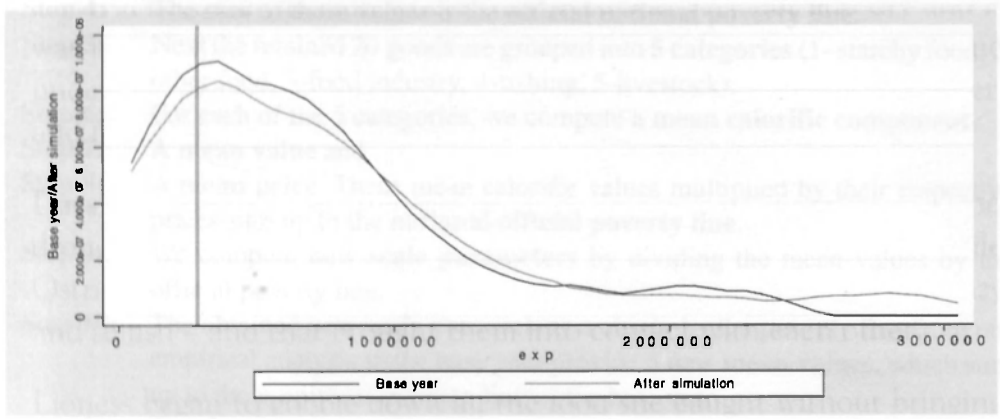
Appendix D Intra group distributions - Four simulations

Figure D1: Intra group distributions (Simulations 1 and 2)

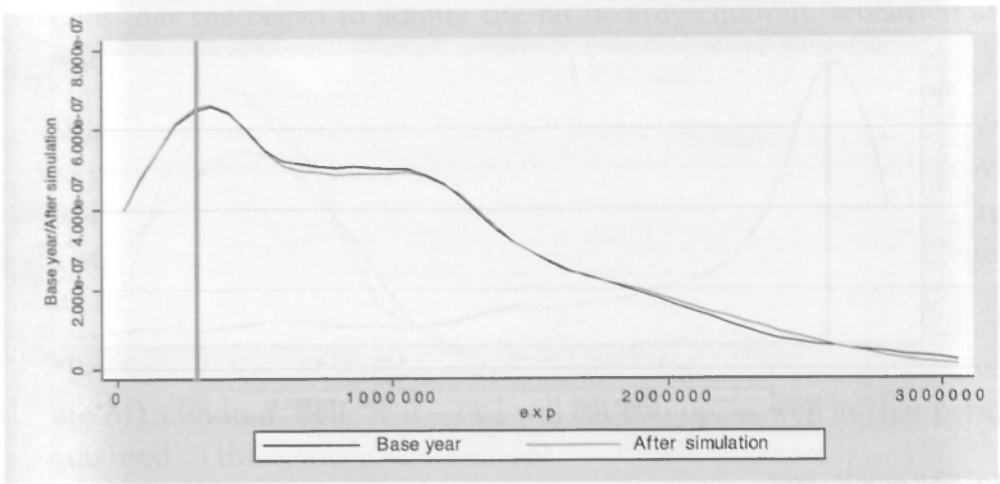
D1a- Coffee and cocoa farmers



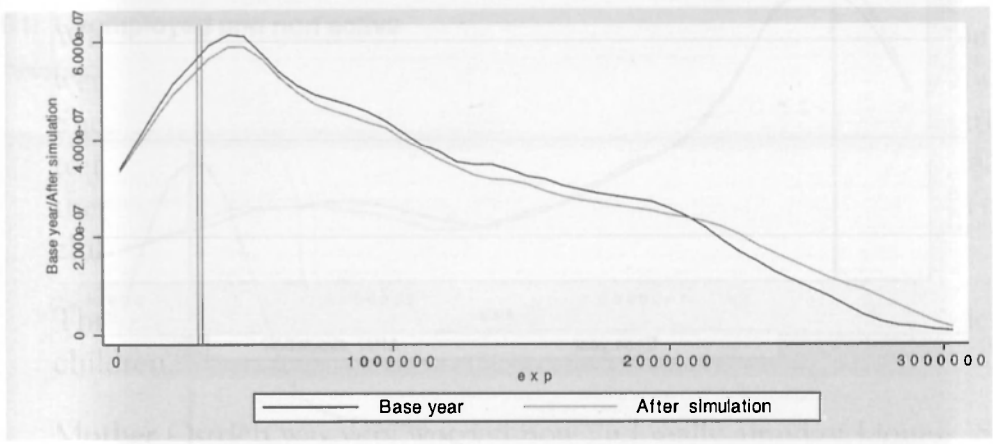
D1b: Other export crop farmers



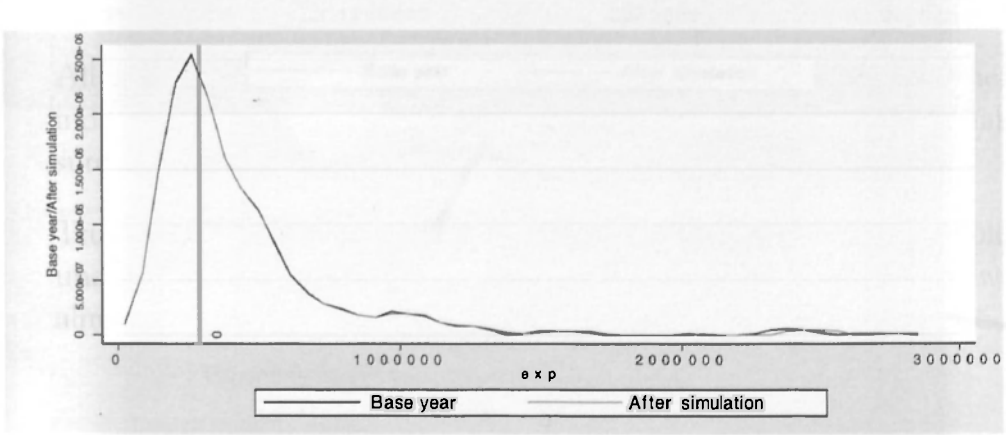
D1c: Starch farmers



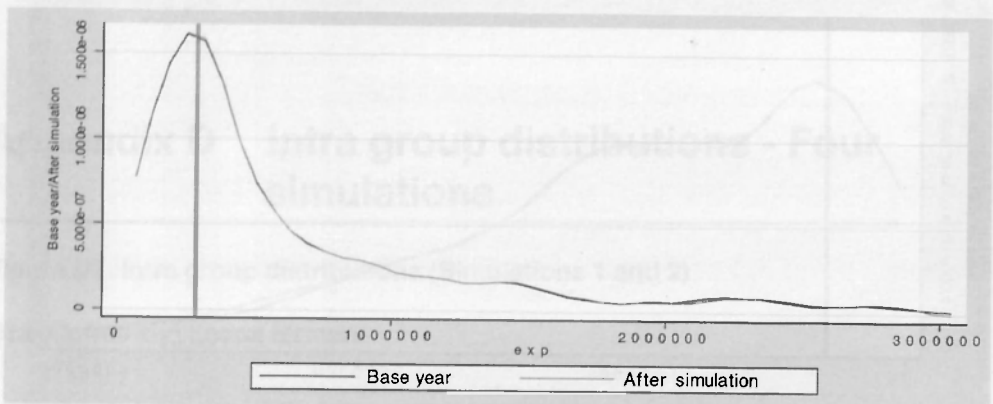
D1d: Other food crop farmers



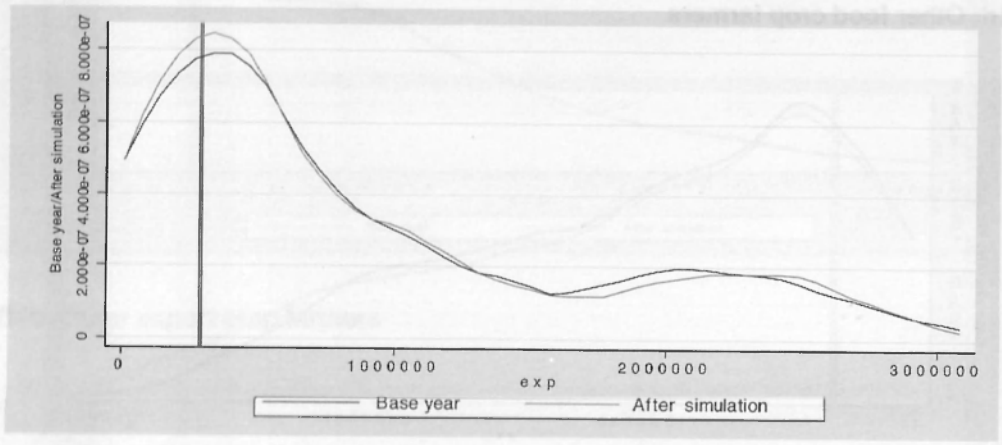
D1e: Public employee



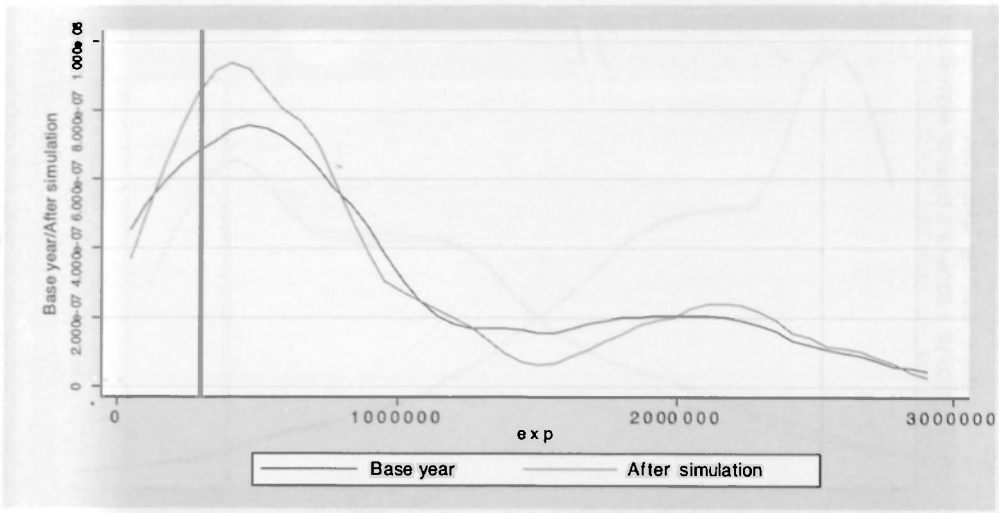
D1f: Private employee



D1g: Self employeed



D1h: Agricultural workers



D1i: Unemployed and non active

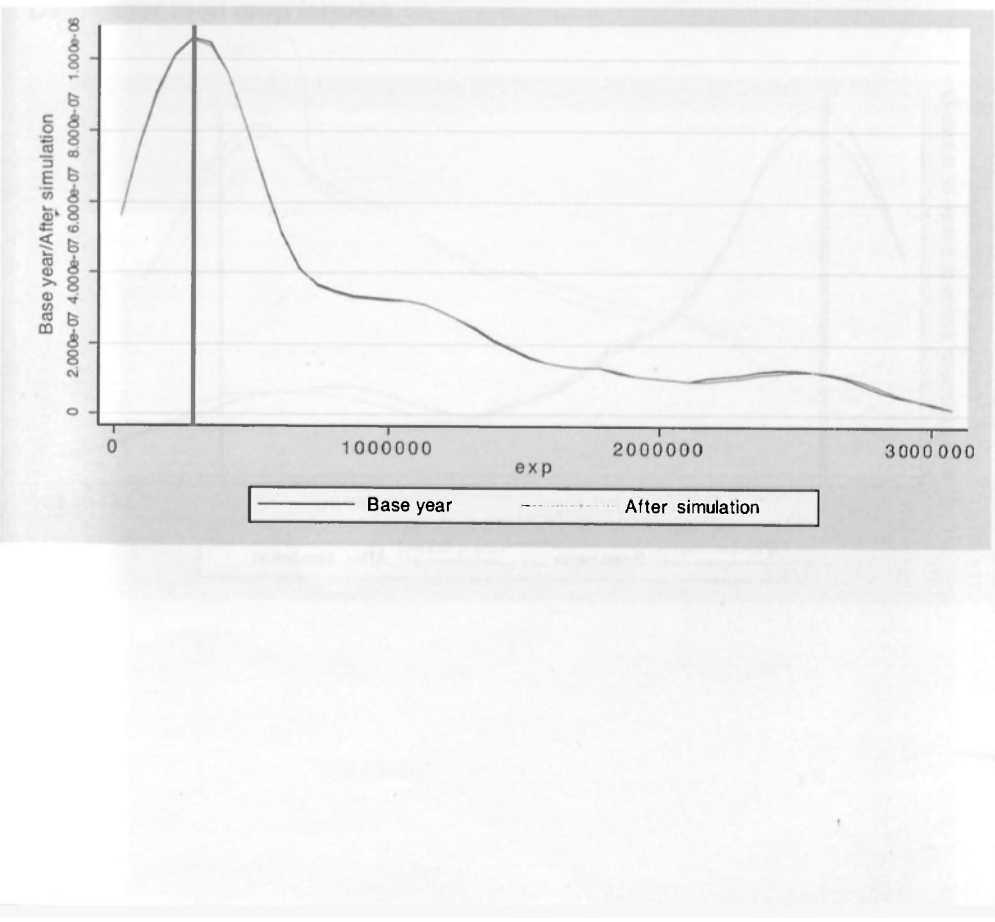
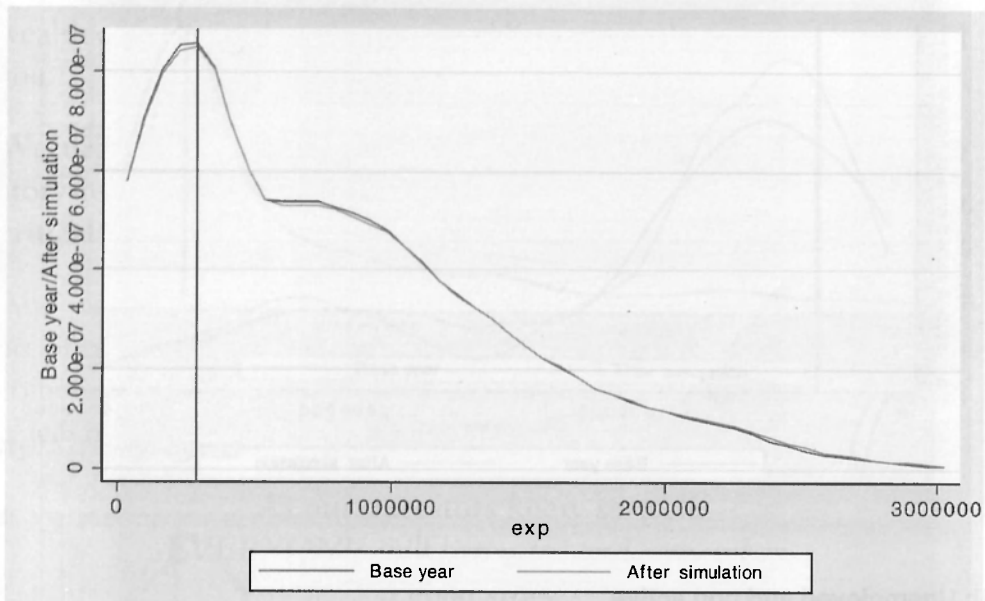
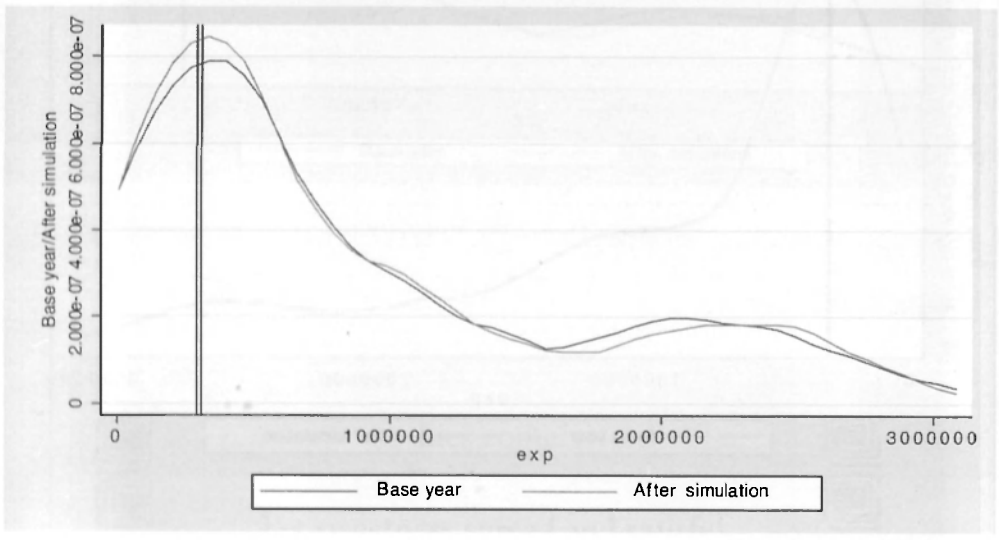


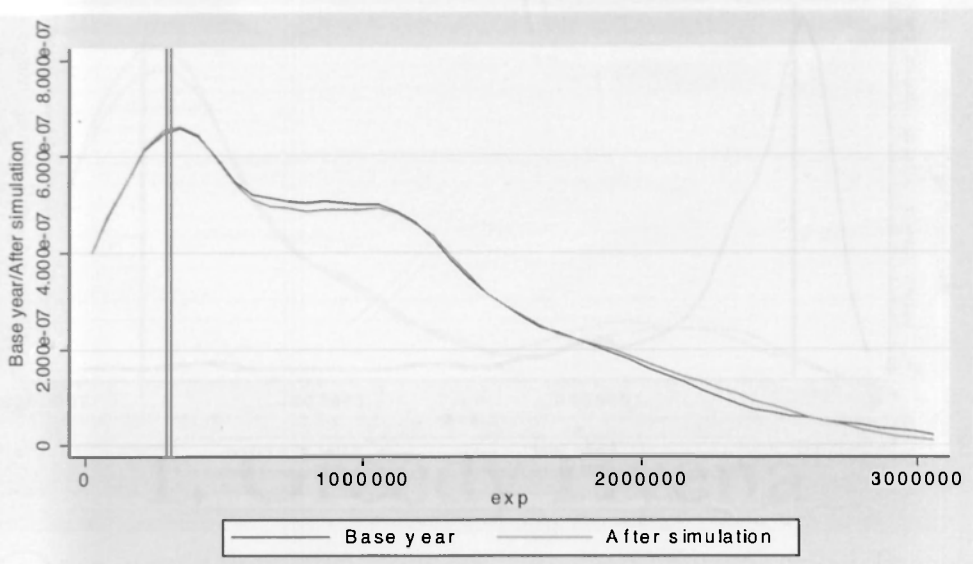
Figure D2: Intra group distribution (Simulations 3 and 4)
D2a: Coffee and cocoa farmers



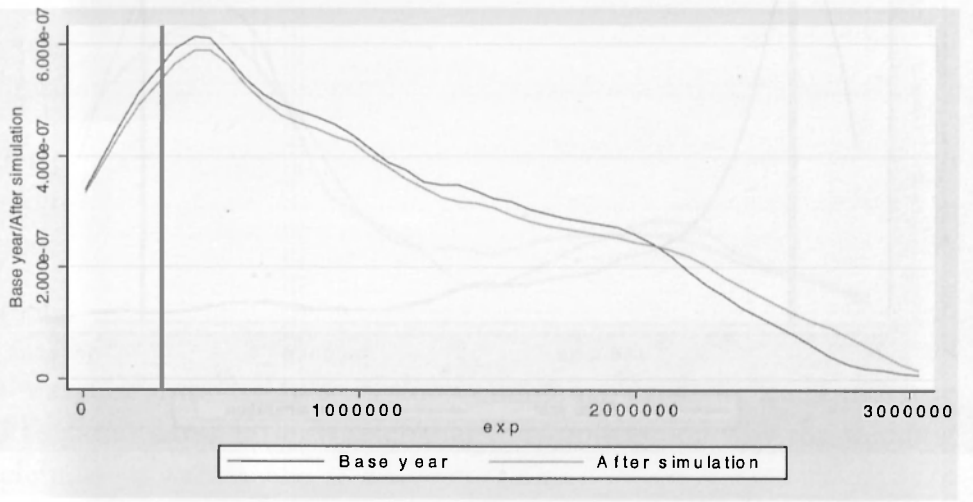
D2b: Other export crop farmers



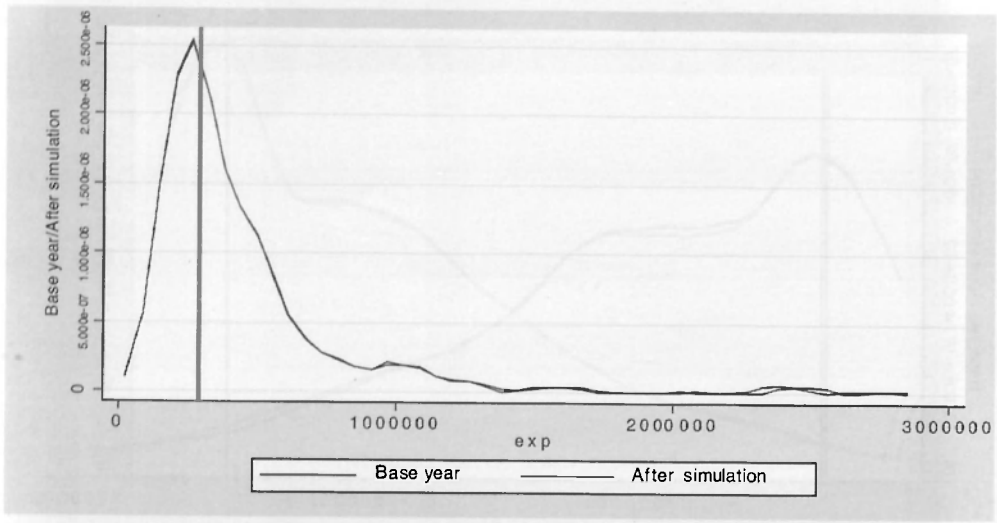
D2c: Starch farmers



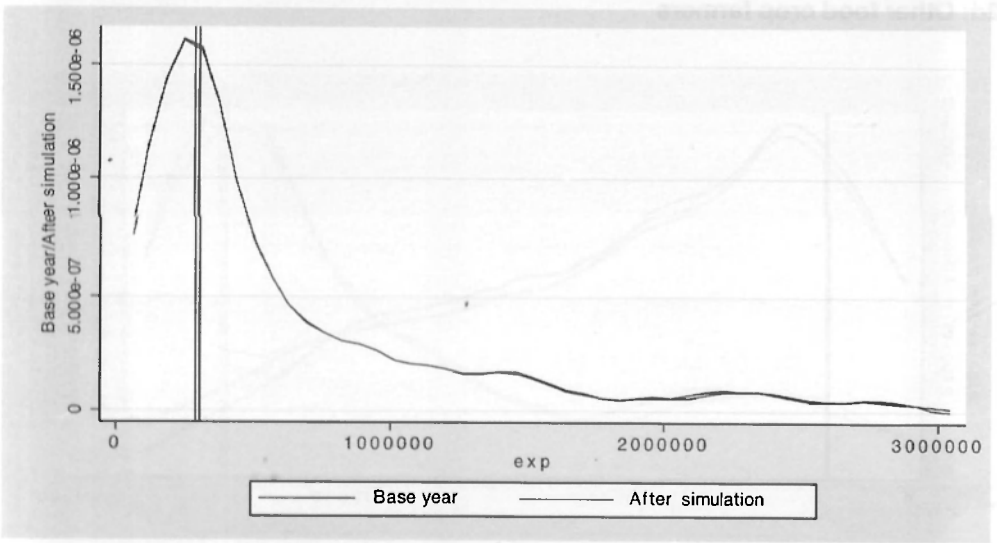
D2d: Other food crop farmers



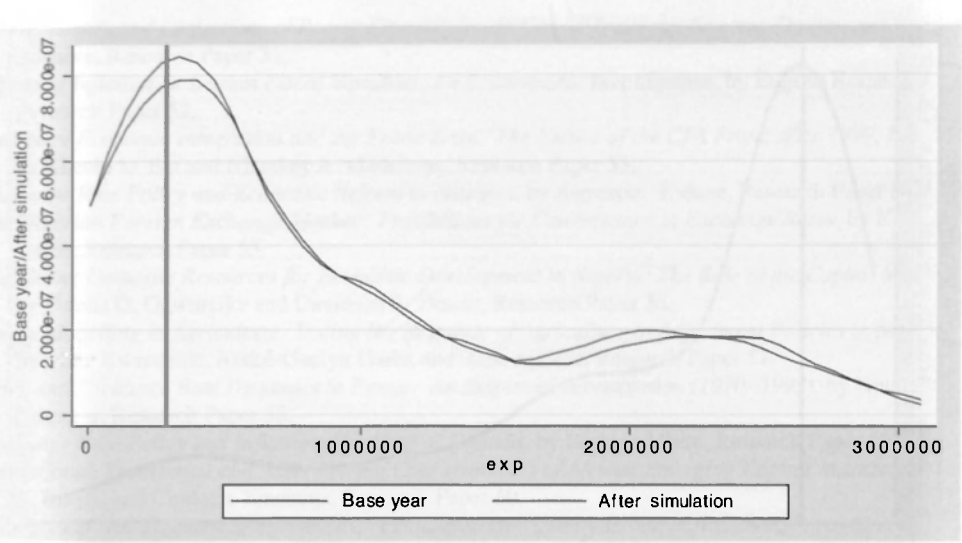
D2e: Public employees



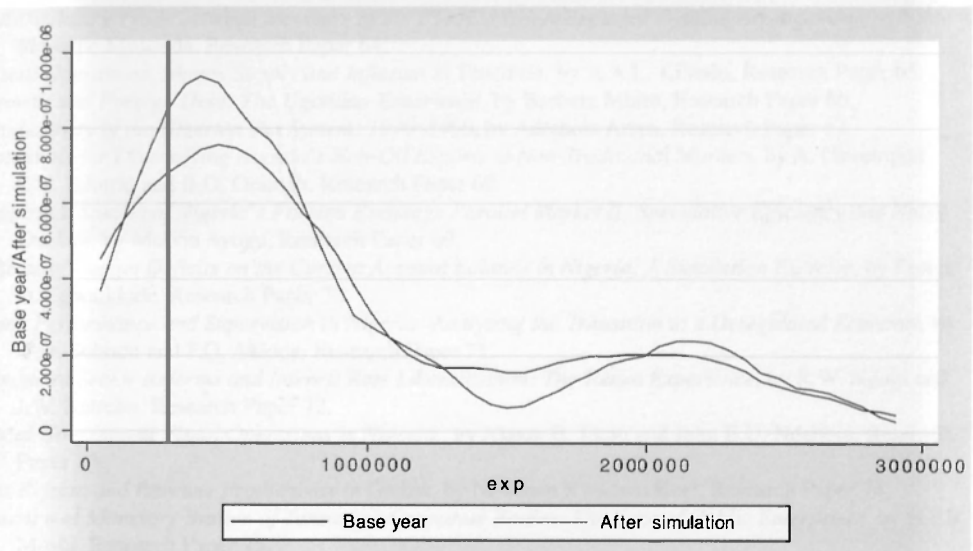
D2f: Private employees



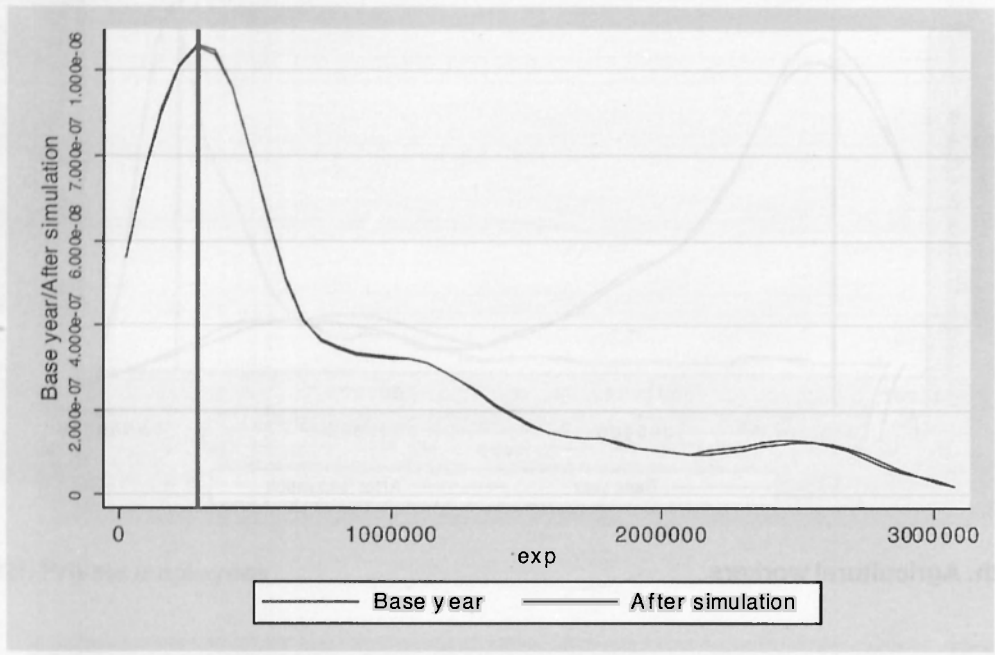
D2g: Self employees



D2h: Agricultural workers



D2i: Unemployed and non active



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