Financing poverty alleviation: IVA vs ISR.
An Applied General Equilibrium Approach.

Gaspar Núñez*
Clemente Polo**

Abstract: The goal of this paper is to analyze two alternative ways of financing poverty alleviation in Mexico: 1) A Value Added Tax (IVA) reform, or 2) A Personal Income Tax (ISR) reform. Using an Applied General Equilibrium Model (AGEM) we evaluate reforms' impact through the money measure in welfare change given by Hicks' Equivalent Variation (EV). Results from four basic simulations, using a Social Accounting Matrix prepared by the authors, suggest that: A) An increase in IVA (maintaining its structure) generates a positive global EV, which is considerably greater than that obtained increasing the ISR (also maintaining its structure). B) However, given ISR's progressive structure, increasing it reduces the distributive gap by diminishing lower income deciles' contribution, and increasing highest income decile's contribution. C) A uniform IVA results in a positive global EV considerably larger than the one obtained with a uniform ISR but, as we would expect, highest income decile's households obtain a high benefit, so deepening the distributive gap.

Key words: Applied general equilibrium, Extreme poverty, Tax reform, Social accounting matrix, Welfare money measure.

* Researcher at the *Centro de Investigaciones Socioeconómicas* (CISE) of the *Universidad Autónoma de Coahuila* (UAdeC), Mexico.

Telephone number: +52(844) 412-11-13 ext. 114.

E-mail: nuroga@yahoo.com

Address: Gaspar Núñez Rodríguez
C. Oaxaca 1115 esq Silao
Fracc. Guanajuato c.p. 25280
Saltillo, Coahuila. Mexico.

** Professor at the *Departamento de Economía e Historia Económica* of the *Universidad Autónoma de Barcelona* (UAB), Spain.

1. Introduction.

Given the extreme poverty problem's magnitude in Mexico,[1] any strategy meant to effectively address it, should have at least two fundamental components: 1) An administratively efficacious medium and long term program, and 2) An internal and sustainable financing program.

With the intended purpose of generating resources to alleviate poverty, during the first half of president Fox's administration, the Mexican government posed and publicized the initiative of an IVA increase as the best way of attaining said purpose. However, little was said about suitability of this measure, its drawbacks, or feasible alternatives.

The goal of this paper is to analyze and compare two alternative ways of internally financing the necessary funds to alleviate extreme poverty: 1) A Value Added Tax (IVA) reform, and 2) A Personal Income Tax (ISR) reform. Using an Applied General Equilibrium Model (AGEM), we simulate IVA reforms and ISR reforms as an alternative to raise funds and alleviate extreme poverty, evaluate the impact on welfare that each reform could have, and perform a comparative analysis through the welfare money measure provided by Hicks' Equivalent Variation (EV).

Results from four basic simulations are reported: 1) An IVA increase maintaining its same structure (that of 1996), 2) An ISR increase maintaining its same structure (that of 1996), 3) A uniform IVA, and 4) A uniform ISR. Every reform generates a surplus, such that, when it is directly transferred to the lowest income decile's households, increases their

[1] According to INEGI's (National Institute of Statistics, Geography and Data Processing) statistics, in 1996 at least the two lowest income deciles were below the extreme poverty line (1996 Households' Income-Expenditure survey). According to R. Cordera (Undated), in that year there were 22.6 million people in extreme poverty, out of a total of 92.6 million.

welfare by the same EV, that is, reforms are comparable in the sense that they increase, by the same amount, target's welfare.

Results obtained using a Social Accounting Matrix (SAM) of Mexico for 1996 (SAM-MX96) prepared by the authors, as the basis for our AGEM, suggest that:

a) An IVA increase, maintaining its structure, generates a positive global VE (4.108)[2] considerably greater than that of an increase in ISR also maintaining its structure (-2.806).

b) However, given the ISR progressive structure, the ISR increase reduces the distributive gap by diminishing the lowest deciles' contribution and increasing the highest decile's contribution.

c) A uniform IVA would result in a global EV considerably larger (3.255) than that given by a uniform ISR (0.235) but, as would be expected, with a uniform ISR the highest income decile's households would obtain a large VE (6.705, one third of the amount directly transferred to the poorest decile), so deepening the distributive gap.

The paper is organized as follows. Section 2 presents the AGEM designed to simulate reforms. Section 3 presents a brief characterization of IVA and ISR structure, according to the SAM-MX96. In section 4 we describe the main features of PROGRESA (Program of Education, Health, and Food), to set up a benchmark for our simulations. Section 5 presents the four basic simulations' results and a discussion on them. Finally, section 6 concludes with some final comments.

[2] Given that all prices are equal to 1 in the inicial, or reference, equilibrium, numbers are equivalent to billions of pesos of 1996.

2. The Model.

2.1. The Social Accounting Matrix.

We prepared a 1996 SAM for Mexico named SAM-MX96. As usual when preparing a SAM, we relied on an Input-Output Table (CIESA, 1996), and on Mexico's National Accounting System (SCNM)[3], as the main statistical sources. This information has been complemented with the "National Survey of Households' Income-Expenditure" (INEGI, 1999b) to workout the relationship between production and private consumption. In addition, the following sources were also used: "Federal Income Accounting" (SHCP, 2001); "Compendium of Fiscal Federal Laws" (Fisco Agenda 97, 1997); "Annual Statistical Information, Exports/Imports, 1993-200" (Bancomext, 2000); and the "Annual Report, 1996" (Banxico, 1996).

The SAM-MX96 disaggregates the circular flow of income. Distinguishes 10 types of Households defined by income decile, one institution called Societies, another one called Public Administrations (or Government), and two External sectors: 1) Other members of NAFTA, and 2) Rest of the world. It also accounts for several fiscal items: Social Security Contributions (CS), Value Added Tax (IVA), Production Taxes, Personal Income Tax (ISR); and for three public services produced by the government: General, health, and educative services. It also contains 18 productive Activities producing homogeneous goods or services, which, added to imports, amount to Total Supply.

Production is carried out using as inputs the 18 homogeneous goods and services, 18 types of labor, and homogeneous capital services. Labor and capital income (plus non-resident income) is distributed between institutions according to their property rights.

[3] SCNM's information comes in three volumen: "Cuentas de Bienes y servicios 1988-00" (Goods and Services Accounting); "Cuentas por Sectores Institucionales, 1993-98" (Institutional Sectors Accounting); "Indicadores Macroeconómicos del Sector Público, 1988-99" (Public Sector Macroeconomic Indicators).

Institutions use their income to absorb goods and services: Households buy 10 Consumption goods, public administrations finance public services, and external sectors buy exports. Savings by residents plus current account deficit absorb the rest of goods and services, which we call gross investment. Appendix 1 defines every entry of the SAM-MX96.

2.2 The Applied General Equilibrium Model (AGEM).

2.2.1. Goods, factors, and agents.

Following the SAM-MX96 our model has 18 Activities, each producing one homogeneous good or service; 10 goods and services for private consumption acquired by households; 3 public goods acquired by public administrations (Public Education, Public Health, and Collective Services); investment; and exports.

Besides, the model includes 10 households, each defined by families in every income decile; a Government, whose activities encompass the set of all public administrations; Societies; and two External sectors: 1) Canada and the USA as the rest of the NAFTA area, and 2) the rest of the world.

2.2.2. Production

Each Activity produces one homogeneous good or service through a CES technology, using three inputs: 1) domestic production, 2) imports from the rest of the NAFTA area, and 3) imports from the rest of the world. Domestic production is a Leontief aggregation of the 18 homogeneous goods and services and Value Added. Finally, Value Added is produced through a Cobb-Douglas technology using 18 types of labor and homogeneous capital services.

The goal of Activities -in what follows also “firms”- is to maximize profits, and given that production has constant returns to scale in the three nested stages, such goal implies that price equals average (unitary) cost. Accordingly, the firm’s problem can be decomposed into three optimization sub-problems, whose solution provide optimal factors demand (and also prices from average unitary costs).

To produce its Value Added, firm *i* solves the following problem:

$$\min_{L_i, K_i} \sum_{l=1}^{l=18} \left(1+\tau_{li}^{cs}\right) p_l L_{li} + p_K K_i$$

s.t. $V_i = A_i \prod_{l=1}^{l=18} L_{li}^{\alpha_{il}} K_i^{\alpha_k i}$ with $\sum_{l=1}^{l=18} \alpha_{li} + \alpha_{ki} = 1$.

Where τ_i^{cs} is the rate for social security contributions (SSC), p_l the labor rate for labor type l, L_{li} the units of labor type l, p_k capital’s price, K_i units of capital, A_i a scale parameter, α_{li} distributive parameters for labor types, and α_{ki} distributive parameters for capital.

Solving we obtain factors’ optimal demands $\left[\left(L_{li}^*\right)_{l=1}^{18}, K_i^*\right]$:

$$K_i^* = \left(\frac{V_i}{A_i}\right)\left(\frac{\alpha_{ki}}{p_K}\right)^{1-\alpha_k} \prod_{l=1}^{l=18} \left(\frac{(1+\tau_i^{cs})\, p_l}{\alpha_{li}}\right)^{\alpha_l}$$

$$L_{li}^* = \frac{V_i}{A_i} \frac{\alpha_{li}}{(1+\tau_i^{cs})\, p_l} \left(\frac{p_K}{\alpha_{ki}}\right)^{\alpha_k i} \prod_{l=1}^{l=18} \left(\frac{(1+\tau_{li}^{cs})\, p_l}{\alpha_{li}}\right)^{\alpha_{li}}$$

And the price of a unit of Value added (equal to average unitary cost):

$$p_{vi} = \sum_{l=1}^{18} p_l \left(1+\tau_{li}^{cs}\right) \frac{L_{li}^*}{V_i} + p_k \frac{K_i^*}{V_i} = \frac{1}{A_i} \left(\frac{P_K}{\alpha_{ik}}\right)^{\alpha_{ki}} \prod_{l=1}^{l=18} \left(\frac{(1+\tau_{li}^{cs}) P_l}{\alpha_{li}}\right)^{\alpha_{li}}$$

At the next level, to obtain domestic production, the firm solves:

$$\min_{X_{ji},V_i} \sum_{j=1}^{l=18} p_j X_{ji} + p_{vi} V_i \quad \text{s.t.} \quad Y_{di} = \min\left(\frac{X_{1i}}{a_{1i}}, \frac{X_{2i}}{a_{2i}}, ..., \frac{X_{18i}}{a_{18i}}, \frac{V_i}{v_i} \right)$$

Where X_{ji} is the quantity of input j used in production of good i, V_i the quantity of value added used in production of good i, a_{ji} the unitary requirement of input j to produce good i, v_i the unitary requirement to of value added to produce good i, p_j the unit price of input j, and p_v the per unit price of value added.

Optimal quantities simply are:

$X^*_{ji} = a_{ji} Y_{di}$ and $V^*_i = v_i Y_{di}$.

And the price giving null profits equals average cost plus taxes:

$$p_{di} = \left(\sum_{j=1}^{18} p_j a_{ji} + p_{vi} v_i \right) \left(1 + t^p_i\right)$$

Where t^p_i is the ad valorem tax rate on good i production.

At the first level of the nested production, to obtain its total supply (Y_i) the firm minimizes the cost of producing a homogeneous good using domestic production and equivalent imports (Armington, 1969). The problem can be stated as:

$$\min\ p_{di} Y_{di} + p_{ai} \left(1 + t^m_{ai}\right) Y_{ai} + \left(1 + t^m_{ri}\right) p_{ri} Y_{ri}$$

$$\text{s.t.}\ \ Y_i = \Phi_i \left[\delta_{YIi} Y_{di}^{\rho_i} + \delta_{ai} Y_{ai}^{\rho_i} + \delta_{ri} Y_{ai}^{\rho i} \right]^{1/\rho_i} \ .$$

Where Y_{ai} and Y_{ri} are equivalent imports from the NAFTA area and the rest of the world respectively; p_{ai} and p_{ri} its corresponding prices; t^m_{ai} and t^m_{ri} the corresponding tax rates; Φ_i a scale parameter; δ_{di}, δ_{ai} y δ_{ri} three distributive parameters (with $\delta_{di} + \delta_{ai} + \delta_{ri} = 1$); and $\rho_i < 1$ a parameter that determines the constant elasticity of substitution:

$$\sigma_i = \frac{1}{1 - \rho_i} .$$

The solution gives the optimal demands:

$$Y_{di}^{*} = \frac{Y_i}{\Phi_i} \frac{\delta_{di}^{\sigma_i} p_{di}^{-\sigma_i}}{(\delta_{di}^{\sigma_i} p_{di}^{1-\sigma_i} + \delta_{ai}^{\sigma_i}\left(1+t_{ai}^{m}\right)p_{ai}^{1-\sigma_i} + \delta_{riP}^{\sigma_i}\left(1+t_{ri}^{m}\right)p_{ri}^{1-\sigma_i})^{\frac{\sigma_i}{\sigma_i-1}}}$$

$$Y_{ai}^{*} = \frac{Y_i}{\Phi_i} \frac{\delta_{ai}^{\sigma_i}\left(1+t_{ai}^{m}\right) p_{ai}^{-\sigma_i}}{(\delta_{di}^{\sigma_i} p_{di}^{1-\sigma_i} + \delta_{ai}^{\sigma_i}\left(1+t_{ai}^{m}\right)p_{ai}^{1-\sigma_i} + \delta_{riP}^{\sigma_i}\left(1+t_{ri}^{m}\right)p_{ri}^{1-\sigma_i})^{\frac{\sigma_i}{\sigma_i-1}}}$$

$$Y_{ri}^{*} = \frac{Y_i}{\Phi_i} \frac{\delta_{ri}^{\sigma_i}\left(1+t_{ri}^{m}\right) p_{ri}^{-\sigma_i}}{(\delta_{di}^{\sigma_i} p_{di}^{1-\sigma_i} + \delta_{ai}^{\sigma_i}\left(1+t_{ai}^{m}\right)p_{ai}^{1-\sigma_i} + \delta_{riP}^{\sigma_i}\left(1+t_{ri}^{m}\right)p_{ri}^{1-\sigma_i})^{\frac{\sigma_i}{\sigma_i-1}}}$$

And the price that maximizes profits:

$$p_i = p_{di}\frac{Y_{di}^{*}}{Y_i} + \left(1+t_{ai}^{m}\right)p_{ai}\frac{Y_{ai}^{*}}{Y_i} + \left(1+t_{ri}^{m}\right)p_{ri}\frac{Y_{ri}^{*}}{Y_i}$$

$$p_i = \frac{(p_{di}^{1-\sigma_i}\delta_{PI}^{\sigma_i} + p_{ai}^{1-\sigma}\delta_{ai}^{\sigma_i} + p_{ri}^{1-\sigma_i}\delta_{ri}^{\sigma_i})^{\frac{1}{1-\sigma_i}}}{\Phi_i}$$

Finally, private consumption goods are obtained with Leontief technologies:

$$\min \sum_{j=1}^{18} p_j Z_j \qquad \text{s.t.} \quad C_m = \min\left(\frac{Z_{1m}}{z_{1m}}, \frac{Z_{2m}}{z_{2m}}, \ldots, \frac{Z_{18m}}{z_{18m}}\right).$$

Solution gives good's demands to satisfy consumption:

$$Z_{jm}^{*} = z_{jm}C_m$$

And the price of consumption's goods that ensures a profit equal to cero:

$$p_m^c = \left(\sum_{j=1}^{18} p_j z_{jm}\right)\left(1+t_m^{iva}\right)$$

Where t_m^{iva} is the tax rate on consumption.

2.2.3. Households' behavior.

Households' welfare is a function of present (C_h) and future (S_h) consumption:

$$U_h = \left[\delta_h C_h^{\rho_h} + (1-\delta_h) S_h^{\rho_h}\right]^{\frac{1}{\rho_h}}, \qquad (h=1,\ldots,10).$$

Where δ_h is distributive parameter; C_h an aggregation of the 10 private consumption goods; and $\rho_h < 1$ the parameter that defines the elasticity of substitution between present and future consumption.

Present consumption is given by:

$$C_h = \prod_{n=1}^{10} C_{hn}^{\beta_{hn}}, \quad \text{with} \quad 0 < \beta_{hn} < 1, \text{ and } \quad \sum_{n=1}^{10} \beta_{hn} = 1,$$

Hence, the problem of choosing optimal quantities of every private consumption good can be posed as: $\min \sum_{n=1}^{10} p_n^c C_{hn}$, subject to the former constraint. And its solution gives optimal demands:

$$C_{hm}^* = \frac{\beta_{hm}}{p_m^c} \prod_{n=1}^{10} \left(\frac{p_n^c}{\beta_{hn}}\right)^{\beta_{hn}} C_h .$$

Aggregated price of present consumption is given by:

$$p_c = \sum_{n=1}^{10} p_n^c \frac{C_{hn}^*}{C_h} = \prod_{n=1}^{10} \left(\frac{p_n^c}{\beta_{hn}}\right)^{\beta_{hn}} .$$

At the first level of the nested utility, the household determines levels of present and future consumption that maximize their welfare solving:

$$\max\left[\delta_h C_h^{\rho_h} + (1-\delta_h) S_h^{\rho_h}\right]^{\frac{1}{\rho_h}}, \quad \text{subject to} \quad p_c C_h + p_I S_h \le ID_h .$$

Where p_I is the investment good's price and ID_h households' disposable income. Optimal demands are:

$$C_h^* = \left(\frac{\delta_h}{p_c}\right)^{\sigma_h} \left[\frac{ID_h}{\delta_h^{\sigma_h}\, p_c^{1-\sigma_h} + (1-\delta_h)^{\sigma_h}\, p_I^{1-\sigma_h}}\right]$$

$$S_h^* = \left(\frac{(1-\delta_h)}{p_I}\right)^{\sigma_h} \left[\frac{ID_h}{\delta_h^{\sigma_h}\, p_c^{1-\sigma_h} + (1-\delta_h)^{\sigma_h}\, p_I^{1-\sigma_h}}\right],$$

with $\sigma_h = \frac{1}{1-\rho_h}$.[4]

Households' gross income comes from selling their labor and capital endowments, and from government's transfers. Disposable income equals gross income minus income taxes:

$$ID_h = \left(\sum_{i=1}^{18} p_l \bar{L}_{hl} + \Theta_{hk}\, p_k \bar{K}_h (1-s) + \Theta_{hg} TR_g\right)(1-t_h^r).$$

Where $\bar{L}_{hl}$ is the endowment of type *l* labor that every household has; Θ_{hk} is every household's participation in capital; s is the tax rate paid by Societies (capital); Θ_{hg} is each household's share in government transfers; TR_g are government transfers; and t_h^r is the tax rate on income, paid by each household.

[4] Aunque la introducción de un parámetro de escala no tiene mucho sentido en una función de utilidad, si especificamos ésta como: $U = \phi(\delta_c C^\rho + \delta_S S^\rho)^{1/\rho}$, y sustituimos por las demandas óptimas: $U = \phi(ID)\left(\delta_C^\sigma p_C^{1-\sigma} + \delta_S^\sigma p_S^{1-\sigma}\right)^{\frac{1}{\sigma-1}}$, es fácil ver que definiendo ϕ como: $\phi = \frac{1}{\left(\delta_C^\sigma p_C^{1-\sigma} + \delta_S^\sigma p_S^{1-\sigma}\right)^{\frac{1}{\sigma-1}}}$, nos queda: U = ID. Esta transformación monótona de U permite visualizar inmediatamente el cambio en el bienestar como la diferencia entre el nivel de utilidad final y el inicial:
VE = E(U_1, p_0) - E(U_0, p_0) = $ID_1 - ID_0 = U_1 - U_0$.

2.2.4. Societies' behaviour.

Societies are intermediary institutions between the productive sector, households, government, and external sectors. Their gross income is given by the capital endowment of the economy: $IB_{SOC} = (P_K*DK)$.

Societies pay a tax on their income, and a constant real quantity for capital reposition (savings). The remaining amount is distributed among households and the rest of the world, according to their share on capital property. Hence, we define distribution of gross exploitation surplus as:

$$IB_{SOC} = \mathrm{P_k DK} * \tau^s + \overline{RPK} + \left(\sum_{h=1}^{h=10} \tau_h^k + \tau_{RdM}^k\right)\left(\mathrm{ID_{SOC}}\right)$$

Where DK is total capital services endowment; τ^s the tax rate paid by Societies; $\overline{RPK}$ capital's reposition (Societies' constant savings), ID_{SOC} Societies income alter taxes and savings; τ_h^k each household's capital share; and τ_{RdM}^k external sector's capital share.

2.2.5. Government behavior.

Government income comes from taxes and from social security contributions. And Government outlays are given by Social Expenditures, Domestic Transfers, Public goods and services, Investment (savings), and transfers to the rest of the world. Government income is:

GI = RISR + RIIMS + RIP + RCS

Where $RISR$ is income tax revenue, $RIIMS$ is Indirect taxes revenue (minus subsidies), RIP is Other taxes on production revenue, and RCS is Social security contributions revenue.

RISR has two components: revenue from Societies (RISRS) and revenue from households (RISRH):

$\text{RISRS} = \tau_{\text{ISRS}}\, P_k\, DK$

$$RISRH = \sum_{H=1}^{H=10} \tau_{ISRH} IB_h \,.$$

Where τ_{ISRS} is the tax rate on Societies income; P_k capital's price; DK total capital endowment; τ_{ISRH} the tax rate on households' income; and IB_h is the households' gross income.

Revenue from production taxes is:

$RIP = \tau_{IP}\, (VPIPF).$

Where τ_{IP} is the tax rate, and $VPIPF$ the production value at factory prices.

Finally, social contributions are:

$$RCS = \sum_{i=1}^{i=10} \sum_{l=1}^{l=18} \tau^{cs} p_l L_{l,i}$$

On the other hand, government expenditures are defined as:

$G_G = PS_G + OT_G + AHR_G + CSC_G + CSP_G + CEP_G + PGRdM_G$

Where PS_G are social expenditures, OT_G other transfers, AHR_G public savings (investment), CSC_G Collective services consumption, CSP_G public health consumption, CEP_G public education consumption, and $PGRdM_G$ payments to the rest of the world.

Government expenditure could be greater (or smaller) than its revenues, therefore we define a public surplus as: $SP = GI_G - G_G$.

2.2.6. External sectors.

External sectors (rest of NAFTA and rest of the world) offer and demand capital, labor, and goods and services. Imports level is endogenously determined through relative prices of domestic and imported goods. Exports are exogenously fixed and, therefore, the external deficit is endogenous.

Net external payments account defines the financing capacity of the economy, and comprises the sum of labor and capital net sales; net transfers received by domestic households, societies, and government; net external consumption (consumption by non-residents); and the net trade balance (exports minus imports).

External sector income is:

$$SEXI = P_{RdM}MX_{RdM} + \tau^{k}_{RdM}\, SOCID + PGRdM_{G}$$

Where MX_{RdM} are imports from the rest of the World, $\tau^{k}_{RdM}*SOCID$ are Societies transfers to the rest of the World, and $PGRdM_{G}$ government transfers to the Rest of the world.

Expenditures of the external sector are:

$$SEXE = P_{RdM}PX_{RdM} + OT_{PGRDM} + AHBR_{PGRDM} + P_{L}L_{RdM}$$

Where PX_{RdM} are exports to the Rest of the World, OT_{PGRDM} transfers from the rest of the World, $AHBR_{PGRDM}$ are the savings of the rest of the World, and $P_{L}L_{RdM}$ is labor income form the rest of the world.

Exports paid by the rest of the world and payments to labor are exogenous, hence, given the budget constraint of the external sector which changes when imports change, the rest of the world account balances transferring its surplus (deficit) to the savings-investment account, that is to say, external sector net payments account is an endogenous variable.

2.2.7. Closures.

Capital and labor endowments are part of the system's constraints: Total factors endowments are supplied.

$$\sum_{i=1}^{18} K_i^* = DOTINI_K$$

$$\sum_{i=1}^{18} L_{l,i}^* = DOTINI_L$$

Total supply (Y_i) equals total demand for every good and service:

$$Y_i = \sum_{j=1}^{18} DEMINS_{i,j} + \sum_{C=1}^{10} INSCP_{i,c} + INV_i + \sum_{b=1}^{3} INSCPUB_{i,b} + XPRDM_i \,.$$

Where Y_i is Activity *i*'s total supply; $DEMINS_{i,j}$ is input i used by Activity j; $INSCP_{i,c}$ is *i*'s input demand to produce the private consumption good or service c; INV_i is investment on good *i*, $INSCPUB_{i,b}$ *i*'s input demand to produce public consumption good *b*; and $XPRDM_i$ are Activity *i* exports.

Investment equals savings:

$$INV_i = \left(\sum_{h=1}^{10} AHR_h + \overline{RPK} + DEF_{RdM} + AP_{AHR} \right) \tau_i$$

Where INV_i is investment on good *i*; AHR_h are household *h*'s savings; RPK are (constant) Societies savings; DEF_{RdM} is the external deficit; and AP_{AHR} are public savings.

Because our model is static, when we simulate a reform to evaluate its effects on welfare, allowing investment variations, we could observe, at the same time, an increase in welfare and a decrease in investment, not knowing how much of the increase in welfare comes from the reform itself, and how much from investment's decrease. Therefore, to isolate the reform's effect, we carry out simulations keeping constant the level of investment at the initial level, by compensating variations in private savings with variations -in the opposite direction- in public savings.

Under the same argument, we fix the external deficit at the initial level, allowing exports' variations to compensate for any variation in imports.

2.2.8 Equilibrium.

The standard definition of equilibrium is used: The model's solution is a price vector such that, the economy is in equilibrium if optimization of agents' rules of behavior imply that quantities offered in each market equal demanded quantities.

2.2.9. Welfare variations.

Welfare changes generated by reforms are evaluated with Hicks' Equivalent Variation, defined as the necessary amount of money –at current prices- for the consumer to reach the utility level he would obtain if the reform would take place.

3. IVA and ISR structure.

Table 3.1 shows the structure of the IVA and of the ISR according to the SAM-MX96. In the case of the IVA, the tax rate paid on every private consumption good, is different from that specified by IVA's Law, because private consumption goods are a Leontief combination of different produced goods, which have different tax rates.

IVA's structure for the 10 private consumption goods under consideration, can be characterized by grouping these goods into three sets:

a) Goods with a high tax rate: C2 (Clothes and Shoes), C4 (Furniture, and domestic equipment and gadgets (supplies)), and C9 (Hotels, coffee shops and restaurants) with a rate of 10.2%. And C10 (Diverse Goods and Services) with 9.5%.
b) Goods with a medium tax rate: C7 (Entertainment and culture) 6.8%; C3 (Housing, electricity, gas, water) 5.7%, and C6 (Transportation) 5.5%.
c) Goods with a low tax rate: C8 (Education) 2.8%; C1 (Food, beverages and tobacco) 0.7%; and C5 (Health) 0.0%.

With respect to the ISR we can see that that it is notoriously progressive, and even more progressive in the two highest income deciles, because of the deep gap in income distribution observed in the Mexican economy.

Cuadro 3.1. IVA and ISRPF structure.

PRIVATE CONSUMPTION GOODS AND SERVICES	**IVA ESTRUCTURE (%)**	HOUSEHOLDS (Deciles)	**ISR STRUCTURE (%)**
C1	0.67	**H1**	0.20
C2	10.18	**H2**	0.65
C3	5.66	**H3**	1.05
C4	10.18	**H4**	1.20
C5	0.00	**H5**	1.31
C6	5.52	**H6**	1.33
C7	6.76	**H7**	1.36
C8	2.79	**H8**	1.69
C9	10.18	**H9**	2.01
C10	9.50	**H10**	4.76

4. PROGRESA.

With the purpose of having a benchmark for our simulations, in this section we briefly describe the main features of PROGRESA (Education, Health, and Food Program), renamed as OPORTUNIDADES by president Fox's administration, which is the main program implemented by the Mexican government to fight extreme poverty.

The PROGRESA started operations on august 8^{th}, 1997, with the main goal of substantially improve conditions of education, health, and nutrition of poor families, particularly children and their mothers, offering enough scholar services and medic care, and also food support. Importance of this program can be better understood if we remember the magnitude of the poverty problem in Mexico: about 60 million Mexicans are poor, and between 20 and 30 million are considered to live in extreme poverty.

Tables 4.1 and 4.2 allow us to have a better idea about the problem. In table 4.1 we have the number of households and the average household size obtained from the ENIGH-96 (National Survey on Households Income-Expenditures).

Cuadro 4.1. Hogares, miembros y tamaño medio del hogar

SOCIODEMOGRAPHIC CHARACTERISTICS	TOTAL NACIONAL
HOUSEHOLDS	20,467,038
HOSEHOLD MEMBERS	92,586,601
AVERAGE HOUSEHOLD SIZE	4.5237

SOURCE: INEGI. Table I.15. ENIGH-96.

Table 4.2 computes, from information of the ENIGH-96, per person average expenditure in each decile, assuming that average household size is the same in every decile. This calculation is enough to highlight two facts: First, the enormous inequality in income distribution and, second, the intense poverty in which a substantial part of the population lives. Tha last column of Table 4.2 shows that, in average, expenditure in the highest income decile (H10) is 17.5 times greater than that of the lowest income decile. Also, average expenditure is almost equal to the standard deviation (24,668,557). The gap between rich and poor would be deeper if the population were divided into 20 quintiles, because the highest income decile's expenditures are 2.4 times greater than the next richest decile (H9).

Cuadro 4.2. Average per capita and decile daily expenditure. (1996 pesos).

A	B	C	D	E	F
			B * (4.5237)	**C / D**	**E / 91**
DECILE [a]	NUMBER OF HOUSE-HOLDS	TOTAL QUARTERLY EXPENDITURE (000 $)	MEMBERS IN EACH DECILE	PER CAPITA TOTAL QUARTERLY EXPENDITURE ($)	PER CAPITA TOTAL DAILY EXPENDITURE ($)
I	2,046,704	5,095,902	9,258,675	550	6.05
II	2,046,704	7,992,259	9,258,675	863	9.49
III	2,046,704	10,025,873	9,258,675	1,083	11.90
IV	2,046,704	12,328,244	9,258,675	1,332	14.63
V	2,046,704	14,931,922	9,258,675	1,613	17.72
VI	2,046,704	17,969,517	9,258,675	1,941	21.33
VII	2,046,704	23,210,510	9,258,675	2,507	27.55
VIII	2,046,704	27,598,027	9,258,675	2,981	32.76
IX	2,046,704	37,392,106	9,258,675	4,039	44.38
X	2,046,702	88,986,655	9,258,666	9,611	105.62
TOTAL	**20,467,038**	**245,531,015**	**92,586,740**	**26,520**	**291.43**
Media	2,046,704	24,553,101	9,258,675	2,652	29.14

[a] Households are ordered according to their quarterly total income, which comprises total current income, and financial and capital perceptions, monetary and/or non-monetary.
SOURCE : INEGI. Table IX.2, ENIGH-96.

In the "Technical note: Determining the extreme poverty line" (SEDESOL, 1999), the "Monetary line of extreme poverty" (LPEM) was fixed in 9.4 daily pesos per capita for December 1996 (1.2 dollars at that month exchange rate). Given that, although the INEGI does not inform about variation of average number of household members in each decile with respect to global average, but considering that the number of members tends to diminish with income, information in the ENIGH-96 allows us to say that, at least the two lowest income deciles were below that LPEM in 1996.

According to the SEDESOL (1999), by the end of 1997 400,000 families, from more than 10,000 localities in 466 municipalities of 30 States, were incorporated to the Progresa. A year alter, there were 1.9 million families and, by September 1999 the number of families receiving Progresa's support , amounted to 2.3 million families (approximately one decile of national total), from 49,000 highly marginated localities in 31 States. According to Coady (2001), by the end of 1999, the number of families receiving Progresa's support , amounted to 2.6 million, which is about 40% of rural families and 1/9 of all households. The 1999 program's budget reached 777 million dollars (approximately 0.2% of the GNP).

Table 4.3 shows the 1997 structure of transfers, and its actualization for 1999. Transfers comprise direct cash transfers (for food and education) and in species transfers (food supplements and school implements in isolated localities). During the second half of 1999, the monthly maximum that a family could receive for educational support (scholarships) was 625 pesos. And the monthly limit for a family, adding up scholarships and food support, was 750 pesos (not including school implements).

Table 4.4 shows some indicators of the program's performance. An interesting program's aspect is that transfers are conditioned, mainly, to children's assistance to school and to family's assistance to health clinics to receive health services and preventive revisions.

Table 4.5 accounts for the structure of the mentioned transfers, in monetary terms and based on the age of the children attending school.

If we consider a per family bimonthly average support, in 1999, of 750 pesos according to Table 4.4, and multiply by the 2.3 million households covered by Progresa according to the SEDESOL (1999), we obtain a total of 10,350 million pesos for the entire year. In that year GNP amounted to 4,593,685 million pesos (Inegi, 2002), therefore the Progresa's budget represented a 0.225% of GNP, which coincides with data reported by Coady (2001).

Table 4.3. Monthly amount of cash transfers (current pesos).

Concept	1997	1999 (2nd. half)
Food support	90	125
Scholarships (elementary school)		
3º grade	60	80
4º grade	70	95
5º grade	90	125
6º grade	120	165
Scholarships (Secundary School)		
1º Grade		
Men	175	240
Women	185	250
2º Grade		
Men	185	250
Woman	205	280
3º Grade		
Men	195	265
Women	225	305
Maximum	550	750
3º to 6º grade elementary school		
Scholar implements		110 niño/año
Scholar implements reposition		55 niño/año
Secundary School		
School Implements		205 niño/año

Fuente: Sedesol (1999).

Cuadro 4.4. Per family bimonthly support (current pesos)

	July-december, 1999
Minimum support	**250**
Per family average support	504
Average support to familias with children attending school	750
Maximum support	**1500**

Fuente: Sedesol (1999).

Table 4.5. Benefit structure of PROGRESA, 1997 (pesos/month)

	Boys	Girls
Education Scholarships		
Primary		
8 years old	60	60
9 years old	70	70
10 years old	90	90
11-12 years old	120	120
Materials (annual)	110	110
Secundary		
13-14 years old	175	185
15 years old	185	205
16-17 years old	195	225
Materials (annual)	140	140
Food transfer	90 per family	
Benefit cap	550 per family	

Note: The benefits structure is meant to mimic as closely as possible that of the actual program that is linked to grades and not age: we choose age since this is consistent with an unconditional transfer program and, in any case, the data on maximum grade achieved is not very reliable. To be consistent with the figures for monthly per adult equivalent consumption, these numbers are deflated by a factor of 2.2868 to bring them to 1994 prices. The structure of scholarships is applied by age group but, in practice, is applied by grade and conditional on enrollment and attendance. All families receive the food transfer but, in practice, this is made conditional on regular visits to a health clinic. The cap on the total benefits a household can receive is applied only to the sum of the education scholarships and food transfer.

Source: Coady (2001).

5. Simulations and results.

To carry out our analysis, we run the four basic simulations mentioned before and, in order the reforms to be comparable, in the sense that each of them increases in the same amount the target's welfare, each reform is carried out in such a way that it generates a public surplus that is directly transferred to the lowest income decile obtaining for it a EV equal to 20:

a) In the first simulation IVA is increased multiplying by the same factor the rate on each private consumption good, so maintaining its same structure

b) In the second simulation ISR is increased multiplying by the same factor the rate on each decile, so maintaining its same structure

c) In the third simulation a uniform IVA is fixed

d) Finally, in the fourth simulation we fix a uniform ISR.

With the AGEM specified before and the reforms we are interested in, in this section we present the most relevant results obtained.

Table 5.1 shows the tax structure implied by each reform. In order to make some comparisons, we carry out some other simulations, two of them to obtain the level of uniform IVA and ISR that maintain the cero public surplus: these levels are 5.94% and 2.57% respectively.

Table 5.1. Simulated reforms.

	IVA STRUCTURE (%)				**ISR ESTRUCTURE (%)**		
GOODS	INITIAL IVA (IVA0)	SIMULATION 1 (IVA0*1.187)	SIMULATION 3 (IVA0=7.06)	**HOUSE-HOLDS** (Deciles)	INITIAL ISR (ISR0)	SIMULATION 2 (ISR0*1.447)	SIMULATION 4 (ISR0 = 3.79)
C1	0.67	0.79	7.06	**H1**	0.20	0.29	3.79
C2	10.18	12.08	7.06	**H2**	0.65	0.94	3.79
C3	5.66	6.71	7.06	**H3**	1.05	1.52	3.79
C4	10.18	12.08	7.06	**H4**	1.20	1.74	3.79
C5	0.00	0.00	7.06	**H5**	1.31	1.89	3.79
C6	5.52	6.55	7.06	**H6**	1.33	1.92	3.79
C7	6.76	8.02	7.06	**H7**	1.36	1.96	3.79
C8	2.79	3.31	7.06	**H8**	1.69	2.44	3.79
C9	10.18	12.08	7.06	**H9**	2.01	2.91	3.79
C10	9.50	11.27	7.06	**H10**	4.76	6.89	3.79

Table 5.2 shows the effects of each reform on revenue from each kind of tax, and changes in percentage terms. The last row shows the public surplus generated with each reform. Indirect taxes to production do not present changes superior to 1%. With respect to

value added, we observe that Reform 1 (An increase in IVA maintaining its structure, column Simulation 1) generates a surplus of 16.495 to achieve the EV=20 on H1, while Reform 3 (Uniform IVA, Column Simulation 3) generates a surplus of 18.355 to achieve the same EV. Social contributions do not present any changes superior to 1% neither and, by construction, tax on societies does not vary. Finally we observe that, unlike IVA, ISR generates a greater surplus when its same structure is maintained (Column Simulation 2, 22.459), than when it is uniform (Column Simulation 4, 20.793). Note that when the necessary surplus is smaller, then the reform is more efficient, and that the difference between the surplus and the EV equals the sum of the individual EVs, that is, the global EV.

Table 5.2. Effects on revenue.

	BASE	**SIM 1**	**SIM 2**	**SIM 3**	**SIM 4**	**CHANGE SIM1 (%)**	**CHANGE SIM2 (%)**	**CHANGE SIM3 (%)**	**CHANGE SIM4 (%)**
Indirect taxes on production	145.892	146.423	146.240	144.828	146.084	0.364	0.239	-0.729	0.132
Value Added Tax	90.095	106.156	89.736	109.504	89.923	17.827	-0.398	21.543	-0.191
Social Contributions	66.688	66.602	66.597	66.680	66.662	-0.129	-0.136	-0.012	-0.039
Tax on Societies	67.437	67.437	67.437	67.437	67.437	0.000	0.000	0.000	0.000
Personal Income Tax	50.592	50.581	73.154	50.610	71.393	-0.022	44.596	0.036	41.115
Total	**420.704**	**437.199**	**443.163**	**439.059**	**441.497**	**3.921**	**5.338**	**4.363**	**4.942**
Generated Surplus		16.495	22.459	18.355	20.793				

Table 5.3 shows effects on total supply for every simulation. The only simulation that generates changes greater than 2% is that corresponding to Reform 3 (Uniform IVA): Activity 1 (Agricultural and livestock sector) and Activity AI (Food, beberages, and tobacco) suffer a downfall near to 3%, mainly because of the cero tax these goods had in the initial situation.

Table 5.3. Effects on total supply.

ACTI-VITY	BASE	SIM 1	SIM 2	SIM 3	SIM 4	CHANGE SIM1 (%)	CHANGE SIM2 (%)	CHANGE SIM3 (%)	CHANGE SIM4 (%)
A1	245.594	249.246	248.034	239.154	246.736	1.487	0.994	-2.622	0.465
A2	80.925	80.990	80.989	80.791	80.972	0.080	0.079	-0.166	0.058
AI	423.766	430.784	428.432	411.403	425.935	1.656	1.101	-2.917	0.512
AII	131.502	131.256	131.505	132.830	131.514	-0.187	0.002	1.010	0.009
AIII	39.538	39.526	39.570	39.794	39.575	-0.030	0.081	0.647	0.094
AIV	74.613	74.570	74.523	74.359	74.595	-0.058	-0.121	-0.340	-0.024
AV	305.131	305.187	305.187	305.131	305.286	0.018	0.018	0.000	0.051
AVI	72.658	72.662	72.744	73.168	72.741	0.006	0.118	0.702	0.114
AVII	120.819	120.867	120.866	120.602	120.862	0.040	0.039	-0.180	0.036
AVIII	815.858	815.887	815.889	814.610	816.100	0.004	0.004	-0.153	0.030
AIX	78.556	78.564	78.546	78.392	78.566	0.010	-0.013	-0.209	0.013
A4	224.752	224.753	224.754	224.752	224.753	0.000	0.001	0.000	0.000
A5	47.549	47.581	47.590	47.574	47.563	0.067	0.086	0.053	0.029
A6	659.246	655.096	657.036	669.268	657.737	-0.630	-0.335	1.520	-0.229
A7	373.467	372.474	372.559	374.174	373.255	-0.266	-0.243	0.189	-0.057
A8	434.424	434.605	434.797	435.348	434.432	0.042	0.086	0.213	0.002
A9	555.579	554.943	554.423	553.328	555.337	-0.114	-0.208	-0.405	-0.044
A10	110.762	110.762	110.762	110.762	110.762	0.000	0.000	0.000	0.000

In Table 5.4 we compare the effect on utility levels of each reform. Normalization of prices and the monotonic transformation of the utility function,[5] allow us to obtain utility levels directly comparable in monetary terms. In our case, utility equals disposable income of every household.

In Table 5.4 we can see that, in percentage terms, the two first reforms do not diminish utility levels in more than 1%, except for the highest income decile in Simulation 2, which suffers a 2.25% decrease. For simulations 3 and 4 we observe that the greatest decrease in utility levels is for lower income deciles, in particular deciles 2, 3, 4 and 5.

[5] See note 5 before.

Table 5.4. Utility.

HOUSE-HOLD	BASE	SIM 1	SIM 2	SIM 3	SIM 4	CHANGE SIM1 (%)	CHANGE SIM2 (%)	CHANGE SIM3 (%)	CHANGE SIM4 (%)
H1	30.719	50.720	50.719	50.720	50.719	65.110	65.106	65.110	65.106
H2	56.167	55.765	56.010	55.066	54.399	-0.716	-0.280	-1.960	-3.148
H3	71.212	70.696	70.882	69.752	69.246	-0.725	-0.463	-2.050	-2.761
H4	91.961	91.246	91.467	90.269	89.556	-0.778	-0.537	-1.840	-2.615
H5	109.484	108.581	108.832	107.697	106.732	-0.825	-0.596	-1.632	-2.514
H6	138.870	137.646	138.032	137.093	135.413	-0.881	-0.603	-1.280	-2.489
H7	174.595	173.094	173.511	172.651	170.294	-0.860	-0.621	-1.113	-2.463
H8	208.020	206.127	206.386	205.812	203.564	-0.910	-0.786	-1.061	-2.142
H9	295.494	292.649	292.711	293.436	290.129	-0.963	-0.942	-0.696	-1.816
H10	658.781	652.887	643.947	656.064	665.486	-0.895	-2.252	-0.412	1.018

Finally, Table 5.5 contains the EV experienced by each decile. In all cases, as we said, reforms are designed in such a way that the lowest income decile obtains an EV equal to 20. Comparison of columns SIM1 (an increase in IVA maintaining its structure) and SIM2 (an increase in ISR maintaining its structure) shows that with the latter, the highest income decile bears a greater part of the cost, but with the former, global EV is positive (4.108) and considerably greater than that of the second reform (-2.806).

Comparison of SIM3 (uniform IVA) and SIM4 (uniform ISR) shows that both, IVA's and ISR's are progressive, but ISR is more progressive, given that the highest income decile is highly benefited, in both cases medium-high income deciles bear the greatest part of the reform's cost.

Considering the four reforms analyzed, and from a global efficiency viewpoint, results suggest that the best policy, among the alternatives considered, would be an increase in IVA maintaining its structure, because this would give the greater global benefit in terms of the EV.[6]

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[6] Although Basic simulations were carried out considering full employment of labor according to the Walrasian paradigm, in order to evaluate possible effects on unemployment, we also carried out a set of simulations introducing an additional endogenous variable to account for the unemployment rate; results do

Table 5.5. Equivalent Variation (EV).

HOGAR	SIM 1	SIM 2	SIM 3	SIM 4
H1	20.000	20.000	20.000	20.000
H2	-0.401	-0.157	-1.101	-1.768
H3	-0.516	-0.330	-1.461	-1.966
H4	-0.715	-0.494	-1.692	-2.405
H5	-0.903	-0.652	-1.787	-2.752
H6	-1.224	-0.838	-1.777	-3.457
H7	-1.501	-1.084	-1.944	-4.301
H8	-1.893	-1.634	-2.208	-4.456
H9	-2.845	-2.783	-2.058	-5.365
H10	-5.894	-14.834	-2.717	6.705
TOTAL	**4.108**	**-2.806**	**3.255**	**0.235**

7. Final comments.

Using an AGEM designed to analyze four alternative reforms that generate funds to alleviate extreme poverty, we observe a different degree of efficiency for each reform: results suggest that, from a global Equivalent Variation (EV) viewpoint, for all reforms under consideration (comparable in the sense that each of them generates the same EV for the lowest income decile), financing the policy of direct transfers through an increase in the IVA (keeping its structure) is more efficient than financing through an increase in ISR (keeping its structure).

Finally, assessment of the analyzed information and of the results obtained through this work, allows us to say that the effort the Mexican economy would have to endure in order to alleviate extreme poverty, is relatively small (for 1996, 0.8% of the GNP approximately) and, that direct transfers might be a more efficient mechanism than what we

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not significantly differ from those obtained before: An increase in IVA (maintaining its structure) appears as the most desirable option in terms of global EV, and indicate a light increase in unemployment.

observe here, given that our model does not account for potential gains, such as the increase in human capital derived, for example, from conditioning direct transfers to school and public health institutions attendance, like in Progresa.

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Appendix 1. Institutions of the SAM-MX96

H1	1	First decile of households
H2	2	Second decile of households
H3	3	Third decile of households
H4	4	Fourth decile of households
H5	5	Fifth decile of households
H6	6	Sixth decile of households
H7	7	Seventh decile of households
H8	8	Eigth decile of households
H9	9	Ninth decile of households
H10	10	Tenth decile of households
L1	11	PROFFESIONALS
L2	12	TECHNICIANS
L3	13	EDUCACION WORKERS
L4	14	ART, SHOWS, AND SPORTS WORKERS
L5	15	FUNCTIONARIES AND MANAGERS OF THE PUBLIC, PRIVATE, AND SOCIAL SECTORS
L6	16	WORKERS IN AGRICULTURAL, LIVESTOCK, FORESTRY, AND HUNTING AND FISHING ACTIVITIES
L7	17	SUPERVISORS AND OTHER CONTROL WORKERS
L8	18	ARTISANS AND WORKERS IN THE TRANSFORMATION INDUSTRY
L9	19	MACHINE OPERATORS IN INDUSTRIAL PRODUCTION
L10	20	ASSISTANTS, PEONS AND THE SIMILAR IN THE TRANSFORMATION INDUSTRY
L11	21	DRIVERS AND ASSISTANTS
L12	22	COORDINATORS AND SUPERVISORS IN ADMINISTRATIVE AND SERVICES ACTIVITIES
L13	23	ASSISTANTS IN ADMINISTRATIVE ACTIVITIES
L14	24	MERCHANTS, COMMERCE EMPLOYEES AND SALES AGENTS
L15	25	WALKING MERCHANTS AND WALKING WORKERS
L16	26	EMPLOYEES IN ESTABLISHMENTS FOR PERSONAL SERVICES
L17	27	WORKERS IN DOMESTIC SERVICES
L18	28	WORKERS IN PROTECTION SERVICES AND THE ARMY
K	29	Capital
A1	30	Agriculture, livestock, forestry, hunting and fishing
A2	31	Mining
AI	32	Food, beberages and tobacco
AII	33	Textiles, clothes, and leather industries
AIII	34	Wood Industry and Wood products
AIV	35	Paper, paper products, printing-houses and publishers
AV	36	Chemicals, oil derivatives, Sustancias químicas, derivados del petróleo, rubber and plastic
AVI	37	Non metallic mining products
AVII	38	Basic metallic industries
AVIII	39	Metallic products, machinery and equipment
AIX	40	Other manufacturing
A4	41	Construction
A5	42	Electricity
A6	43	Comerse, restaurants and hotels
A7	44	Transportation, storage and comunications
A8	45	Financing services, insurance and real estate
A9	46	Comunal, social, and personal services
A10	47	Collective services
C1	48	Food, beberages and tobacco
C2	49	Clothes and shoes
C3	50	Housing, electricity, gas, and water
C4	51	Furniture, and domestic equipment and gadgets
C5	52	Health
C6	53	Transportation
C7	54	Entertainment and culture
C8	55	Education
C9	56	Hotels, coffe shps, and restaurants
C10	57	Diverse goods and services
AAPP	58	Government
IIRE	59	Income tax
IIMS	60	Indirect taxes minus subsidies
IP	61	Other taxes to production
IVA	62	Value added tax
CS	63	Social Contributions
PS	64	Social transfers
OT	65	Other transfers
AHBR	66	Savings-Investment
CSC	67	Collective services consumption
CSP	68	Public health consumption
CEP	69	Public education consumption
PGRDM	70	PAYMENTS TO THE REST OF THE WORLD
TLCAN	71	EXTERNAL SECTOR NAFTA AREA
RDP	72	EXTERNAL SECTOR REST OF COUNTRIES

Appendix 2. Specification of parameters.

2.1. Parameters of the value added production function.

The assumption of zero profits implies that the product must be distributed among all factors, in our case, even when workers receive only the salary as remuneration, the producer must pay the social contributions (CS), hence, we compute the Value Added for each Activity, at the initial equilibrium, as:

$$V^0 = \sum_{l=1}^{18} REM_l^0 + CS^0 + EBO^0$$

Where V^0 is the value added produced by each Activity; REM^0_l is the remuneration paid to every type of work; CS^0 are the social contributions; and EBO^0 is the gross exploitation surplus.

According to the Social Security Law, contributions are computed as a constant percentage on the base salary, therefore, for every Activity, we calibrate the rate of contributions dividing the social contributions paid by total remunerations:

$$\tau^{CS} = \frac{CS^0}{\sum_{l=1}^{18} REM_l^0}$$

And then, we calibrate the parameters of participation for each activity, as:

ALFAL = $REM^0_l\,(1+\tau^{cs})\,/\,V^0$ for every type of work *l*, and

ALFAK = EBO^0 / V^0 for capital.

The efficiency parameter for every Activity is simply computed as:

$$A = \frac{V}{K^{\alpha_k} * \prod_{l=1}^{18} L_l^{\alpha_l}}$$

2.2. Domestic Production

Domestic production is a Leontief aggregation of inputs and value added, parameters correspond to the fix coefficients matrix of the Input-Output table, and to the unitary requirement of value added. Then:

$a_{i,j} = INS0_{i,j} / PI0_i$ is the fix coefficients matrix and,

$v_i = V0_i / PI0_i$ the unitary requirement of value added.

2.3. Total production.

From optimal demands, obtained when minimizing the cost of producing a homogeneous good with domestic production and imports:

$$\frac{Y_{di}}{Y_{ai}} = \frac{\delta_{di}^{\sigma} p_{di}^{-\sigma}}{\delta_{ai}^{\sigma} p_{ai}^{-\sigma}} \quad \text{and} \quad \frac{Y_{di}}{Y_{ri}} = \frac{\delta_{di}^{\sigma} P_{di}^{-\sigma}}{\delta_{ri}^{\sigma} P_{ri}^{-\sigma}}$$

Solving for δ_{ai} y δ_{ri} respectively, and given that $\delta_{di}+\delta_{ai}+\delta_{ri}=1$, we obtain:

$$\delta_{di} = \frac{1}{1+\left(\frac{Y_{ai}}{Y_{di}}\right)^{1/\sigma}\frac{p_{ai}}{p_{di}}+\left(\frac{Y_{ri}}{Y_{di}}\right)^{1/\sigma}\frac{p_{ri}}{p_{di}}}$$

$$\delta_{ai} = \frac{1}{1+\left(\frac{Y_{di}}{Y_{ai}}\right)^{1/\sigma}\frac{p_{di}}{p_{ai}}+\left(\frac{Y_{ri}}{Y_{ai}}\right)^{1/\sigma}\frac{p_{ri}}{p_{ai}}}$$

$$\delta_{ri} = \frac{1}{1+\left(\frac{Y_{di}}{Y_{ri}}\right)^{1/\sigma}\frac{p_{di}}{p_{ri}}+\left(\frac{Y_{ai}}{Y_{ri}}\right)^{1/\sigma}\frac{p_{ai}}{p_{ri}}}$$

Finally, for every Activity:

$$\Phi = \frac{Y}{(\delta_d Y_d^{\frac{\sigma-1}{\sigma}} + \delta_a Y_a^{\frac{\sigma-1}{\sigma}} + \delta_r Y_r^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}}$$

where Y is total productrion at Basic prices.

To specify the values of σ (Armington elasticities), we use estimations of the Salter model (1991)[7], presented in Table 2.3.1.

Calibration of taxes on production (minus subsidies) is given by:

τ_{IP} = IMP PRODN / (PRODN INTERNA - IMP PRODN).

Cuadro 2.3.1. Elasticidades Armington por Actividad.

Rama de Actividad	σ	Rama de Actividad	σ
1 Agriculture	2.2	9 Financial institutions and insurance	1.9
2 Energy and Water	2.2	10 Rents	-
3 Mining and Chemicals	1.9	11 Other services	1.9
4 Precision mechanics. Metals.	2.2	12 Private Education	-
5 Other manufactures	2.2	13 Private health	-
6 Construction	-	14 Public Services	-
7 Commerce, Rest. And Hotels	1.9	15 Public Education	-
8 Transp. And communications.	3.0	16 Public Health	-

2.4. Production of final consumption goods.

Production of final consumption goods is a Leontief aggregation of produced goods at factory prices. Then, for each consumption good:

$z_i = Z_{0i} / C_0$ is the fix coefficients matrix,

where Z_{0i} is the quantity of each good (produced by Activities) used to produce C_0 units of the final consumption good *c*.

[7] A general equilibrium model applied to the world economy by the Industry Comission for the Department of Foreign Affairs and Trade of Australia. Cited by M. Fernández in “Política Fiscal y Capital Público: Un Modelo de Equilbrio General de la Economía Española”. Doctoral dissertation. Universidad Autónoma de Barcelona. 1999.

Calibration of the IVA rate: For each private consumption good,

τ_{IVA} = IVA / (C - IVA),

where IVA is revenue from IVA and C is the total value of each private consumption good.

2.5. Parameters of the households

From optimal demands for consumption and savings, for each household:

$$\frac{C*}{S*} = \left(\frac{\delta P_S}{(1-\delta)P_C} \right)^{\sigma} \quad \text{y} \quad \delta = \frac{P_c C*^{1/\sigma}}{P_c C*^{1/\sigma} + P_s S*^{1/\sigma}}$$

We consider σ as a exogenous parameter, and use a value of 2.9 for simulations. (See Fernández (1999)).

Calibration of the scale parameter:

$$\eta = \frac{U}{(\delta C^{\frac{\sigma-1}{\sigma}} + (1-\delta) S^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}}$$

From optimal demands for final consumption goods:

$$\alpha_c = \frac{P_c C_c^*}{IDS}$$

2.6. Parameters of the Societies.

Initial gross income of Societies equals the sum of the row (column) K of the SAM-MX96: $IB_{SOC0} = K_0$

And we call inicial disposable income of Societies (ID_{SOC0}) what they distribuye among capital owners, alter taxes and savings:

$ID_{SOC0} = IB_{SOC0}(1-\tau_{SOCISR}) – MCS(‘AHBR’,’SOC’)$

Households participation in Capital is:

$\tau_{SOCHOGh} = MCS(h,’SOC’) / ID_{SOC0}$

And participation of the Rest of the World in Capital is:

$\tau_{SOCSEX} = MCS(‘PGRdM’,’SOC’ / ID_{SOC0}$

2.7. Parameters of the Government

All public sector variables are exogenous and given by the referente equilibrium represented by the SAM-MX96.

2.8. Parameters of the Rest of the World

The External sector, NAFTA and Rest of the World, offers and demands capital, labor, and goods. Imports level is endogenously determined as function of relative prices of domestic and imported goods. Exports are exogenous and, therefore, the external deficit will be endogenous.