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Micro-simulation and Multi-decomposition.

A Case Study: Philippines.

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ABSTRACT.

This article combines computable general equilibrium (CGE) micro-simulation modeling and the Gini multi-decomposition analysis. The CGE-micro-simulation approach enables one to generate endogenous income distributions following government policy interventions. The introduction of these endogenous distributions into the Gini multi-decomposition, that merges income source and subgroup decompositions, provides powerful information to decision makers, which analyze the trade-off between inequality and efficiency whereas Gini multi-decomposition is usually applied in a partial equilibrium context. This is done by imposing the assumption that either the income or the price effects are exogenous.

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I. INTRODUCTION

In recent years, micro-simulation modeling such as presented by Decaluwé, Dumont and Savard (1999), Gørtz et al. (2000), and Bourguignon, Robilliard and Robinson (2003) has become a commonly used technique to inform policy-makers of the impact of policy reform on poverty and income distribution in developing countries. Fiscal policy analysts can plan several policies aimed at achieving better economic growth, improvement of social welfare or a combination of both objectives. This points to an old debate in economics, that is, to choose between economic efficiency (e.g. Pareto type efficiency) and social justice such as equity [cf. Fleurbaey (1996)] or equality [see Rawls (1971)].

Since the seminal article of Theil (1967), decomposition analysis has become an important and powerful framework in the economic development research field. Two methods are itemized: subgroup and income source decomposition. The decomposition by subgroup yields the inequality contribution between and within groups whereas the decomposition by income source provides the contribution of each income component to the overall inequality measure. These two methods, traditionally viewed as two disjointed approaches, when combined enable one to identify exactly the determinants of the overall inequality.

The aim of this article is to merge the three methods: CGE-micro-simulation, subgroup decomposition, and income source decomposition. Consequently, we perform comparative analysis of achieving increase government income with four types of fiscal policy reform[1]. For each fiscal policy reform, we determine the welfare implications throughout decomposability that yields indications to improve and re-orient fiscal policies. We also provide succinct macroeconomic result of the CGE-micro-simulation model to provide some sense of the trade-off between distributional and efficiency objectives.

The remainder of the paper is presented as follows. In Section 2 we provide a brief literature review of CGE-micro-simulation approaches. Section 3 presents a unified Gini decomposition, simultaneously based on income source and subgroup decomposition, and how this synthetic approach can be linked to micro-simulation design. Section 4 is devoted to an illustration on Philippine's incomes. Finally, Section 5 yields the theoretical and empirical conclusions.

II. REPRESENTATIVE AGENT AND MICRO-SIMULATION METHODS

Since the late 90's an increasing number of researchers have been developing and applying CGE-micro-simulation in developing countries. The impetus to this research area has come from criticism made with respect to doing poverty and income distributional analysis with representative agent CGE modeling (CGE-RA) approach. This technique does not allow taking into account within-group income distribution changes in the analysis and many studies (among others Huppi and Ravaillon (1991) and Savard (2005)), have shown that within-group inequality changes can be more important than between-group inequality changes after policy simulation. This is true for the static measure but also for variations following policy simulations. Moreover, Savard (2005) compared CGE-RA approach to one of the CGE-micro-simulation approaches (i.e. the TD/BU approach) and demonstrates that results of poverty and income distribution analysis can be completely reversed when taking into account the within-group distributional effects.

The CGE-RA approach consists of using household subgroups in a CGE model and inferring changes in the income of all household within each group based on the change of income of the representative household in the CGE model. As mentioned previously, within-group income redistribution is not taken into account and can lead to misleading conclusions[2]. The second approach first proposed by Decaluwé, Dumont and Savard in 1999, is the CGE integrated multi-household approach (CGE-IMH). This method relies on including a large number of household from household survey or all households of the survey into a CGE model. This approach has the advantage of being fully coherent between the micro and macro part of the model albeit data reconciliation can be very problematic [Rutherford et al. (2005)] and numerical resolution can also be challenging [Chen and Ravallion (2004)]. However, this approach takes into account the within-group distributional effects. The other drawback of the approach is that it can become constraining in terms of the types of behaviors that can be modeled. For example, regime switching behaviors such as employment-unemployment decisions are extremely difficult to model in this context and have yet to be modeled to our knowledge. As employment type and unemployment are strong determinants of household welfare, a second micro-simulation approach was proposed by Bourguignon, Robilliard and Robinson (2003) to rigorously integrate these behaviors. Their approach is referred to as the CGE micro-simulation sequential CGE-MSS method with rich household behavior. It consists of constructing a CGE module that feeds price changes into a micro-simulation household model[3]. As the previous CGE-IMH approach it allows to capture within-group distributional changes but it offers more flexibility in terms of household behaviors being modeled. The main drawback of this process is that it does not always fully take into account the feedback effect of household behavior being modeled in the micro-simulation module. To circumvent this problem, Savard (2003) proposed the CGE-TD/BU approach that draws from the CGE-MSS approach but links the two modules (CGE and household micro-simulation) by using the results of the CGE module into the household module and then the household module results are feed back into the CGE module and iterations are performed until results from one iteration to the other converge. This approach, as the two others, takes into account the within-group income distributional changes, the feedback effects of the household behavior and offer similar flexibility as the CGE-MSS approach. The main drawback of this technique is that convergence is not guaranteed and must be verified for each simulation.

In this paper we apply the Top-down/Bottom-up (TD/BU) micro-simulation approach proposed by Savard (2003) and latter applied by Aaberge et al. (2004), Bento de Sousa and Horridge (2004) and Savard (2005). This allows us to have more endogenous income components in the model than those of the CGE-IMH approach. Furthermore, we include the feedback effect of the micro household behavior with an endogenous labor supply and unemployment. The labor supply model is based on the non-competitive model in Magnac (1991) and is estimated using Family, Income and Expenditure Survey (FIES-1997) and Labor Force Surveys (LFS-1997) of data. Both surveys are based on the same master sample and 91% of households are found in the FIES and the three rounds of the LFS (see Savard (2003) for a detailed). The CGE component integrates all the standard characteristics of the CGE model of a small developing country with an open economy. The 1997 social accounting matrix (SAM) of the Philippines used for modeling covers 20 production sectors and 4 agents (government, firms, rest of the world, and households). This model reflects an open economy using Armington's hypothesis (1969) for import demand and the small country hypothesis for exports that do not influence world market prices. On this basis, the country is faced with infinite demand for its exports. However, export supply is constrained by a constant elasticity of transformation (CET) function. The household demand system is derived from a Stone-Geary utility function. Regarding households, we have an income function consisting of two types of labor (formal and informal) and capital remuneration, dividends and transfers from other agents. As capital is not mobile therefore the return on capital is sector specific. These households pay taxes, make savings, effect transfers to the other agents and consume goods and services. The government obtains its direct and indirect tax earnings, customs duties and transfers from the other agents. Its main expenditure consists of publicly produced goods consumption and pay subsidies to other agents.

III. GINI DECOMPOSITIONS AND MICRO-SIMULATION

III.1. SUBGROUP DECOMPOSITION AND MICRO-SIMULATION

As shown previously, when CGE-RA models and CGE-TD/BU micro-simulations are compared, some difficulties appear with the former. Representative households need to be selected prior to the modeling exercise and the decomposition can be based on any socio-demographic or regional criterion. Let us partition the household population into seven household head levels of education, with one representative agent per group. In this case, it is impossible to compute inequality changes within the groups because we can only generate a change in the income of the representative household. Moreover, the evaluation of the between-group inequalities depends on a strong limitation since it relies on the differences between the seven representative agents. Furthermore, measuring inequality in the representative agent context is not rigorous, since the income variations of seven representative agents of the model cannot accurately represent the variance, the asymmetry and the other statistical characteristics of the overall income distribution.

Contrary to this, CGE-TD/BU micro-simulations use equivalent variation or disposable income of each household found in the household survey to compute poverty and income distribution measures[4]. This enables one to compute inequalities with respect to the fundamental characteristics of the overall income distribution of the population as a whole or subgroups of the population. Moreover, no choice needs to be made prior to the modeling exercise since the subgroups are completely independent from the CGE micro-simulation modeling exercise.

Decomposition can be performed on the entire household database of the household survey used in order to determine within-group and between-group inequalities. Simulations are then implemented with the model and ex-ante analysis is conducted with the same sample of households but with new income vectors[5]. A fundamental problem remains to complete the decomposition analysis. When policy makers intend to use entropy inequality measures in the context of subgroup decomposition [see Shorrocks (1980)], the between-group inequality element consists in measuring the differences in mean between the groups. It is equivalent to impose an equally distributed income vector within each group (equal to the mean income of the corresponding group) and to compute the inequalities in mean. As Dagum (1997) states, this representation of between-group inequality is not valid since it is very similar the one-way variance analysis, that is:

(a) the subgroups have equal variances;

(b) the observations are statistically independent;

(c) the observations are equally distributed.

Then, using only the mean income to measure between-group inequality with TD/BU approach is equivalent to consider a CGE-RA model where only the average is used to represent their groups. As it is important to capture variance and asymmetry for the *between-group* analysis, the TD/BU micro-simulation approach must be applied with a decomposition structure to avoid the (a), (b), and (c) criticisms. In this sense, the Gini decomposition can provide an answer to these critiques.

Let P be a population with n income units y_i (i = 1,…, n) and mean μ. P is partitioned into k groups P_j (j = 1,…k). The j-th group P_j has n_j income units and mean μ_j (j = 1,…, k). Let p_j and s_j be the income share and the population share of the j-th sub-population:

$$p_j = \frac{n_j}{n},\ s_j = \frac{n_j \mu_j}{n \mu}. \tag{1}$$

Subgroup consistency (SC) property [Shorrocks (1988)]

A measure of inequality I(x) satisfies the subgroup consistency property if:

$$I = f\left(I_1,..., I_j,..., I_k; p_1,..., p_j,..., p_k; s_1,..., s_j,..., s_k\right), \tag{SC}$$

where I_j is the level of inequality in subgroup P_j and where f is increasing in its first k arguments.

If the inequalities go up (down) in at least one group, then the global inequality goes up (down). In this interesting characterization of subgroup decomposition (quite similar to subgroup consistency of poverty indices) the monotony is questionable. Indeed, if the inequality decreases in group P_j, the overall inequality does not have to decline systematically if many individuals of the other groups feel deprived or excluded from this reduction of inequality in group P_j. If this feeling of exclusion is stronger than the decrease in inequality in group P_j, it is then possible to have an increase in the total inequality. This property invalidates the monotony of subgroups and therefore the entropy indices and this validates the Gini index. Hence, in many situations if the deprivation is greater than the inequality reduction in P_j, the total inequality can increase. This violates the SC property. A characterization of this violation is the Gini index of inequality. For instance, Gini can lead to the particular situation where the inequality decreases in every subgroup whereas the total Gini ratio goes up. This is due to the fact that the Gini index captures variance and asymmetry between each and every pairs of subgroups, whereas between-group entropy is only based on mean incomes.

For consistency poverty measures, Sen (1992) proposed valuable insight to the subgroup consistency property. When poverty goes down in one (or several groups), the overall poverty does not have to decline if the members of the other groups suffer from this decrease.

We use the same argument to show that the Gini coefficient is a good candidate when we want to apply a decomposable measure. Furthermore, following Dagum (1998) and Pyatt (1976), the Gini decomposition is based on interpersonal comparisons in incomes (and utility) that is a crucial normative property since individuals constantly make these comparisons.

On the other hand, we can highlight the fact that this property leads to the subgroup decomposition of the Gini ratio. If interpersonal comparisons in incomes are gathered within each subgroup and between each and every pair of subgroups, this entails a two-term Gini decomposition:

$$\begin{aligned} G &= \frac{\sum_{j=1}^{k}\left(\sum_{i=1}^{n_j}\sum_{r=1}^{n_j}\left|x_{ij}-x_{rj}\right|\right)}{2\mu n^2} + \frac{2\sum_{j=2}^{k}\sum_{h=1}^{j-1}\left(\sum_{i=1}^{n_j}\sum_{r=1}^{n_h}\left|x_{ij}-x_{rh}\right|\right)}{2\mu n^2} \\ &= G_w + G_{gb}\ , \end{aligned} \tag{2}$$

where x_{ij}, x_{rj}, and x_{rh} stands respectively for the income of the i-th individual of group P_j, the r-th individual's income of group P_j, and the r-th individual's income of group P_h.

We can then obtain a within-group component [G_w] and a gross between-group component [G_{gb}] that explain the total Gini ratio[6]:

$$G = \frac{\sum_{i=1}^{n}\sum_{r=1}^{n}\left|x_{ij} - x_{rj}\right|}{2\mu n^2} \tag{3}$$

III.2. THE GINI MULTI-DECOMPOSITION

Another reason that motivates researchers to use the Gini index is the income source decomposition (factor component decomposition). Indeed, when income is separated in q income sources (labor income, capital income, transfers and dividends) or q expenditure components (food expenditures, saving, taxes, transfers, etc.), it is possible to isolate and measure the contribution of each source (factor) to the overall amount of the Gini index.

Consider that incomes are composed in q sources x^m ($\forall m = 1, \ldots, q$):

$$x_i = \sum_{m=1}^{q} x_i^m \ . \tag{4}$$

From (3), the Gini index can be formulated as:

$$G = \sum_{m=1}^{q} \left(\frac{\sum_{i=1}^{n}\sum_{r=1}^{n}\left(x_i^m + x_r^m - 2\min\{x_i,\ x_r\}\right)}{2\mu n^2} \right) . \tag{5}$$

Then, in order to decompose the interaction term "2min{x_i, x_r}" by income source, we impose an operator that decomposes the minimum between incomes x_i and x_r:

$$2\min\{x_i, x_r\} = \sum_{m=1}^{q} 2x_{ir}^{*m} . \tag{6}$$

Therefore, the factor component Gini decomposition is:

$$G = \sum_{m=1}^{q} \left(\frac{\sum_{i=1}^{n}\sum_{r=1}^{n}\left(x_i^m + x_r^m - 2x_{ir}^{*m}\right)}{2\mu n^2} \right) . \tag{7}$$

Hence, we can measure the contribution of a particular source of income such as labor income or transfers to the total Gini ratio.

To summarize, the Gini decompositions by subgroup (2) and the Gini decomposition by income source (7), can be presented with Table 1.

If the population is partitioned in two groups (men and women) and if we consider three income sources (labor income, transfers, and capital income), the two methods used independently yield “marginal contributions”. For instance, on the one hand, the male group contributes with a 40% to the overall inequality, whereas the inequalities between men and women represent 40% of the total Gini index. It is also possible to evaluate the contribution of the transfers, which in this illustrative example, come to 10% of the total inequalities. As Table 1 shows, these two disjointed techniques of decomposition cannot provide a combination of dimensions between household groups and income sources. Hence, we have missing values “×” in intersecting cells of Table 1. It is therefore, impossible to compute the contribution of labor income (and the other factors) to the inequalities between the men and the women, to the inequalities within the male group and the inequalities within the female group.

In the literature we find many alternative for decompositions by income source [see e.g. Rao (1969), Fei, Ranis and Kuo (1978), Silber (1989)]. The advantage of the income source decomposition such as equation (7) is that it allows the two decomposition procedures to be merged [see Mussard (2004)]:

$$G = \sum_{m=1}^{q}\left(\frac{\sum_{j=1}^{k}\left(\sum_{i=1}^{n_j}\sum_{r=1}^{n_j}\left(x_{ij}^{m} + x_{rj}^{m} - 2x_{j,ir}^{*m}\right)\right)}{2\mu n^2}\right) + \sum_{m=1}^{q}\left(\frac{2\sum_{j=2}^{k}\sum_{h=1}^{j-1}\left(\sum_{i=1}^{n_j}\sum_{r=1}^{n_h}\left(x_{ij}^{m} + x_{rh}^{m} - 2x_{jh,ir}^{*m}\right)\right)}{2\mu n^2}\right), \quad (8)$$

where $x^{*m}_{j,ir}$ is the m-th source of the minimum between x_{ij} and x_{rj} and where $x^{*m}_{jh,ir}$ is the m-th source of the minimum between x_{ij} and x_{rh}. Therefore, the combinations "source/within-group" and "source/between-group" can be determined.

IV. EMPIRICAL ILLUSTRATIONS

The micro or household data used in the paper are drawn from the Family Income and Expenditure Survey of the Philippines for 1997. The survey was conducted between July 1997 and January 1998. The sample of the survey is drawn from a master sample of 1995 and it includes 39520 households with rich information on all forms of expenditures and all forms of incomes. The survey has a two stage, stratified cluster structure. The policy simulation performed on the CGE micro-simulation model were done with the following objective of increasing government income to provide a service of implicitly a transfer to household through the provision of a public good such as free education or health. We simulated an objective increase of 10% in government income that will be converted in increase of production public services and we compare for types of fiscal reform to provide the source of funds that will contribute to this increase in government income[7]. The first simulation allows the sales tax to be adjusted, the second is an increase in import duties, the third is an increase in household income tax and finally the last one is an increase in firms' income tax.

IV.I THE CGE-TD/BU MACRO AND SECTORAL RESULTS

We provide a very brief presentation of the macro and sectoral results produced by the CGE micro-simulation model in order to highlight on the one hand changes in key variables affecting different component of household income and to inform on the efficiency effect of the policy simulations. If we first look at the impact on GDP we note that all simulations produce a positive impact as the increase in government income is used to increase public services and this reduces unemployment in all scenarios. As the formal wage is fixed, the demand for labor in the public service sector will produce an upward pressure on the informal wage. We note that all scenarios produce an increase in aggregate household income with the exception of the fourth simulation. We also observe that the income of firms decrease in all scenarios (see Table 2).

As more workers are active in the economy and the nominal wage in the informal sector increase, the households endowed with informal labor will benefit from all the scenarios. Moreover, the workers leaving unemployment to work either in the formal of informal sector will gain the most from the situation. The differentiating effects will come from the relative differences. We note in this respect that the first scenario is the most beneficial and the least one is the fourth scenario. Another element of some of the households' income is the dividend which is a function of the firms' income. In this respect, the households who own shares will face the strongest decrease in dividend in the second scenario and they will be least negatively affected in the fourth scenario.

The final important component of household income formation is the changes in rental rate of capital. On this front we observe much less uniform effect. In general the impact on the rental rate of capital is negative in the majority of sectors for all simulations. We observe the same qualitative impact (same sign) in 11 sectors and qualitative changes in 8 sectors. We observe quantitative differences between the scenarios for all sectors. This will lead to different income effect based on the endowment of capital of the different households. We can highlight that the agriculture sectors seems to be most negatively affected in most scenarios although this is not systematic.

Finally we can say that in general households drawing the majority of their income from labor will be advantaged in all scenarios versus households endowed mostly with capital income (see Table 3).

IV.I THE GINI DECOMPOSITION

We apply the Gini multi-decomposition on the household incomes, which are partitioned into seven educational groups based on the level of schooling of the head of household: (1) no level of education; (2) primary school level of education without diploma; (3) primary school level of education with diploma; (4) secondary school without diploma (one, two or three years of study); (5) secondary school with diploma; (6) university level without diploma; and (7) university level with diploma. Consequently, it is possible to obtain (see Table 4 to Table 8) the contribution of the first group 'G_{w1}' to the overall inequality or the contribution between groups 1 and 2 'G_{gb12}' to the total inequality. On the other hand, we disaggregate each individual's income into five sources: (*LI*) labor income; (*CI*) capital income; (*TR*) net transfers; (*DIV*) dividends; (*TX*) taxes. Hence, the total income is defined as: $X = LI + CI + TR + DIV - TX$. Therefore, the different sources of income allow us to determine the precise structure of the within-group inequalities and the gross between-group inequalities. For instance, the computed value from row 'G_{gb12}' and column '*LI*' yields the contribution of the labor income of the inequalities between groups 1 and 2 to the global inequality. Also, from row 'G_{w7}' and row 'TR' we have the contribution of the transfers of group 7 to the global Gini ratio.

First, we apply the Gini multi-decomposition on the reference period, that is, on the household incomes without simulation (Table 4). The global Gini index (G = 0.42414) is mainly explained by the gross between-group inequalities (83.52% of G).

These important inequalities are principally due to the income differences between group 2 (primary school level of education without diploma) and group 3 (primary school level of education with diploma), with a 9.23% of G. We then have the inequalities between group 3 (primary school level of education with diploma) and group 5 (secondary school with diploma), with a 8.03% of G. The lowest between-group inequalities are concerned, surprisingly, with group 1 (no level of education) and group 7 (university level with diploma). In each case (G_{gb23}, G_{gb35} and G_{gb17}), the Ginis are determined by the transfers received by the households. The same conclusion is obtained with the within-group analysis, where the most important inequalities are recorded for group 3 (4.81% of G), group 2 (4.43% of G), and group 5 (3.35% of G). The transfers are the crucial factor with a 60.98% of the Gini ratio, whereas the income taxes represent -4.31% of G. Let us now analyze the impact of a government decision concerning with an increase of 10% of the receipts in order to plan socio-economic policies (Table 5).

Simulation 1 deals with a tax on production. The Gini index goes up: 0.42414 $\rightarrow$ 0.54056: income taxes do not reduce the inequalities any more. Indeed, it represents 33.81% of G. On the contrary, dividends, transfers, capital incomes and labor incomes contribute with a lower part in the overall inequality. The biggest between-group Ginis G_{gb23} and G_{gb35} are more important (practically multiplied by 2) and are explained (approximately with a 50%) by the income taxes. On the contrary, the lowest Gini, G_{gb17}, is less important (0.00534 $\rightarrow$ 0.00436) and is still determined by the transfers (with a 60.3%).

If we now analyze the second simulation (Table 6), that allows us to increase the 10% receipts with customs dues, we observe a quasi-similar situation compared with simulation 1. The overall Gini index goes up 0.42414 $\rightarrow$ 0.54013, and the precedent remarks holds with exactly the same values.

Simulation 3, to increase the household's incomes taxes (Table 7), is the worst solution because the Gini coefficient increases with a 70% (0.42414 $\rightarrow$ 0.72113). This growth is due to the taxes (*TX*), which represent 29.53% of *G*, whereas it represents -4.31% of *G* in the situation of reference. For instance, the income differences between groups 1 and 7 are determined by the taxes with a 111.5%. But, we now observe that the transfers between the more educated group (7) and the less educated group (1) are more efficient because they diminish G_{gb17} with a 23.1%. We then have the same conclusions compared with developed countries where transfers tend to decrease the overall inequalities [see e.g. Mussard (2004)]. Simulation 3 shows that the inequalities between the more educated and the less educated can be reduced. This reduction is available for G_{gb12}, G_{gb13}, G_{gb14}, G_{gb15}, G_{gb16}, G_{gb17}, G_{gb27}, G_{gb37}, G_{gb57}. Then, the taxes on household's incomes are efficient to decrease the gross between-group inequalities, but not for decreasing to the overall inequalities. On the other hand, the transfers yield a reduction of the inequalities within groups 1 and 7. Other diminutions are also itemized. The labor income of group 1 decreases the overall inequalities with a 0.00416%, the capital income of group 7 reduces the total inequalities with a 0.00139%, and the dividends of group 3 decrease the total Gini ratio with a 0.02496%.

Simulation 4, the taxes on factories (Table 8), is very close to simulations 1 and 2. No income sources give a decrease of the total Gini ratio (which increases 0.42414 $\rightarrow$ 0.53642). Compared with the reference situation, we obtain an important decrease of the capital income inequalities. It represents 27.48% in the reference situation compared with a 16.34% in simulation 4. The gross between-group inequalities in capital incomes are less important (0.09 $\rightarrow$ 0.073). For instance, for the strong between-group income differences, like G_{gb23} and G_{gb35}, we notice a decrease (G_{gb23}: 0.01 $\rightarrow$ 0.008; G_{gb35}: 0.008 $\rightarrow$ 0.007) and for the weak between-group inequalities, we also note a decrease (G_{gb17}: 0.0014 $\rightarrow$ 0.0011). The within-group inequalities in capital incomes are all decreasing. For example, the capital income inequalities within the group with no level of education (1) diminish with a 18.6% (G_{w1}: 0.00043 $\rightarrow$ 0.00035).

IV. CONCLUSION

Simulation 3 points out the fact that the Gini multi-decomposition captures some complex "group / sources" combinations. Indeed, the transfers increase the total Gini ratio with a 6.40% of *G*. But this positive contribution does not mean that all the within-group and the between-group inequalities in transfers are positive. We observe that an increase of the household taxes enable to decrease the income inequalities between the two opposite educated groups (group 1 and group 7). We then show that the more efficient tool to decrease the educational inequalities is the tax on household's incomes. But, these policies increase considerably the tax payment of inequalities. Then, we conclude that the tax on household's income is welcome for industrialized countries that intend to reduce the income differences between education level, but for the case of Philippines it seems better to choose either tax on firms, custom duties, or tax on production which yield a weaker growth of inequalities with exactly the same intensities in the inequality combinations "group / sources".

Finally is seems that the mixture model "multi-decomposition an micro-simulation" can yield precise predictions about the impact of socio-economic policies on well-being, and hopefully more works can be conducted in combining several economic policies.

NOTES

(1) The implicit objective of increasing government income is to provide more basic services such as primary education and primary health care. However, as the externalities of these services are not taken into account in our micro-simulation exercise, this increase in income will be converted in increase public services produced.

(2) In this approach the second and superior moment of the income distribution of sub-groups are held constant after policy simulation.

(3) Micro household behaviour can be estimated econometrically to enrich the micro-simulation model.

(4) This is also true for the two other CGE-micro simulation approaches described previously (CGE-IMH and CGE-MMS).

(5) In this case we cite income as the proxy to measure household welfare. Other measures such as change in equivalent variation can be used to compute the change in welfare. The indirect utility function, the total expenditure, etc. could also be used.

(6) As the between-group element does not reflect the inequalities in mean, Dagum (1997) names it "gross between-group Gini". It can be divided into a net between-group inequality (inequality in mean between the groups) and the intensity of transvariation between groups, that is, the inequalities due to the overlap between the distributions [see Gini (1916), Dagum (1959, 1960, 1961)]. Without using a three-term decomposition, the two-term Gini decomposition is statically valid and attractive since the gross between-group element gives all the inequalities between the pairs of the groups. This yields more information than a simple measure based on mean differences.

(7) Is it important to note that we do not take into account the utility gains generated by the provision of more public goods or externalities of these public goods as is done in Savard et Adjovi (1998), Fougère and Merette (1999) Jung and Thorbecke (2003).

Capturing these effects would increase the efficiency of the policy. Integrating this hypothesis in the model would provide an interesting extension to verify if the equity effects would be different.

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TABLE 1: STRUCTURE OF INEQUALITY DECOMPOSITION POSSIBILITIES

Sources → Groups ↓	**Labor income**	**Transfers**	**Capital income**	**Total**
Inequalities within male group	×	×	×	40%
Inequalities within female group	×	×	×	20%
Inequalities between male and female	×	×	×	40%
Total	70%	20%	10%	100%

Table 1 explains the problem related to the "marginal" techniques of decomposition. The traditional methods cannot yield the income source contributions to the between-group and to the within-group elements.

TABLE 2: SUCCINCT MACROECONOMIC RESULTS *

Variables	Definition	Reference	Sim 1: Sales Tax	Sim 2: Import duties	Sim 3: Household income tax	Sim 4: Firms Income Tax
w^1	Formal wage	1	0,00	0,00	0	0
w^2	Informal wage	0,5	1,29	1,09	1,18	0,96
Yg	Government income	20367	10,00	10,00	10	10
Sg	Government savings	-1163,1	-21,70	-37,43	-56,02	-152,02
Ym	Aggregate household income	16818,8	0,55	0,48	0,47	-0,36
u	Unemployment	16,84	-2,76	-2,32	-2,5	-0,5
Ye	Firms income	26172,9	-0,44	-0,68	-0,42	-0,08
Se	Firms savings	7810,5	-0,77	2,30	-0,73	-0,29
e	Nominal exchange rate	1	-1,78	-0,33	0,23	0,04
GDP	Gross domestic product	101255	0,65	0,58	0,54	0,11

* *Source :* All simulation results are obtained from the CGE micro-simulation model and are presented as % changes.

TABLE 3: CHANGES IN RENTAL RATE OF CAPITAL

Variables	branches	Reference	Sim 1: Sales Tax	Sim 2: Import duties	Sim 3: Household income tax	Sim 4: Firms Income Tax
r (Capital Return Rate)	Palay & corn	1	-1,58	-0,84	-0,78	-0,40
	Fruit & vegetable	1	-2,23	-1,53	-1,64	-0,40
	Coconut	1	-0,46	0,12	0,27	0,02
	Livestock	1	-1,66	-0,70	-1,71	-0,41
	Fishing	1	-0,92	-1,50	-1,11	-0,33
	Other agriculture	1	0,09	0,91	-0,10	-0,07
	Logging % timber	1	-1,45	-1,69	-1,90	-0,20
	Mining	1	0,56	-2,83	-0,13	-0,04
	Manufacturing	1	-0,48	-0,41	-0,03	-0,02
	Rice manufacturing	1	-0,53	-0,66	-0,08	-0,15
	Meat industry	1	-0,85	-0,40	-1,62	-0,34
	Food manufacturing	1	-1,63	0,23	-0,18	-0,10
	Elec., gas & water	1	2,32	1,61	1,88	0,40
	Construction	1	-1,22	-1,71	-0,38	0,00
	Commerce	1	-0,53	-0,43	-0,21	-0,06
	Transport & communi.	1	0,94	0,56	-0,33	0,06
	Finance	1	2,41	2,09	2,33	0,48
	Real estate	1	-0,99	-1,14	-3,33	-0,35
	Services	1	0,55	-0,15	1,10	0,29

* *Source :* All simulation results are obtained from the CGE micro-simulation model and are presented as % changes.

TABLE 4. GINI MULTI-DECOMPOSITION: REFERENCE SITUATION*

Sources→ Indices ↓	LI	CI	TR	DIV	TX	Total
G_{gb12}	0.00031 0.07309	0.00312 0.73561	0.00753 1.77536	0.00013 0.03065	0 0.00000	**0.01109** **2.61470**
G_{gb13}	0.00044 0.10374	0.00321 0.75683	0.00708 1.66926	0.00005 0.01179	0.00078 0.18390	**0.01156** **2.72552**
G_{gb14}	0.00017 0.04008	0.00167 0.39374	0.00366 0.86292	0.00007 0.01650	0.0002 0.04715	**0.00577** **1.36040**
G_{gb15}	0.00045 0.10610	0.00266 0.62715	0.00603 1.42170	0.00011 0.02593	0.00046 0.10845	**0.00971** **2.28934**
G_{gb16}	0.00031 0.07309	0.00164 0.38666	0.00392 0.92422	0.00007 0.01650	0.00015 0.03537	**0.00609** **1.43585**
G_{gb17}	0.00048 0.11317	0.00141 0.33244	0.00326 0.76861	0.00007 0.01650	0.00012 0.02829	**0.00534** **1.25902**
G_{gb23}	0.00531 1.25195	0.01073 2.52983	0.026 6.13005	-0.00003 -0.00707	-0.00285 -0.67195	**0.03916** **9.23280**
G_{gb24}	0.00255 0.60122	0.00565 1.33211	0.01358 3.20177	0.00016 0.03772	-0.00252 -0.59414	**0.01942** **4.57868**
G_{gb25}	0.00538 1.26845	0.00862 2.03235	0.02188 5.15867	0.00026 0.06130	-0.00347 -0.81813	**0.03267** **7.70265**
G_{gb26}	0.00358 0.84406	0.00525 1.23780	0.01432 3.37624	0.00017 0.04008	-0.00281 -0.66252	**0.02051** **4.83567**
G_{gb27}	0.0044 1.03739	0.00395 0.93130	0.01043 2.45909	0.00016 0.03772	-0.00083 -0.19569	**0.01811** **4.26982**
G_{gb34}	0.00314 0.74032	0.00567 1.33682	0.01201 2.83161	-0.00002 -0.00472	-0.00055 -0.12967	**0.02025** **4.77437**
G_{gb35}	0.0064 1.50894	0.00863 2.03471	0.01919 4.52445	-0.00005 -0.01179	-0.00011 -0.02593	**0.03406** **8.03037**
G_{gb36}	0.00422 0.99495	0.00525 1.23780	0.01269 2.99194	-0.00003 -0.00707	-0.00075 -0.17683	**0.02138** **5.04079**
G_{gb37}	0.005 1.17886	0.00395 0.93130	0.00901 2.12430	0 0.00000	0.00092 0.21691	**0.01888** **4.45136**
G_{gb45}	0.00314 0.74032	0.00455 1.07276	0.01008 2.37657	0.00014 0.03301	-0.00103 -0.24284	**0.01688** **3.97982**
G_{gb46}	0.00208 0.49040	0.00276 0.65073	0.00665 1.56788	0.00009 0.02122	-0.00099 -0.23341	**0.01059** **2.49682**
G_{gb47}	0.00249 0.58707	0.00207 0.48805	0.00469 1.10577	0.00008 0.01886	0.00003 0.00707	**0.00936** **2.20682**
G_{gb56}	0.00406 0.95723	0.00419 0.98788	0.01065 2.51096	0.00014 0.03301	-0.00122 -0.28764	**0.01782** **4.20144**
G_{gb57}	0.00468 1.10341	0.00312 0.73561	0.00753 1.77536	0.00013 0.03065	0.00029 0.06837	**0.01575** **3.71340**
G_{gb67}	0.00301 0.70967	0.0019 0.44797	0.00508 1.19772	0.00009 0.02122	-0.0002 -0.04715	**0.00988** **2.32942**
Total: G_{gb}	**0.06160** **14.52351**	**0.09000** **21.21941**	**0.21527** **50.75447**	**0.00179** **0.42203**	**-0.01438** **-3.39039**	**0.35428** **83.52902**
G_{w1}	-0.00001 -0.00236	0.00043 0.10138	0.00105 0.24756	0.00002 0.00472	0.00002 0.00472	**0.00151** **0.35601**
G_{w2}	0.0021 0.49512	0.00535 1.26138	0.0144 3.39511	0.00015 0.03537	-0.00322 -0.75918	**0.01878** **4.42778**
G_{w3}	0.00324 0.76390	0.00538 1.26845	0.01144 2.69722	-0.0002 -0.04715	0.00056 0.13203	**0.02042** **4.81445**
G_{w4}	0.00076 0.17919	0.00149 0.35130	0.00315 0.74268	0.00004 0.00943	-0.00043 -0.10138	**0.00501** **1.18121**
G_{w5}	0.00311 0.73325	0.00345 0.81341	0.00804 1.89560	0.00011 0.02593	-0.00052 -0.12260	**0.01419** **3.34559**
G_{w6}	0.00132 0.31122	0.00127 0.29943	0.00351 0.82756	0.00005 0.01179	-0.00056 -0.13203	**0.00559** **1.31796**
G_{w7}	0.00161 0.37959	0.00069 0.16268	0.00176 0.41496	0.00004 0.00943	0.00026 0.06130	**0.00436** **1.02796**
Total: G_w	**0.01213** **2.85990**	**0.01806** **4.25803**	**0.04335** **10.22068**	**0.00021** **0.04951**	**-0.00389** **-0.91715**	**0.06986** **16.47098**
Total: G	**0.07373** **17.38341**	**0.10806** **25.47744**	**0.25862** **60.97515**	**0.00200** **0.47154**	**-0.01827** **-4.30754**	**0.42414** **100.00000**

** Source : FIES-97 * Blue Values: % contribution to G*

This is the Gini multi-decomposition estimated from the panel, without simulation.

TABLE 5. GINI MULTI-DECOMPOSITION: SIMULATION 1 *

Sources→ / Indices ↓	LI	CI	TR	DIV	TX	Total
G_{gb12}	0.00027 0.04995	0.00252 0.46618	0.0061 1.12846	0.00011 0.02035	0 0.00000	**0.009** **1.66494**
G_{gb13}	0.00038 0.07030	0.00259 0.47913	0.00565 1.04521	0.00005 0.00925	0.01017 1.88138	**0.01884** **3.48527**
G_{gb14}	0.00015 0.02775	0.00135 0.24974	0.00296 0.54758	0.00006 0.01110	0.00016 0.02960	**0.00468** **0.86577**
G_{gb15}	0.00039 0.07215	0.00215 0.39774	0.00488 0.90277	0.00009 0.01665	0.00037 0.06845	**0.00788** **1.45775**
G_{gb16}	0.00027 0.04995	0.00132 0.24419	0.00317 0.58643	0.00006 0.01110	0.00012 0.02220	**0.00494** **0.91387**
G_{gb17}	0.00045 0.08325	0.00114 0.21089	0.00263 0.48653	0.00005 0.00925	0.00009 0.01665	**0.00436** **0.80657**
G_{gb23}	0.00444 0.82137	0.00862 1.59464	0.02076 3.84046	-0.00003 -0.00555	0.03934 7.27764	**0.07313** **13.52856**
G_{gb24}	0.00213 0.39404	0.00454 0.83987	0.01097 2.02938	0.00013 0.02405	-0.00202 -0.37369	**0.01575** **2.91365**
G_{gb25}	0.00448 0.82877	0.00692 1.28015	0.01769 3.27253	0.00021 0.03885	-0.00279 -0.51613	**0.02651** **4.90417**
G_{gb26}	0.00297 0.54943	0.00421 0.77882	0.01158 2.14222	0.00013 0.02405	-0.00226 -0.41808	**0.01663** **3.07644**
G_{gb27}	0.00382 0.70667	0.00314 0.58088	0.00836 1.54654	0.00012 0.02220	-0.00062 -0.11470	**0.01482** **2.74160**
G_{gb34}	0.00261 0.48283	0.00455 0.84172	0.00956 1.76854	-0.00001 -0.00185	0.02158 3.99216	**0.03829** **7.08339**
G_{gb35}	0.00531 0.98231	0.00694 1.28385	0.01526 2.82300	-0.00004 -0.00740	0.03717 6.87620	**0.06464** **11.95797**
G_{gb36}	0.00349 0.64563	0.00421 0.77882	0.01009 1.86658	-0.00002 -0.00370	0.02273 4.20490	**0.04050** **7.49223**
G_{gb37}	0.0043 0.79547	0.00315 0.58273	0.00708 1.30975	-0.00001 -0.00185	0.02081 3.84971	**0.03533** **6.53581**
G_{gb45}	0.0026 0.48098	0.00366 0.67708	0.00814 1.50585	0.00011 0.02035	-0.00083 -0.15354	**0.01368** **2.53071**
G_{gb46}	0.00171 0.31634	0.00223 0.41254	0.00535 0.98971	0.00007 0.01295	-0.00078 -0.14429	**0.00858** **1.58724**
G_{gb47}	0.00215 0.39774	0.00165 0.30524	0.00375 0.69373	0.00007 0.01295	0.00004 0.00740	**0.00766** **1.41705**
G_{gb56}	0.00335 0.61973	0.00336 0.62158	0.0086 1.59094	0.00011 0.02035	-0.00098 -0.18129	**0.01444** **2.67130**
G_{gb57}	0.00399 0.73812	0.00249 0.46063	0.00604 1.11736	0.00011 0.02035	0.00026 0.04810	**0.01289** **2.38456**
G_{gb67}	0.00256 0.47358	0.00151 0.27934	0.00408 0.75477	0.00007 0.01295	-0.00015 -0.02775	**0.00807** **1.49290**
Total: G_{gb}	**0.05182** **9.58635**	**0.07225** **13.36577**	**0.17270** **31.94835**	**0.00144** **0.26639**	**0.14241** **26.34490**	**0.44062** **81.51177**
G_{w1}	-0.00001 -0.00185	0.00035 0.06475	0.00085 0.15724	0.00002 0.00370	0.00002 0.00370	**0.00123** **0.22754**
G_{w2}	0.00176 0.32559	0.00431 0.79732	0.01165 2.15517	0.00012 0.02220	-0.00259 -0.47913	**0.01525** **2.82115**
G_{w3}	0.00269 0.49763	0.00433 0.80102	0.00896 1.65754	-0.00017 -0.03145	0.04395 8.13046	**0.05976** **11.05520**
G_{w4}	0.00063 0.11655	0.0012 0.22199	0.00254 0.46988	0.00003 0.00555	-0.00034 -0.06290	**0.00406** **0.75107**
G_{w5}	0.00257 0.47543	0.00277 0.51243	0.0065 1.20246	0.00009 0.01665	-0.00042 -0.07770	**0.01151** **2.12927**
G_{w6}	0.00109 0.20164	0.00102 0.18869	0.00284 0.52538	0.00004 0.00740	-0.00046 -0.08510	**0.00453** **0.83802**
G_{w7}	0.00139 0.25714	0.00056 0.10360	0.00142 0.26269	0.00003 0.00555	0.0002 0.03700	**0.0036** **0.66598**
Total: G_w	**0.01012** **1.87213**	**0.01454** **2.68980**	**0.03476** **6.43037**	**0.00016** **0.02960**	**0.04036** **7.46633**	**0.09994** **18.48823**
Total: G	**0.06194** **11.45849**	**0.08679** **16.05557**	**0.20746** **38.37872**	**0.00160** **0.29599**	**0.18277** **33.81123**	**0.54056** **100.00000**

** Source : FIES-97 * Blue Values: % contribution to G*

This is the Gini multi-decomposition estimation after a tax simulation on production.

TABLE 6. GINI MULTI-DECOMPOSITION: SIMULATION 2 *

Sources→ Indices ↓	LI	CI	TR	DIV	TX	Total
G_{gb12}	0.00027 0.04999	0.00252 0.46655	0.0061 1.12936	0.00011 0.02037	0 0.00000	**0.009** **1.66627**
G_{gb13}	0.00038 0.07035	0.00259 0.47951	0.00565 1.04604	0.00005 0.00926	0.01015 1.87918	**0.01882** **3.48435**
G_{gb14}	0.00015 0.02777	0.00135 0.24994	0.00296 0.54802	0.00006 0.01111	0.00016 0.02962	**0.00468** **0.86646**
G_{gb15}	0.00039 0.07220	0.00215 0.39805	0.00488 0.90349	0.00009 0.01666	0.00037 0.06850	**0.00788** **1.45891**
G_{gb16}	0.00027 0.04999	0.00132 0.24439	0.00317 0.58690	0.00006 0.01111	0.00012 0.02222	**0.00494** **0.91459**
G_{gb17}	0.00045 0.08331	0.00113 0.20921	0.00263 0.48692	0.00005 0.00926	0.00009 0.01666	**0.00435** **0.80536**
G_{gb23}	0.00442 0.81832	0.00863 1.59776	0.02077 3.84537	-0.00004 -0.00741	0.03928 7.27232	**0.07306** **13.52637**
G_{gb24}	0.00212 0.39250	0.00454 0.84054	0.01098 2.03284	0.00013 0.02407	-0.00202 -0.37398	**0.01575** **2.91596**
G_{gb25}	0.00447 0.82758	0.00693 1.28302	0.0177 3.27699	0.00021 0.03888	-0.0028 -0.51839	**0.02651** **4.90808**
G_{gb26}	0.00297 0.54987	0.00421 0.77944	0.01158 2.14393	0.00013 0.02407	-0.00226 -0.41842	**0.01663** **3.07889**
G_{gb27}	0.0038 0.70353	0.00314 0.58134	0.00837 1.54963	0.00013 0.02407	-0.00064 -0.11849	**0.0148** **2.74008**
G_{gb34}	0.0026 0.48137	0.00456 0.84424	0.00956 1.76994	-0.00001 -0.00185	0.02154 3.98793	**0.03825** **7.08163**
G_{gb35}	0.00529 0.97939	0.00695 1.28673	0.01527 2.82710	-0.00004 -0.00741	0.03711 6.87057	**0.06458** **11.95638**
G_{gb36}	0.00348 0.64429	0.00422 0.78129	0.01010 1.86992	-0.00003 -0.00555	0.02269 4.20084	**0.04046** **7.49079**
G_{gb37}	0.00428 0.79240	0.00315 0.58319	0.0071 1.31450	-0.00001 -0.00185	0.02075 3.84167	**0.03527** **6.52991**
G_{gb45}	0.00259 0.47951	0.00366 0.67761	0.00815 1.50890	0.00011 0.02037	-0.00083 -0.15367	**0.01368** **2.53272**
G_{gb46}	0.00171 0.31659	0.00222 0.41101	0.00537 0.99421	0.00007 0.01296	-0.00079 -0.14626	**0.00858** **1.58851**
G_{gb47}	0.00214 0.39620	0.00165 0.30548	0.00376 0.69613	0.00007 0.01296	0.00003 0.00555	**0.00765** **1.41633**
G_{gb56}	0.00334 0.61837	0.00336 0.62207	0.00861 1.59406	0.00011 0.02037	-0.00098 -0.18144	**0.01444** **2.67343**
G_{gb57}	0.00397 0.73501	0.00249 0.46100	0.00606 1.12195	0.00011 0.02037	0.00024 0.04443	**0.01287** **2.38276**
G_{gb67}	0.00255 0.47211	0.00152 0.28141	0.00409 0.75723	0.00007 0.01296	-0.00016 -0.02962	**0.00807** **1.49408**
Total: G_{gb}	**0.05164** **9.56066**	**0.07229** **13.38382**	**0.17286** **32.00341**	**0.00143** **0.26475**	**0.14205** **26.29922**	**0.44027** **81.51186**
G_{w1}	-0.00001 -0.00185	0.00035 0.06480	0.00085 0.15737	0.00002 0.00370	0.00002 0.00370	**0.00123** **0.22772**
G_{w2}	0.00175 0.32400	0.0043 0.79610	0.01166 2.15874	0.00012 0.02222	-0.00259 -0.47951	**0.01524** **2.82154**
G_{w3}	0.00269 0.49803	0.00433 0.80166	0.00896 1.65886	-0.00016 -0.02962	0.04388 8.12397	**0.0597** **11.05289**
G_{w4}	0.00063 0.11664	0.0012 0.22217	0.00254 0.47026	0.00003 0.00555	-0.00034 -0.06295	**0.00406** **0.75167**
G_{w5}	0.00256 0.47396	0.00277 0.51284	0.0065 1.20341	0.00009 0.01666	-0.00041 -0.07591	**0.01151** **2.13097**
G_{w6}	0.00108 0.19995	0.00102 0.18884	0.00284 0.52580	0.00004 0.00741	-0.00045 -0.08331	**0.00453** **0.83869**
G_{w7}	0.00138 0.25549	0.00056 0.10368	0.00142 0.26290	0.00003 0.00555	0.0002 0.03703	**0.00359** **0.66465**
Total: G_w	**0.01008** **1.86622**	**0.01453** **2.69009**	**0.03477** **6.43734**	**0.00017** **0.03147**	**0.04031** **7.46302**	**0.09986** **18.48814**
Total: G	**0.06172** **11.42688**	**0.08682** **16.07391**	**0.20763** **38.44075**	**0.00160** **0.29622**	**0.18236** **33.76224**	**0.54013** **100.00000**

* *Source : FIES-97* * *Blue Values: % contribution to G*

This is the Gini multi-decomposition estimation after a tax simulation on custom dues.

TABLE 7. GINI MULTI-DECOMPOSITION: SIMULATION 3 *

Sources→ Indices ↓	LI	CI	TR	DIV	TX	Total
G_{gb12}	-0.00005 -0.00693	0.00177 0.24545	-0.00201 -0.27873	0.00005 0.00693	0.01409 1.95388	**0.01385** **1.92060**
G_{gb13}	0.0001 0.01387	0.00184 0.25516	-0.0024 -0.33281	0.00001 0.00139	0.03139 4.35289	**0.03094** **4.29049**
G_{gb14}	0.00004 0.00555	0.00098 0.13590	-0.00088 -0.12203	0.00003 0.00416	0.00684 0.94851	**0.00701** **0.97209**
G_{gb15}	0.00017 0.02357	0.00156 0.21633	-0.00152 -0.21078	0.00006 0.00832	0.01159 1.60720	**0.01186** **1.64464**
G_{gb16}	0.00012 0.01664	0.00095 0.13174	-0.00093 -0.12896	0.00003 0.00416	0.00729 1.01091	**0.00746** **1.03449**
G_{gb17}	0.00031 0.04299	0.00054 0.07488	-0.0018 -0.24961	0.00003 0.00416	0.0087 1.20644	**0.00778** **1.07886**
G_{gb23}	0.00236 0.32726	0.00629 0.87224	0.00569 0.78904	-0.00012 -0.01664	0.09025 12.51508	**0.10447** **14.48699**
G_{gb24}	0.00117 0.16225	0.00338 0.46871	0.00428 0.59351	0.00007 0.00971	0.0061 0.84589	**0.015** **2.08007**
G_{gb25}	0.00263 0.36471	0.00523 0.72525	0.00709 0.98318	0.00012 0.01664	0.01036 1.43663	**0.02543** **3.52641**
G_{gb26}	0.00178 0.24683	0.00313 0.43404	0.00448 0.62125	0.00007 0.00971	0.00661 0.91662	**0.01607** **2.22845**
G_{gb27}	0.00266 0.36887	0.00141 0.19553	-0.00066 -0.09152	0.00006 0.00832	0.0164 2.27421	**0.01987** **2.75540**
G_{gb34}	0.00169 0.23435	0.00346 0.47980	0.00376 0.52140	-0.00004 -0.00555	0.04493 6.23050	**0.0538** **7.46051**
G_{gb35}	0.00349 0.48396	0.00536 0.74328	0.00624 0.86531	-0.00007 -0.00971	0.07604 10.54456	**0.09106** **12.62740**
G_{gb36}	0.00231 0.32033	0.00322 0.44652	0.00394 0.54636	-0.00005 -0.00693	0.04774 6.62017	**0.05716** **7.92645**
G_{gb37}	0.00315 0.43681	0.00143 0.19830	-0.00131 -0.18166	-0.00004 -0.00555	0.05217 7.23448	**0.0554** **7.68239**
G_{gb45}	0.00175 0.24267	0.00289 0.40076	0.0044 0.61015	0.00008 0.01109	0.00306 0.42433	**0.01218** **1.68902**
G_{gb46}	0.00116 0.16086	0.00174 0.24129	0.00278 0.38551	0.00005 0.00693	0.00198 0.27457	**0.00771** **1.06916**
G_{gb47}	0.00159 0.22049	0.00081 0.11232	0.00001 0.00139	0.00004 0.00555	0.00738 1.02339	**0.00983** **1.36314**
G_{gb56}	0.00227 0.31478	0.00269 0.37303	0.00465 0.64482	0.00008 0.01109	0.00336 0.46594	**0.01305** **1.80966**
G_{gb57}	0.00293 0.40631	0.00117 0.16225	-0.00002 -0.00277	0.00007 0.00971	0.01249 1.73200	**0.01664** **2.30749**
G_{gb67}	0.00187 0.25932	0.00068 0.09430	0.00002 0.00277	0.00004 0.00555	0.00788 1.09273	**0.01049** **1.45466**
Total: G_{gb}	**0.03350** **4.64549**	**0.05053** **7.00706**	**0.03581** **4.96582**	**0.00057** **0.07904**	**0.46665** **64.71094**	**0.58706** **81.40835**
G_{w1}	-0.00003 -0.00416	0.00024 0.03328	-0.00068 -0.09430	0.00001 0.00139	0.00279 0.38689	**0.00233** **0.32310**
G_{w2}	0.00069 0.09568	0.00309 0.42849	0.00338 0.46871	0.00005 0.00693	0.00831 1.15236	**0.01552** **2.15218**
G_{w3}	0.00169 0.23435	0.00322 0.44652	0.00226 0.31340	-0.00018 -0.02496	0.08524 11.82034	**0.09223** **12.78965**
G_{w4}	0.00042 0.05824	0.00093 0.12896	0.00132 0.18305	0.00002 0.00277	0.0009 0.12480	**0.00359** **0.49783**
G_{w5}	0.00174 0.24129	0.00224 0.31062	0.00368 0.51031	0.00007 0.00971	0.00259 0.35916	**0.01032** **1.43109**
G_{w6}	0.00074 0.10262	0.0008 0.11094	0.00147 0.20385	0.00002 0.00277	0.00109 0.15115	**0.00412** **0.57133**
G_{w7}	0.00106 0.14699	-0.00001 -0.00139	-0.00107 -0.14838	0.00002 0.00277	0.00596 0.82648	**0.00596** **0.82648**
Total: G_w	**0.00631** **0.87502**	**0.01051** **1.45743**	**0.01036** **1.43663**	**1E-05** **0.00139**	**0.10688** **14.82118**	**0.13407** **18.59165**
Total: G	**0.03981** **5.52050**	**0.06104** **8.46449**	**0.04617** **6.40245**	**0.00058** **0.08043**	**0.57353** **79.53212**	**0.72113** **100.00000**

* *Source : FIES-97*   * *Blue Values: % contribution to G*

This is the Gini multi-decomposition estimation after a tax simulation on households.

TABLE 8. GINI MULTI-DECOMPOSITION: SIMULATION 4 *

Sources→ Indices ↓	LI	CI	TR	DIV	TX	Total
G_{gb12}	0.00026 0.04847	0.00254 0.47351	0.00611 1.13903	0.00008 0.01491	0.00001 0.00186	**0.009** **1.67779**
G_{gb13}	0.00037 0.06898	0.00261 0.48656	0.00567 1.05701	0.00004 0.00746	0.00997 1.85862	**0.01866** **3.47862**
G_{gb14}	0.00015 0.02796	0.00136 0.25353	0.00297 0.55367	0.00004 0.00746	0.00016 0.02983	**0.00468** **0.87245**
G_{gb15}	0.00038 0.07084	0.00216 0.40267	0.00489 0.91160	0.00008 0.01491	0.00037 0.06898	**0.00788** **1.46900**
G_{gb16}	0.00026 0.04847	0.00134 0.24980	0.00318 0.59282	0.00005 0.00932	0.00012 0.02237	**0.00495** **0.92278**
G_{gb17}	0.0004 0.07457	0.00114 0.21252	0.00264 0.49215	0.00004 0.00746	0.00011 0.02051	**0.00433** **0.80720**
G_{gb23}	0.00435 0.81093	0.00871 1.62373	0.02089 3.89434	-0.00002 -0.00373	0.03847 7.17162	**0.0724** **13.49689**
G_{gb24}	0.00208 0.38776	0.00458 0.85381	0.01101 2.05250	0.0001 0.01864	-0.00203 -0.37843	**0.01574** **2.93427**
G_{gb25}	0.00441 0.82212	0.007 1.30495	0.01774 3.30711	0.00017 0.03169	-0.00281 -0.52384	**0.02651** **4.94202**
G_{gb26}	0.00293 0.54621	0.00425 0.79229	0.01161 2.16435	0.0001 0.01864	-0.00226 -0.42131	**0.01663** **3.10018**
G_{gb27}	0.00361 0.67298	0.0032 0.59655	0.00844 1.57339	0.0001 0.01864	-0.00065 -0.12117	**0.0147** **2.74039**
G_{gb34}	0.00257 0.47910	0.00459 0.85567	0.00963 1.79524	-0.00001 -0.00186	0.02111 3.93535	**0.03789** **7.06350**
G_{gb35}	0.00523 0.97498	0.007 1.30495	0.01538 2.86716	-0.00004 -0.00746	0.03641 6.78759	**0.06398** **11.92722**
G_{gb36}	0.00344 0.64129	0.00425 0.79229	0.01016 1.89404	-0.00002 -0.00373	0.02225 4.14787	**0.04008** **7.47176**
G_{gb37}	0.00409 0.76246	0.0032 0.59655	0.00719 1.34037	0 0.00000	0.02036 3.79553	**0.03484** **6.49491**
G_{gb45}	0.00256 0.47724	0.00369 0.68789	0.00817 1.52306	0.00009 0.01678	-0.00084 -0.15659	**0.01367** **2.54838**
G_{gb46}	0.00169 0.31505	0.00224 0.41758	0.00538 1.00295	0.00006 0.01119	-0.00079 -0.14727	**0.00858** **1.59949**
G_{gb47}	0.00204 0.38030	0.00168 0.31319	0.00379 0.70654	0.00005 0.00932	0.00003 0.00559	**0.00759** **1.41494**
G_{gb56}	0.00332 0.61892	0.00339 0.63197	0.00862 1.60695	0.00009 0.01678	-0.001 -0.18642	**0.01442** **2.68819**
G_{gb57}	0.00382 0.71213	0.00252 0.46978	0.00609 1.13530	0.00009 0.01678	0.00025 0.04661	**0.01277** **2.38060**
G_{gb67}	0.00246 0.45860	0.00154 0.28709	0.00411 0.76619	0.00005 0.00932	-0.00015 -0.02796	**0.00801** **1.49323**
Total: G_{gb}	**0.05042** **9.39935**	**0.07299** **13.60688**	**0.17367** **32.37575**	**0.00114** **0.21252**	**0.13909** **25.92931**	**0.43731** **81.52381**
G_{w1}	0 0.00000	0.00035 0.06525	0.00085 0.15846	0.00001 0.00186	0.00002 0.00373	**0.00123** **0.22930**
G_{w2}	0.00172 0.32064	0.00435 0.81093	0.01169 2.17926	0.0001 0.01864	-0.00261 -0.48656	**0.01525** **2.84292**
G_{w3}	0.00265 0.49402	0.00436 0.81280	0.00907 1.69084	-0.00014 -0.02610	0.04306 8.02729	**0.059** **10.99884**
G_{w4}	0.00062 0.11558	0.00121 0.22557	0.00255 0.47537	0.00003 0.00559	-0.00035 -0.06525	**0.00406** **0.75687**
G_{w5}	0.00254 0.47351	0.00279 0.52011	0.00652 1.21547	0.00007 0.01305	-0.00041 -0.07643	**0.01151** **2.14571**
G_{w6}	0.00108 0.20133	0.00103 0.19201	0.00284 0.52944	0.00003 0.00559	-0.00046 -0.08575	**0.00452** **0.84262**
G_{w7}	0.00131 0.24421	0.00056 0.10440	0.00143 0.26658	0.00003 0.00559	0.00021 0.03915	**0.00354** **0.65993**
Total: G_w	**0.00992** **1.84930**	**0.01465** **2.73107**	**0.03495** **6.51542**	**0.00013** **0.02423**	**0.03946** **7.35618**	**0.09911** **18.47619**
Total: G	**0.06034** **11.24865**	**0.08764** **16.33794**	**0.20862** **38.89117**	**0.00127** **0.23675**	**0.17855** **33.28549**	**0.53642** **100.00000**

* *Source : FIES-97 * Blue Values: % contribution to G*

This is the Gini multi-decomposition estimation after a tax simulation on firms.