SAM and AGEM of Mexico and Taxes on Hydrocarbons Extraction*

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Abstract

In this article we build a SAM for Mexico (2008) and design an Applied General Equilibrium Model, both of which can be applied to other research. We use them to analyze taxes on hydrocarbons extraction, given their importance for public budget and recent energy reforms. An increase in Households Income Taxes is simulated while those taxes decrease: results show that the former would have to triple to compensate for the later, and that the first four deciles would benefit with a positive equivalent variation (given progressive Income tax), but deciles V to X would suffer a severe loss that outweighs by far the gain in low income deciles.

Keywords: Applied General Equilibrium Model, Social Accounting Matrix, Mexico, taxes, hydrocarbons, extraction.

JEL: C68, D58, D69, H22

Matriz de Contabilidad Social y Modelo de Equilibrio General aplicado para México. Impuestos sobre la extracción de hidrocarburos

Resumen

En este artículo se construyó una Matriz de Contabilidad Social para México (2008) y se diseñó un modelo de equilibrio general aplicado; ambos utilizables para otras investigaciones, además de analizar los impuestos sobre la extracción de hidrocarburos dada su importancia para el presupuesto público y las recientes reformas energéticas. Se realizó una simulación de un incremento en el impuesto sobre la renta de los hogares (ISR) mientras dichos impuestos disminuyen: los

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resultados muestran que el ISR tendría que triplicarse para compensar la disminución, que los primeros cuatro deciles se beneficiarían con una Variación Equivalente positiva, pero los deciles V a X experimentarían una alta pérdida que supera por mucho la ganancia de los deciles pobres.
Palabras clave: Modelo de Equilibrio General Aplicado, Matriz de Contabilidad Social, México, impuestos, extracción, hidrocarburos.
JEL: C68, D58, D69, H22.

Introduction

At the international level, the importance of hydrocarbons could hardly be overstated and, in the case of Mexico, it has come to play a preponderant role in the economic, politic, and social arenas. Modern exploitation started in the mid-19th century and in 1938, after almost one century and thanks to several developments, a most relevant event took place: President Cárdenas nationalized the petroleum industry, and PEMEX was created as a government monopoly to handle every aspect of hydrocarbons exploitation, from exploration and extraction to refining and distribution.

After an uneven evolution, by the 1980s the Mexican petroleum industry had become a world power. Mexico was the fifth country with the largest production and held 8.2% of world reserves; petroleum contributed 18% of the Mexican GDP, and more than 90% of primary energy generation. Regarding government income, during almost the last three decades, hydrocarbons contributed an average of 32% with a peak of 44% in 2008; after the petroleum reform of 2013, that percentage dropped to 13% in 2015 (Hernández, 2017).

Therefore, this research is concerned with a quantitative appraisal of this decrease, in terms of an increase in income taxes that should be implemented in order to compensate for the loss and allow the government to maintain its budget. To this end, we build a Social Accounting Matrix (SAM) and design an Applied General Equilibrium Model (AGEM) with the main objective of assessing household's welfare loss.

As far as we know, no research on the specific issue of taxes on hydrocarbons has been carried out using this methodology, although a good deal of AGEMs have been developed and validated on energy topics (Bhattacharyya, 1996; Beckman, Hertel & Teyner, 2011). Also, according to a recent paper published by *Transportation Research*: "Computable general equilibrium (CGE) models are an increasingly popular method for assessing the economic impact of transport, including both direct and wider economic impacts, as they can determine the distribution of impacts among every market and agent in the economy by simulating the behaviour of households, firms and others from microeconomic first principles. Aside from their traditional role estimating changes in macroeconomic variables, CGE models can provide a measure of welfare that guarantees no double counting and accounts for nth order effects" (Robson, Wijayaratna & Dixit, 2018). The same applies to our case and to any other application of CGE models.

In the first part of this paper, we build a Social Accounting Matrix of Mexico for 2008 (SAM-Mx08). We start from the input-output table of Mexico for 2008 (IOT-Mx08), prepared by the National Institute of Statistics and Geography (INEGI). House are disaggregated based on results from the National Survey of Households' Income and Expenditures (ENIGH08). The information is complemented with several additional sources.

It is worth noting that the SAM is not only a database to carry out Applied General Equilibrium (AGE) analysis, but also a valuable result in itself, since it provides a comprehensive and detailed vision of the Mexican socio-economy. More importantly, it is possible to apply a wide range of analytical methods to obtain a better understanding of the economy.

In the second part, we design an Applied General Equilibrium Model (AGEM-Mx08), robust and parsimonious, of general application; that is to say, we believe that this AGEM could also be modified and applied to a wide range of economic issues (environment, energy, trade, etc.).

Finally, in the third part we implement an application of the AGEM to the specific case of taxes on the extraction of hydrocarbons. This is of great socio-economic importance, given their high participation in the financing of public services such as education and health.

By the above, we consider that this work contributes substantially to generate (and to enable the generation of) knowledge about Mexican socio-economy to sustain social development and the construction of public policies of national scope. The paper ends with section four, dedicated to our main findings and final comments.

Social Accounting Matrix of Mexico for 2008 (SAM-Mx08)

To build the SAM-Mx08, we follow the conceptual framework developed by several authors (Bellú, 2012; Breisinger, Marcelle & Thurlow, 2010; Defourney & Thorbecke 1984; Keuning & Ruijter 1988; Miller & Blair 2009; Müller, Pérez & Gay, 2009; Thiele & Piazolo, 2002; Yusuf, 2007). For the case of Mexico, we follow the work of Núñez (2008; 2004).

We start from the input-output table of Mexico for 2008, the domestic economy product-by-product of 19 sectors according to the North American Industry Classification System (NAICS) (Instituto Nacional de Estadística y Geografía [INEGI], 2013b), published in INEGI's site[1], which we call IOT-Mx08; and develop the SAM with additional information from the Goods and Services Accounts (G&SA) (INEGI, 2010a), Institutional Sectors Accounts (ISA) (INEGI, 2010b), National Survey of Income and Expenditure of Households 2008 traditional (ENIGH08) (INEGI, 2009), and the 2008 Law of Income Tax.

[1] http://www3.inegi.org.mx/sistemas/tabuladosbasicos/tabniveles.aspx?c=33683

Construction of the MCS - Mx08

To develop the SAM-Mx08 (in what follows the SAM) we follow as main criteria that of maintaining the structure of the economy implied by the IOT-Mx08 (in what follows the IOT), and that of achieving the greatest possible consistency with national accounts.

To begin with, we reorganize the IOT data to clarify how the accounts are structured, particularly the structure of value added (VA) and taxes. Table 1 presents the IOT, rearranged with the columns of the productive sectors as a succession of concepts whose sum leads to the total gross output (at basic prices) of each sector. For illustrative purposes, we use a version aggregated to three sectors: we add the first 4 sectors into Sector1, manufactures are Sector2, and the remaining sectors are lumped into Sector3. Then remuneration is disaggregated into the three components specified by the IOT: salaries and wages, effective social contributions, and other social benefits; Taxes on Production follow, and then the Gross Operating Surplus (GOS or Capital Rents). Unless otherwise noted, all figures are in millions of current 2008 pesos.

With this, we can see production as a succession of added concepts. Let's consider the Sector1 column:

a) The sum of inputs from the three sectors is the total for domestic inputs (1 243 426).

b) Imports plus (net) taxes on goods and services plus the previous sum, amounts to total use for Sector1 (1 461 917).

c) The sum of wages and salaries, effective social contributions and other social benefits, amounts to total remunerations (638 083).

d) Gross value added (GVA) equals total remunerations plus taxes on production plus Gross Operating Surplus (GOS) (2 743 218).

e) Finally, total output (at basic prices) is equal to the sum of Gross Value Added (GVA) plus total inputs (4 205 135). In a similar manner, we obtain total gross production for the rest of productive sectors.

f) Turn now to the fourth column (intermediate demand or inputs to production), which can be interpreted as an aggregation of all productive sectors: In the last row the total GDP at basic prices is precisely in the fourth column (11 781 115), and adding the total taxes on goods and services we obtain GDP at market prices (12 256 864).

g) The columns of final consumption are kept just as they are in the IOT, but we aggregate gross fixed capital formation and changes in inventories into a unique vector of gross investment.

h) Once the IOT has been more conveniently reorganized, we proceed to use the conceptual framework referred to earlier to get the scheme of Table 2 (which we will refer to as

the Macro-SAM), which consists, in principle, of 14 accounts: Companies[2], Households, Government, Taxes on Goods and Services (G&S Tax), Taxes on Production (ProdnTax), Savings-Investment (SAV-INV), Capital, Labor, Effective Social Benefits (EfeSocBen), Other Social Benefits (OtrSocBen), the three Productive Sectors, and the Rest of the World (RoW).

In Table 2, we see that the column for Households is that of Private Consumption in the IOT: G&S Tax (which include VAT), demand from productive sectors, and imports. The corresponding row contains income from Labor: Wages and Social Benefits.

Companies only have the Gross Operating Surplus (GOS or Income from Capital rents) transferred from the Capital account.

[2] In Mexico National Accounts, "Companies" are recorded as "Financial and Non-Financial Societies".

Table 1. MIP reorganized and aggregated to three productive sectors

	Sector1	Sector2	Test3	**Intermediate consumption**	Private consumption	Public consumption	Gross investment	Export FOB	Statist. discrep.	**Final demand**	Total uses
Sector1	237 728	981 884	176 254	**1 395 865**	277 150	34	1 978 310	553 776		**2 809 270**	4 205 135
Sector2	595 854	1 014 412	572 058	**2 182 324**	2 175 058	1934	210 437	2 371 480	7909	**4 766 818**	6 949 142
Sector3	409 845	873 668	1 391 970	**2 675 482**	4 860 909	1 330 536	316 007	345 355		**6 852 807**	9 528 289
Total inputs Dom.prodn.	**1 243 426**	**2 869 964**	**2 140 281**	**6 253 671**	**7 313 116**	**1 332 505**	**2 504 753**	**3 270 612**	**7909**	**14 428 895**	**20 682 566**
Tot. imports	257 277	2 109 683	280 821	**2 647 781**	429 813	1302	470 528	148 829		**1 050 472**	3 698 252
G&S Tax	-38 786	-7805	-113 494	**-160 085**	455 905	0	19 843	1		**475 749**	315 664
Tot. uses pc	**1 461 917**	**4 971 842**	**2 307 608**	**8 741 367**	**8 198 835**	**1 333 807**	**2 995 123**	**3 419 442**	**7909**	**15 955 116**	**24 696 483**
Wages	518 046	330 861	1 943 428	**2 792 335**							
EfeSocBen	64 839	45 678	304 769	**415 285**							
OthSocBen	55 199	53 558	94 918	**203 675**							
Tot. remun.	**638 083**	**430 097**	**2 343 116**	**3 411 296**							
Prodn. Tax	10 936	22 160	36 795	**69 891**							
GOS	2 094 199	1 525 042	4 840 771	**8 460 012**							
GVA bp	**2 743 218**	**1 977 300**	**7 220 682**	**11 941 199**							
Total prodn. Basic prices	4 205 135	6 949 142	9 528 289	**20 682 566**							
GDP	2 704 432	1 969 495	7 107 188	**11 781 115**						**475 749**	12 256 864

Source: Compilation based on the MIP (INEGI, 2013a).

The public sector has three accounts: Government, Taxes on Goods and Services (G&S Tax), and Production taxes (ProdnTax). The last two collect taxes from Households, and transfer them to the Government which, so far, only spends on goods produced by sectors and by the RoW (Column of Government consumption in the IOT).

Table 2. IOT data into the scheme of the Macro SAM. Part 1

	Households	Companies	Government	G&S Tax	Prodn Tax	SAV-INV	Capital	Labor	EfeSocBen
Households								2 792 335	415 285
Companies							8 460 012		
Government				315 664	69 891				
G&S Tax	455 905					19 843			
Prodn Tax									
SAV-INV									
Capital									
Labor									
EfeSocBen									
OtrSocBen									
Sector1	277 150		34			1 978 310			
Sector2	2 175 058		1934			210 437			
Sector3	4 860 909		1 330 536			316 007			
RoW	429 813		1302			470 528			
Total	**8 198 835**	**0**	**1 333 807**	**315 664**	**69 891**	**2 995 123**	**8 460 012**	**2 792 335**	**415 285**

Source: Compilation based on the MIP (INEGI, 2013a).

Table 2. IOT data into the scheme of the Macro SAM. Part 2

	OtrSocBen	Sector1	Sector2	Sector3	RoW	**Total RoW**	Total column	**Difference**
Households	203 675					**3 411 296**	8 198 835	**-4 787 539**
Companies						**8 460 012**	0	**8 460 012**
Government						**385 556**	1 333 807	**-948 251**
G&S Tax		-38 786	-7805	-113 494	1	**315 664**	315 664	**0**
Prodn Tax		10 936	22 160	36 795		**69 891**	69 891	**0**
SAV-INV							2 995 123	**-2 995 123**
Capital		2 094 199	1 525 042	4 840 771		**8 460 012**	8 460 012	**0**
Labor		518 046	330 861	1 943 428		**2 792 335**	2 792 335	**0**
EfeSocBen		64 839	45 678	304 769		**415 285**	415 285	**0**
OtrSocBen		55 199	53 558	94 918		**203 675**	203 675	**0**
Sector1		237 728	981 884	176 254	553 776	**4 205 135**	4 205 135	**0**
Sector2		595 854	1 014 412	572 058	2 371 480	**6 941 233**	6 949 142	**-7909**
Sector3		409 845	873 668	1 391 970	345 355	**9 528 289**	9 528 289	**0**
RoW		257 277	2 109 683	280 821	148 829	**3 698 252**	3 419 442	**278 811**
Total	**203 675**	**4 205 135**	**6 949 142**	**9 528 289**	**3 419 442**			

Source: Compilation with data of the IOT-Mx08 (INEGI, 2013a).

Then, the Savings-Investment account, which is the gross investment we have got from the OIT. And the Capital account, which is simply the capital rents generated by the economy (Gross Operating Surplus, GOS) as defined in the Mexican System of National Accounts.

Total remunerations have also three elements: Labor (wages and salaries), Efective Social Benefits (EfeSocBen), and Other Social Benefits (OtrSocBen), which are payments from productive sectors to workers; these payments are transferred to the Households account.

Next, we have productive sectors, which pay taxes, employ Capital and Labor, and buy inputs (domestic and imported) to generate production, which is distributed among intermediate demand (inputs) and final demand (private, public, investment and exports). Finally, the RoW obtains income from imports and spends in exports.

Up to this point, we have not introduced any new data, but just reorganized the numbers in the OIT according to the square format of the SAM, whereupon it is possible to add the total per column and per row, and to compare both: total revenues and total expenses.

The last column is the difference (income minus expenditure) for each account. Households, Companies, Government, Savings-Investment, and RoW, have non-zero differences because some elements are missing. For example, Households do not have income from Capital, nor from transfers; on the other hand, Households are not paying income taxes, and they are not saving. Since all the information of the IOT has been already included into the macro SAM, in what follows we resort to the system of national accounts, and to other sources to complete and balance the SAM.

To begin with, we open a new account for Income Taxes (IncTax), and include the figures given by the Institutional Sectors Accounts (ISA) (INEGI, 2010b), where Households (and Non-Profit Institutions that Serve Households) pay income taxes of 351 023, and Companies 380 139. The total revenue, 731 163, is transferred to the Government account.

Also according to the ISA, Companies' gross savings equal 1 637 683; Government saves 492 324; Households 973 198; and RoW (174 277), then total savings amount to 3 277 481. The RoW pays 12 979 to documented Labor, and transfers from the RoW to households (remittances from Non-Documented Labor) are 282 176 (283 778 – 1601). The Government pays to households *social benefits other than social in-kind transfers* (198 367), and *other net current transfers* (28 036), for a total of 226 403.

After we include this data in the SAM, opening at the same time another new account for Private Consumption (PrivCons), in which we place production for private consumption, we obtain a vector of differences between the total per row and the total per column, with a deficit for the Government of 935 815, a surplus in SAV-INV of 282 358, and a deficit for the RoW of 190 622.

The Statistical Discrepancy (SD) in Sector2 (Manufacturing) of 7909 is only 0.1% of total manufacturing. On the other hand, the RoW has a deficit of 190 622, while the ISA report for the RoW 197 464 *Net Property Income*. Therefore, we assume that SD is an additional amount of exports by Sector2, paid by the RoW, then Sector2 gets balanced.

With regard to the public deficit of 935 815, it happens that the Government is not receiving the levy corresponding to the Other Taxes on Production (OTP), which for some reason in the IOT have been aggregated to the Gross Operating Surplus (GOS). To separate the OTP from GOS, we draw on Table 58 of the Goods and Services Accounts (G&SA) (INEGI, 2010a), and subtract to obtain effective GOS and therefore OTP (Table 3)[3].

Table 3. Other taxes on production and gross operating surplus unbundling

	Sector1	Sector2	Sector3	Total
GOS IOT	2 094 199	1 525 042	4 840 771	**8 460 012**
OTP G&SA	906 524	13 729	51 186	**971 440**
GOS SAM	1 187 674	1 511 313	4 789 585	**7 488 572**

Source: Compilation based on the IOT-Mx08 (INEGI, 2013a) and G&SA (INEGI, 2010a).

After the inclusion of these additional data into the SAM under construction, the Government has a surplus of 35 625, thanks to the additional revenue from collection of the OTP. The RoW now has a deficit of 198 531, almost equal to its income from the net property (197 464). Then, we assume that the Government transfers its surplus to the RoW as Property Rent, and

[3] The GOS reported by G&SA is 7 468 149, then a non-explained difference of 20 423 would arise, but it is very small.

the rest (198 531 minus 35 625) is covered by Companies (162 906). Therefore, the RoW and Government accounts are also already balanced.

Companies have now a surplus of 5 307 844 and, since they have covered all their expenses, said surplus is transferred to Households as capital rents. With these changes, as expected, the difference between Savings and Investment, which was not spent on capital goods (282 358), appears as a deficit in Households' spending, which would be absorbing an excessive quantity of produced goods and services.

To correct this difference, according to the criterion of maintaining the structure of the IOT, we adjust production for private consumption and investment to the amounts given for such difference, namely 7 030 759 (= 7 313 116 – 282 358) for private consumption, and 2 787 111 (= 2 504 753 + 282 358) for investment. Calculations are presented in Table 4.

With these changes, all the accounts in the SAM are balanced, but as an effect of the adjustments, the following differences result in the productive sectors: 212 312 for Sector 1, -60 256 for Sector2, and -152 056 for Sector3.

Table 4. Adjustment of investment and private consumption

	Investment in IOT	Relative structure	**Adjusted investment**	Private consumption in IOT	Relative structure	**Adjusted private consumption**
Sector 1	1 978 310	0.790	**2 201 322**	277 150	0.038	**266 449**
Sector 2	210 437	0.084	**234 159**	2 175 058	0.297	**2 091 079**
Sector 3	316 007	0.126	**351 630**	4 860 909	0.665	**4 673 230**
Total	**2 504 753**	**1.000**	**2 787 111**	**7 313 116**	**1.000**	**7 030 759**
Adjustment	282 358			282 358		
Adjusted total	2 787 111			7 030 759		

Source: Compilation based on the MIP (INEGI, 2013a) and CByS (INEGI, 2010a).

In recent decades, multiple methods for balancing matrices have been developed: from simple programs, such as that of Zenios, Drud & Mulvey (1986) that minimizes a deviation function, to more sophisticated methods such as the cross entropy approach by Robinson, Cattaneo y El-Said (2000) (Debowicz & Golan, 2012; Temurshoev, Miller & Bouwmeester, 2013), which are used to ensure that the data are adjusted to balance the matrix under the fundamental idea that adjustment minimizes the change in the underlying structure of the economy.

In our case, we have arrived to relatively small differences (4.8%, -0.87% and -1.6% in the productive sectors), according to which, and to maintain the transparency of the data and the consistency with the system of national accounts, we consider that a manual adjustment is the most appropriate.

The adjustment is made as follows: from investment in Sector1 we subtract the difference 212 312, with which this sector is balanced. Then, to keep total investment at the same level (given by gross savings of 3 277 481), we add the same amount to investment in the other

two sectors, weighted by their relative weight: 84 868 and 127 444 respectively. Finally, private consumption in sectors 2 and 3 is adjusted by the resulting difference: 24 612.

The matrix thus obtained is already fully balanced, as shown in Table 5.

Table 5. Balanced macro SAM-Mx08. Part 1

	Households	Companies	Government	IncTax	G&S Tax	ProdnTax	SAV-INV	Capital	Labor
Households			226 403						2 805 315
Companies								7 488 572	
Government				731 163	315 664	1 041 331			
IncTax	351 023	380 139							
G&S Tax	455 905						19 843		
ProdnTax									
SAV-INV	973 198	1 637 683	492 324						
Capital									
Labor									
EfeSocBen									
OtrSocBen									
Sector1			34				1 989 010		
Sector2			1934				319 027		
Sector3			1 330 536				479 074		
PrivCons	7 030 759								
RoW	429 813	162 906	36 927				470 528		
Total col	**9 240 698**	**7 488 572**	**2 088 158**	**731 163**	**315 664**	**1 041 331**	**3 277 481**	**7 488 572**	**2 805 315**

Source: Compilation based on the MIP (INEGI, 2013a) and CByS (INEGI, 2010a).

Table 5. Balanced macro SAM-Mx08. Part 2

	EfeSocBen	OtrSocBen	Sector1	Sector2	Sector3	PrivCons	RoW	**Total RoW**	TR - TC
Households	415 285	203 675					282 176	**9 240 698**	0
Companies								**7 488 572**	0
Government								**2 088 158**	0
IncTax								**731 163**	0
G&S Tax			-38 786	-7805	-113 494		1	**315 664**	0
ProdnTax			917 461	35 890	87 981			**1 041 331**	0
SAV-INV							174 277	**3 277 481**	0
Capital			1 187 674	1 511 313	4 789 585			**7 488 572**	0
Labor			518 046	330 861	1 943 428		12 979	**2 805 315**	0
EfeSocBen			64 839	45 678	304 769			**415 285**	0
OtrSocBen			55 199	53 558	94 918			**203 675**	0
Sector1			237 728	981 884	176 254	266 449	553 776	**4 205 135**	0
Sector2			595 854	1 014 412	572 058	2 066 468	2 379 389	**6 949 142**	0
Sector3			409 845	873 668	1 391 970	4 697 842	345 355	**9 528 289**	0
PrivCons								**7 030 759**	0
RoW			257 277	2 109 683	280 821		148 829	**3 896 783**	0
Total col	**415 285**	**203 675**	**4 205 135**	**6 949 142**	**9 528 289**	**7 030 758**	**3 896 783**		

Source: Own elaboration.

Disaggregation of Households

To elaborate a more complete and useful SAM for the analysis of economic issues, and, in particular, of public policies and their impact on the well-being of households, in this section we work a disaggregation of households, based on deciles as defined by the national survey of income and expenditure of households 2008 (ENIGH08) (INEGI, 2009).

In Table 6 we can see the income distribution in Mexico, according to the ENIGH08 (INEGI, 2009). The distance between the deciles with the highest and lowest revenue becomes immediately noticeable: decile X has more than 20 times more income than decile I, which gives an account of the deep distributive gap that exists in Mexico. In what follows, we use the classification by deciles in Table 6.

Table 6. Households total quarterly income

Decile of income *	Homes	Income
I	2 787 462	18 435
II	2 787 462	30 455
III	2 787 462	40 667
IV	2 787 462	51 263
V	2 787 462	62 052
VI	2 787 462	76 992
VII	2 787 462	96 135
VIII	2 787 462	122 046
IX	2 787 462	171 262
X	2 787 467	386 289
Total	**27 874 625**	**1 055 594**

*Households organized by deciles according to quarterly total current income.
Source: National survey of income and expenditure of the households 2008. Traditional. Table 6.2. (INEGI, 2009).

We start breaking down private consumption and respective taxes; calculations are presented in Table 7. We use the structure of the distribution of the *total current expenditure*, implied by data in Table 7.2 of the ENIGH08, and distribute the consumption and taxes weighing participation in each decile.

Now, to disaggregate the Income Tax we use the provisions specified by the Law on Income Tax of 2008 (DOF, 2007), stipulated by article 113. Table 8 contains the applicable provisions. In Table 9 we first calculate the tax paid by households with data from table 6.2 of the ENIGH08, and then distribute the taxes in the SAM on the resulting structure of relative participation.

Table 7. Breakdown of consumption and taxes on goods and services

Income decile	Total current expenditure	Relative structure	Disaggregated private consumption	Disaggregated tax
I	24 384	0.0302	212 216.0	13 761
II	34 468	0.0427	299 976.5	19 452
III	42 533	0.0526	370 161.7	24 003
IV	50 461	0.0625	439 157.2	28 477
V	58 693	0.0727	510 802.5	33 123
VI	68 721	0.0851	598 074.4	38 782
VII	78 467	0.0971	682 891.3	44 282
VIII	95 053	0.1177	827 236.0	53 642
IX	124 278	0.1538	1 081 582.3	70 135
X	230 803	0.2857	2 008 660.5	130 250
Total	**807 862**	**1.0000**	**7 030 758**	**455 905**

Source: Compilation based on the MCS-Mx08 and table 7.2 of the ENIGH08 (INEGI, 2009).

Table 8. Income Tax on the monthly income of physical persons, 2008

Lower limit (Pesos)	Upper limit (Pesos)	Fixed fee (Pesos)	Rate on surplus of the lower limit (%)
0.01	496.07	0.00	1.92
496.08	4210.41	9.52	6.40
4210.42	7399.42	247.23	10.88
7399.43	8601.50	594.24	16.00
8601.51	10 298.35	786.55	17.92
10 298.36	20 770.29	1090.62	19.94
20 770.30	32 736.83	3178.30	21.95
32 736.84	Hereinafter	5805.20	28.00

Source: Law of the income tax. DOF 01-10-2007.

Table 9. Breakdown of Income Tax by decile. Part 1

	Total	Decile I	Decile II	Decile III	Decile IV	Decile V
Households	**27 874 625**	2 787 462	2 787 462	2 787 462	2 787 462	2 787 462
Quarterly total revenue (millions of pesos)	**1 055 594**	18 435	30 455	40 667	51 263	62 052
Total quarterly income per household (thousands of Mexican pesos)	**37.869**	6.613	10.926	14.589	18.390	22.261
Monthly income per household (pesos)	**12 623**	2204	3642	4863	6130	7420
Lower limit		496	496	4210	4210	7399
Fixed fee		9.52	9.52	247.23	247.23	594.24
Over on lower limit		1708	3146	653	1920	21

	Total	Decile I	Decile II	Decile III	Decile IV	Decile V
Rate on the surplus		6.40	6.40	10.88	10.88	16.00
Income tax on the surplus		109.34	201.33	71.01	208.87	3.34
Total income tax paid	**18 567**	119	211	318	456	598
Relative structure	**1 000**	0.006	0.011	0.017	0.025	0.032
Income Tax SAM	**351 023**	2247	3986	6016	8623	11 298

Source: Own elaboration, based on the ENIGH08 (National Households Income-Expenditure Survey 2008).

Table 9. Breakdown of Income Tax by decile. Part 2

	Decile VI	Decile VII	Decile VIII	Decile IX	Decile X
Homes	2 787 462	2 787 462	2 787 462	2 787 462	2 787 467
Quarterly total income (millions of pesos)	76 992	96 135	122 046	171 262	386 289
Total quarterly income per household (thousands of Mexican pesos)	27.621	34.488	43.784	61.440	138.581
Monthly income per household (pesos)	9207	11 496	14 595	20 480	46 194
Lower limit	8602	10 298	10 298	10 298	32 737
Fixed fee	786.55	1090.62	1090.62	1090.62	5805.20
Over on lower limit	605	1198	4296	10 182	13 457
Rate on the surplus	17.92	19.94	19.94	19.94	28.00
Income tax on the surplus	108.48	238.83	856.69	2030.22	3767.88
Total income tax paid	895	1329	1947	3.121	9573
Relative structure	0.048	0.072	0.105	0.168	0.516
Income Tax SAM	16 921	25 134	36 815	59 001	180 983

Source: Own elaboration, based on the ENIGH08 (National Households Income-Expenditure Survey 2008).

We continue with the breakdown of savings, using the same procedure followed for private consumption, but with the structure of the table 7.2 of the ENIGH08 *deposits to savings, batches, saving, etc*.

To end with Households' expenses, we disaggregate imports of households, based on the data of Table 5.2 of the ENIGH08 *other miscellaneous expenses*; calculations are presented in Table 10.

Table 10. Breakdown of direct imports by households

Income decile	Other miscellaneous expenses	Relative structure	Imports of households SAM
I	92	0.0115	4959
II	182	0.0228	9791
III	167	0.0209	8992
IV	170	0.0212	9106
V	314	0.0392	16 865
VI	301	0.0376	16 149
VII	437	0.0546	23 450
VIII	927	0.1159	49 802
IX	1442	0.1802	77 454
X	3970	0.4961	213 246
Total	8003	**1.0000**	**429 813**

Source: Own elaboration, based on the ENIGH08 (National Households Income-Expenditure Survey 2008).

We now proceed to disaggregate the elements of households' income. Starting with Labor, we use the relative structure implicit in the data in Table 3.2 of the ENIGH08 to *pay for subordinated work*, we assume that these proportions are also applied to Social and Other Social benefits. Table 11 presents the estimates.

The following element is Government transfers, so we use data from Table 3.3 of the ENIGH08 *benefits from government programs*, in the same way as before for Labor.

We still have the RoW transfers, so we use the *revenues from other countries* from Table 3.3 of the ENIGH08, to disaggregate in the same way as we did before, using the relative structure.

Table 11. Breakdown of payments to Labor

Decile	Remuneration for subordinated work	Relative structure	Labout SAM	Social contributions SAM	Other social benefits SAM
I	4195	0.0083	23 349	3456	1695
II	11 072	0.0220	61 633	9124	4475
III	17 853	0.0354	99 374	14711	7215
IV	23 637	0.0469	131 570	19 477	9552
V	30 840	0.0612	171 663	25 412	12 463
VI	40 412	0.0802	224 947	33 300	16 332
VII	52 761	0.1047	293 686	43 476	21 323
VIII	66 380	0.1317	369 493	54 698	26 826
IX	95 744	0.1900	532 943	78 894	38 693
X	161 086	0.3196	896 658	132 737	65 100
Total	**503 979**	**1.0000**	**2 805 315**	**415 285**	**203 675**

Source: Own elaboration, based on the ENIGH08 (National Households Income-Expenditure Survey 2008).

Finally, the deficit between what was spent by each household and the revenues distributed so far, is necessarily contributed by income from capital (GOS). Whereupon, the SAM-Mx08, with 19 productive sectors, ten representative households, prepared according the described procedure, is fully detailed and balanced[4].

Applied General Equilibrium Model of Mexico for 2008 (AGEM-Mx08)

This section describes the mathematical model. The equations of the model are specified. Table 12 describes the parameters and Table 13 the variables.

The AGEM-Mx08 Equations

Following the SAM ordering, we start to specify the equations we start with Households, using 4 blocks of behavioral equations. Disposable income of each household is equal to its capital and labor income (putting together effective social benefits and other social benefits for the sake of simplicity), from which households pay income tax; then, transfers from Government and from the RoW complete their income. In what follows, please refer to Tables 12 and 13 for a detailed explanation of parameters and variables.

$$DISPINC_h = [\tau_{CAPHHh} * captotecon * P_{CAP} + \tau_{LABHHh}(labtotecon - LABRoW)P_{LAB}] (1 - partinctaxhh_h)VARINCTAXHH + \beta_{TRGOVHHh} * TRGOVHH + \beta_{TRRoWHHh} * TRRoWHH + \tau_{LABHHh} * LABRoW * P_{RoWIND} * ER \quad [1]$$

Out from their disposable income, households dedicate a proportion to save (Marginal Propensity to Save):

$$SAVHH_h = MPS_h * DISPINC_h, \; h = 1, 2, \ldots, 10 \quad [2]$$

And the rest is allocated to goods imported directly from the RoW, and goods from the domestic economy. Households have Cobb-Douglas preferences on imports and a composite good for private consumption. This composite good pays the tax on products (mainly VAT):

$$PRIVCONS_h = \frac{\alpha_{CONSPCh}[DISPINC_h - SAVHH_h]}{P_{PC}(1+\tau_h^{TPH})} \quad [3]$$

$$IMPHH_h = \frac{\alpha_{CONSMh}[DISPINC_h - SAVHH_h]}{P_{RoWIND} * ER} \quad [4]$$

We continue with Government, for which we define four variables for income and four for expenditures. The public fundraising total is the sum of revenues by Income Tax (Households and Capital), Taxes on products and production (Households and Activities), and Taxes on the import of capital goods:

[4] Available from the author upon request.

$$GOBREV = REVINCTAX + REVPRODTAX + REVIMPINV \quad [5]$$

Total income tax revenue equals income tax from households plus that from firms:

$$REVINCTAX = \sum [\tau_{CAPHHh} * captotecon * P_{CAP} + \tau_{LABHHh}(labtotecon - LABRoW)P_{LAB}] * partinctaxthh_h * VARINCTAXHH + \tau_{INCTAXCAP} * captotecon * P_{CAP} \quad [6]$$

Revenue from taxes on products and production is the sum of taxes paid by Households, plus taxes on products and other taxes on production paid for Activities. We impute the taxes paid by the activities, including those of imports, to domestic production:

$$REVPRODTAX = \sum_h [PRIVCONS_h * P_{PC}]\tau_h^{PTH} + \sum_i [DOMPRODN_i * PDP_i]\tau_{PTi} \quad [7]$$

And revenues from imports of capital goods:

$$REVIMPINV = (INVIMPORT * P_{RoWIND} * ER)\ \tau^{IMPINV} \quad [8]$$

Regarding Government outlays, we assume that the policy is to allocate a fixed proportion of total collection to each element of public expenditure:

$$TRGOVHH = \alpha_{TRGOVHH} * GOVREV \quad [9]$$

$$SAVGOV = \alpha_{SAVGOV} * GOVREV \quad [10]$$

$$PUBCONS_i = \frac{\beta_{PUBCONSi}(\alpha_{PUBCONS} * GOVREV)}{P_{TOTSUPi}} \quad [11]$$

$$IMPGOV = \frac{\alpha_{IMPGOV} * GOVREV}{P_{RoWIND} * ER} \quad [12]$$

$$SPVT = GOVTOTREV - TRGOVHH - SAVGOV - \sum_i PUBCONS_i * P_{TOTSUPi} - IMPGOV * P_{RoWIND} * ER \quad [13]$$

Now consider the savings-investment account. Total savings of the economy equal the sum of savings by each institution:

$$SAVTOT = \sum_h SAVHH_h + SAVGOV + deprec * P_{CAP} + SAVRoW * ER \quad [14]$$

The economy assigns a fixed fraction of total savings to import capital goods; the tax is included in the price of imported capital goods:

$$INVIMP = \frac{\alpha_{INVIMP} * SAVTOT}{P_{RoWIND} * ER(1 + \tau_{IMPINV})} \quad [15]$$

The block of equations corresponding to the macroeconomic closure that equals total savings to total investment is placed below, in the last section of equations, devoted to macro-closures.

We now turn to model the production of goods and services, assuming it is carried out in three stages: 1) production factors are combined to generate Value Added (VA), 2) total supply inputs are added to generate domestic production, and 3) imported inputs are added to domestic production to generate the total supply.

Consider the first nesting, generation of value added (VA), where there are two blocks of variables for the demands of factors and a block of prices for the VA generated by each Activity. Assuming a function of Cobb-Douglas production with constant returns to scale, and minimization of costs, we obtain the optimum demands:

$$DEMCAP_i = \frac{VA_i}{ascva_i}\left[\frac{P_{LAB}}{P_{CAP}}\frac{\alpha_{CAPi}}{\alpha_{LABi}}\right]^{\alpha_{LABi}} \quad [16]$$

$$DEMLAB_i = \frac{VA_i}{ascva_i}\left[\frac{P_{CAP}}{P_{LAB}}\frac{\alpha_{LABi}}{\alpha_{CAPi}}\right]^{\alpha_{CAPi}} \quad [17]$$

And assuming perfect competition (price equals average cost):

$$P_{VAi} * VA_i = DEMCAP_i * P_{CAP} + DEMTRAB_i * P_{LAB} \quad [18]$$

Similarly, for domestic production (*DOMPRODN*) there are three blocks of variables, one for the demand of VA, one for inputs, and the third for prices. Considering a Leontief combination, optimum demands are:

$$DEMINP_{i1,i} = DOMPRODN_i * ruii_{i1,i} \quad [19]$$

$$VA_i = DOMPRODN_i * ruva_i \quad [20]$$

And from the assumption of perfect competition:

$$P_{DPi1} * DOMPRODN_{i1} = P_{VAi1} * VA_{i1} + \sum_{i1} DEMINS_{i,i1} * P_{TSi1} \quad [21]$$

Now, with respect to production of Total Supply (SUPTOT) we have three blocks of variables, one for domestic production demand, another one for imported inputs demand, and the third for prices. Also assuming a Cobb-Douglas production function, with constant returns to scale, from the problem of cost minimization, optimal demands are:

$$DOMPRODN_i = \frac{SUPTOT_i}{ascst_i}\left[\frac{P_{RoWIND}*ER}{P_{DPi}\left(1+\tau_i^{PT}\right)}\frac{\alpha_{DPi}}{\alpha_{Mi}}\right]^{\alpha_{Mi}} \quad [22]$$

$$DEMIMP_i = \frac{SUPTOT_i}{ascst_i}\left[\frac{P_{DPi}\left(1+\tau_i^{PT}\right)}{P_{RoWIND}*TC}\frac{\alpha_{Mi}}{\alpha_{DPi}}\right]^{\alpha_{DPi}} \quad [23]$$

And from the assumption of perfect competition:

$$P_{TSi} * SUPTOT_i = DOMPRODN_i * P_{DPi}(1 + \tau_i^{PT}) + DEMIMP_i * P_{RoWIND} * ER \quad [24]$$

The block of variables of total supply is determined by the equilibrium condition of market clearing. We also place this block at the end, in the macro-closures section.

Total private consumption equals the sum of Households demands:

$$PRIVCONSTOT = \sum_h PRIVCONS_h \quad [25]$$

Then, we define the price of the private consumption composite good, also given by the condition that unit price be equal to the average unit cost:

$$P_{PC} = \sum_i P_{TSi} * rupc_i \;\; \sum P_{OTi}\, rucp_i \quad [26]$$

Finally, there is the Rest of the World, whose equations are:

RoW revenues (at RoW prices):

$$RoWREV = [\sum IMPHH_h + IMPGOV + INVIMP]P_{RoWIND} + \sum DEMIMP_i\, P_{RoWIND} + dotcaprdm \frac{P_{CAP}}{ER} \quad [27]$$

RoW expenses (at RoW prices):

$$TRRoWHH = \alpha_{TRRoW} * RoWREV \quad [28]$$

$$SAVRoW = \alpha_{SAVRoW} * RoWREV \quad [29]$$

$$LABRoW = \alpha_{LABRoW} * RoWREV \quad [30]$$

$$EXP_i = \frac{\beta_{EXPi}(\alpha_{EXP} * RoWREV)}{P_{STi}/ER} \quad [31]$$

With respect to the RoW, we adopt the small country assumption, which implies that all the prices of the RoW will remain constant and equal to 1.

As for macroeconomic closures, the first two equations to close the model, are given by the equilibrium in factor markets:

$$\sum_i DEMCAP_i = captotecon \quad [32]$$

$$\sum_i DEMLAB_i = labtotecon - LABRoW \quad [33]$$

Then we have the basic closure for Savings-Investment: Marginal Propensity to Save (MPS) fixed, Investment flexible:

$$\left[SAVTOT - (INVIMP * P_{RoWIND} * ER)(1 + \tau^{IMPINV})\right]\beta_{INVi} = INV_i P_{STi} \quad [34]$$

Alternatively: fixed Investment, MPS flexible:

$$SAVHH_h = \left[\sum_i INV_i * P_{STi} + INVIMP * P_{RoWIND} * ER(1 + \tau^{IMPINV})\right]\tau_h^{savhh} - (SAVGOV + \tau^{deprec} * captotecon * P_{CAP} + SAVRoW * ER)\tau_h^{savhh}$$

Finally, the closure for goods' markets is:

$$SUPTOT_i = \sum_i DEMINP_{i1,i} * PRIVCONSTOT * rupc_i + CONSPUB_i + INV_i + EXP_i \quad [35]$$

Table 12. Parameters of the AGEM-Mx08

Parameter	Description	Parameter	Description
Factors		Investment	
captotecon	Total capital in the economy	*Deprec*	Depreciation (firms savings)
trabtotecon	Total labor in the economy	τ_{DEPREC}	Depreciation rate
Households		$\alpha_{INVIMPORT}$	Share of imported capital in total investment (TotInv)
τ_{CAPHHh}	Share of Households (HH) in *captotecon*	α_{INVDOM}	Share of domestic capital in TotInv
$\tau_{LABHOGh}$	Share of HH in *trabtotecon*	β_{INVi}	Share of good *i* in domestic investment
$\beta_{TRGOVHHh}$	Share of HH in social transfers		
$\beta_{TRRoWHHh}$	Share of HH in RoW transfers	Production	
MPS_h	Marginal propensity to save	α_{CAPi}	Share of capital in value added
τ_{SAVHHh}	Share per household in private savings	α_{LABi}	Share of labor in value added
$\tau o_{CONSCPh}$	Share of composite good in private consumption	$ascva_i$	Scale value-added parameter
τo_{CONSMh}	Share of imports in consumption	$ruii_{i1,i}$	Unit requirement of inputs
		$ruva_i$	Unit requirements of VA
Government		α_{DPi}	Share of domestic production in total supply
$\tau_{INCTAXHH}$	Rate of income tax of HH	α_{Mi}	Share of imports in total supply
VARINCTAXHH	Sum of HH income tax rates	$ascts_i$	Total supply scale parameter
$partinctaxhh_h$	Share of HH in *VARINCTAXHH*	$rupc_i$	Unit requirement for composite good
$\tau_{INCTAXCAP}$	Firms' income tax rate		
τ_{PTHh}	Private consumption-tax	RDM	
τ_{PTi}	Tax on production	*Dotcaprow*	Endowment of capital of the RdM
τ_{IMPINV}	Tax on capital imports	τ_{CAPRoW}	Share of RoW in *captotecon*
$\alpha_{TRGOVHH}$	Share of Transfers in Gov't Expenditure (GovExp)	τo_{LABRoW}	Share of labor in RoW spending
α_{SAVGOV}	Share of Savings in GovExp	$\beta_{TRRoWHH}$	Share of remittances in RoW spending
α_{IMPGOV}	Share of Imports in GovExp	α_{SAVRoW}	Share of savings in RoW spending
$\alpha_{PUBCONS}$	Share of Consumption in GovExp	α_{EXP}	Share of exports in RoW spending
$\beta_{PUBCONSi}$	Share of good *i* in Government consumption	β_{EXPi}	Share of good *i* in exports

Source: Own elaboration.

Table 13. Endogenous Variables of the AGEM-Mx08. Part 1

Households	**Subtotal**	**50**
	Real variables	
Private household consumption	$CONSPRIV_h$	10
Imports for home	$IMPORTHOG_h$	10
	Nominal variables	
Disposable income per household	$DISPINC_h$	10
Each household saving	$AHRHOG_h$	10
Marginal propensity to save	$PMAHOG_h$	10
Government	**Subtotal**	**28**
	Real variables	
The Government imports	*IMPORTGOB*	1
Government consumption	$CONSPUB_i$	19
	Nominal variables	
Revenue from income tax	*REVINCTAX*	1
Revenue from products tax	*REVPRODTAX*	1
Revenue from capital imports	*REVIMPINV*	1
Government total revenues	*INGGOB*	1
Government transfers to households	*TRGOVHH*	1
Public savings	*SAVGOV*	1
Government surplus	*SPVTGOV*	1
Variable for income tax of households	*VARINCTAXHH*	1
Savings-investment	**Subtotal**	**21**
	Real variables	
Investment in imported capital	*INVIMPORT*	1
Investment in national capital	INV_i	19
	Nominal variables	
Total savings in the economy	*AHRTOT*	1

Source: Own elaboration.

Table 13. Endogenous Variables of the AGEM-Mx08. Part 2

Production	**Subtotal**	**536**
	Real variables	
Demand for capital by activity	$DEMCAP_i$	19
Demand for labor by activity	$DEMTRAB_i$	19
Value added by activity	GO_i	19
Demand for inputs by activity	$_{i1}, _{i}DEMINS$	361
Domestic product by activity	$PRODNINT_i$	19
Demand for imports by activity	$DEMIMPORT_i$	19
Offer total per activity	$OFTOT_i$	19
Total private consumption	*CONSPRIVTOT*	1
	Prices	
Price of capital	P_{CAP}	1
Price of the work	P_{TRAB}	1
Price from value added	P_{Vai}	19
Price of domestic production	P_{IIP}	19
The total offer price	P_{Oti}	19
The private consumer goods price	P_{CP}	1
Rest of the world	**Subtotal**	**25**
	Real variables	
Work contracted by RoW	*LABRoW*	1
Exports by activity	$EXPORT_i$	19
	Nominal variables	
Income of the RdM	*INGRDM*	1
RoW transfers to Households	*TRRoWHH*	1
Savings of the RoW	*SAVRoW*	1
	Prices	
Exchange rate	*TC*	1
Price index of the RdM	*PRDMIND*	1
	Total	**660**

Source: Own elaboration.

Analysis of Taxes on Hydrocarbons Extraction

According to the IOT-Mx08, taxes paid by sectors and total production are presented in Table 14. The *Other taxes on production (OIP)* are from Table 58 of the Accounts of Goods and Services (AG&S), where it is seen that *Other taxes on the extraction of oil and gas* (901 548.6) are 99.9% of the *Other taxes on mining*. The global tax rate in the penultimate column is calculated by dividing total taxes by production at basic prices. In the last column the tax rate by sector is calculated, with data obtained for the MCS-Mx08, dividing total taxes by domestic production net of taxes.

According to SAM's data in the last column, Mining pays a global tax of 172.5%; and the average tax rate paid by all sectors amounts to 11.59%. The simulation we implement decreases Mining taxes from 172.5% down to the average tax of 11.59% assuming that, after the reform of 2013, hydrocarbons extraction would pay a tax close to that average.

Table 14. Taxes on Productive Sectors

Sector	Total production Basic prices	Net Taxes on goods and services	Net production taxes	Other net production taxes	Total taxes	Global Tax % IOT-Mx08	Global Tax % SAM-Mx08
A1	586 319	-3624	1465	160	-1999	-0.34	-4.8
A2	**1 238 359**	**-5351**	**827**	**902 563**	**898 040**	**72.52**	**172.5**
A3	454 744	-21 393	1813	1424	-18 157	-3.99	15.4
A4	1 925 713	-8418	6831	2378	792	0.04	4.0
A5	6 949 142	-7805	22 160	13 729	28 085	0.40	0.6
A6	2 332 613	-4911	6711	12 397	14 197	0.61	3.0
A7	1 152 579	-84 204	-1020	-1443	-86 668	-7.52	-10.7
A8	487 363	-1469	2108	2457	3096	0.64	-6.8
A9	598 298	-384	10 960	9591	20 166	3.37	-2.0
A10	1 615 425	-6816	1448	10 648	5279	0.33	21.4
A11	402 904	-1336	1271	1321	1256	0.31	-8.1
A12	84 260	-330	592	5576	5838	6.93	56.2
A13	475 101	-634	3582	1430	4378	0.92	0.8
A14	539 239	-841	1723	1948	2830	0.52	-8.1
A15	362 835	-1505	1392	1068	955	0.26	-18.3
A16	74 044	-317	519	391	593	0.80	18.3
A17	399 154	-1816	2502	1573	2260	0.57	3.4
A18	346 327	-2077	971	866	-241	-0.07	-6.4
A19	658 148	-6852	4036	3364	548	0.08	-0.4
Total	**20 682 566**	**-160 085**	**69 891**	**971 440**	**881 247**	**4.26**	**11.59**

Source: Compilation with data of the MIP-Mx08 and CByS (INEGI, 2010a).

Table 15 shows the income tax rate paid by households according to the SAM-Mx08, which goes from 1.1% on the poorest decile, to 6.2% on the richest one.

The simulation we implement reduces the total tax rate paid by Mining (hydrocarbons extraction) down to the average level of 11.59%, compensating with a uniform increase to income tax paid by households, so that (nominal) global revenue remains at the same level.

Macroeconomic closure

Since effects on households' wellbeing are a major concern for this research, we use Hick's Equivalent Variation (HEV) to evaluate changes in monetary terms. In order to compute a sensible HEV we set the following macro-closures combination: a) fixed real investment with flexible households savings (MPS_h), to prevent fluctuations in investment from biasing the

HEV; b) fixed total government revenues and flexible Income Tax on Households, so that Government maintains the level of spending, and the welfare of households is not affected by the change in the consumption of public goods; c) by the same token, for the RoW we specify fixed income (and hence fixed RoW savings), and flexible exchange rate.

Table 15. Rate of Income Tax Paid by Taxpayers According to the MCS-Mx08

Taxpayer	Initial income tax rate (SAM-Mx08)	Final income tax rate (after simulation)	Final rate / initial rate	Hicks' equivalent variation
Decile I	0.011	0.034	3.08	6.5358
Decile II	0.014	0.043	3.06	4.4743
Decile III	0.016	0.050	3.07	3.8506
Decile IV	0.019	0.057	3.07	2.8795
Decile V	0.021	0.063	3.06	-0.0183
Decile VI	0.025	0.076	3.06	-2.3725
Decile VII	0.032	0.098	3.06	-16.0101
Decile VIII	0.036	0.111	3.07	-26.6316
Decile IX	0.041	0.127	3.07	-43.4359
Decile X	0.062	0.189	3.07	-201.4302
Total				**-272.1584**

Source: Own elaboration.

Simulation results

The implementation of the described simulation shows that reducing the tax on Mining (extraction of hydrocarbons), from 172.5 to 11.59%, to keep constant total government revenue would triple the income tax paid by households. The resulting simulation rates are also in Table 15; the penultimate column results from dividing the final rate by the initial.

In the last column are Hicks' Equivalent Variations, which show that lower income deciles are benefited, while from decile V on households begin to have a negative HEV due to the progressive income tax; if we sum up all ten of them, we obtain a negative total of (-272.1584) which accounts for total welfare loss in monetary terms. This negative effect obeys primarily to the fact that, with this reform, households have to pay for public services that were financed with taxes on Mining and, although a positive effect is observed through a fall in prices, this is much smaller and surpassed by far by the negative effect.

Table 16 contains the prices resulting from the simulation, which decrease more or less depending on the degree of integration of each sector with Mining. The price of labor increases slightly (0.1%) and final consumption prices decrease by 3.5%.

By construction, the AGEM-Mx08 is a model of perfect competition (although in this case Pemex is a monopoly; the small country assumption implies that it can't modify international oil prices). Therefore, price formation occurs from costs and taxes; hence, to lower taxes in

Mining reduces its prices, which in turn lowers prices in other sectors, which would improve the competitiveness of the Mexican economy.

According to the simulation, the mining sector prices decrease by 59% (but as we said, international markets could prevent oil prices from decreasing). Consequently, prices in other sectors decrease from 0.3% in activity 14 up to 9.1% in activity 5 (which uses more imputs from the mining sector).

Table 16. Final prices obtained through simulation

Activity	Price	Activity	Price	Activity	Price
A1	0.980	A7	0.975	A13	0.995
A2	**0.411**	**A8**	**0.987**	**A14**	**0.997**
A3	0.956	A9	0.994	A15	0.988
A4	0.968	A10	0.996	A16	0.991
A5	0.909	A11	0.995	A17	0.985
A6	0.993	A12	0.995	A18	0.989
				A19	0.989

Source: Own elaboration.

Conclusions

The first goal of this research was to build a Social Accounting Matrix of Mexico for 2008 (SAM-Mx08), fully transparent and documented, which we consider to be a relevant achievement in itself, providing a complete view of the Mexican economy and enabling the application of a wide range of analytical methods (Breisinger, Marcelle & Thurlow, 2010).

We believe that transparency is an essential criterion, which will allow results from investigations carried out with the SAM database to be replicated by other researchers and to be sufficiently discussed to arrive to solid and useful conclusions. Moreover, the SAM can be corrected and/or modified to do further studies. In addition, the SAM can be immediately broken down to the next level of the North American Industry Classification System (NAICS) with 79 subsectors (INEGI, 2013b), and even to the level of 262 branches, which enables a more detailed and comprehensive understanding of the economy.

To build the SAM, we assumed some simplifications in order to reconcile inconsistencies between the IOIT and the National Accounts; while it is commendable that INEGI has restarted the five-year development of the IOT for Mexico, it is also desirable that data in future editions be properly reconciled, so that the information is reliable and consistent for the public and private decision-making, and to enable scholars to perform deeper and more comprehensive economic investigations. INEGI might also consider the elaboration of a comprehensive SAM at least at the national level, and generate the necessary data so that researchers can build OITs and SAMs at the state and other regional levels.

The second objective was to develop a robust and parsimonious Applied General Equilibrium Model of Mexico for 2008 (AGEM-Mx08) based on the SAM-Mx08. In this we also believe that transparency is essential, because only the replication of results by other researchers and reasoned discussion will lead to valid and useful results. Therefore, both the SAM and the GAMS code for the AGEM will be provided by the author upon request.

In the same way, the AGEM-Mx08 may also be modified to apply it to the study of other problems, since we believe that its parsimony and robustness allow it to serve as a base or starting point for more complex models and more sophisticated simulations. The range of possibilities is wide: analysis of reform of VAT, effects of changes in public spending policies, evaluation of programs to alleviate poverty, international trade, etc.

The third objective was to apply the AGEM to a problem of high current interest in the Mexican economy and public finances: taxes on the extraction of hydrocarbons. This as accomplished with a simulation that is a first approach to a complex problem and that requires additional developments, for instance: a) A more elaborated specification of the functions of production and price formation, particularly in the extraction of hydrocarbons; b) Use of alternative closures and discussion of its implications on the results; and c) a more detailed assessment of impact on finances and spending, and their consequences for the welfare of households.

Results from the simulation we implemented indicate that even though low-income households would benefit slightly when reducing the taxes paid by the extraction of hydrocarbons and compensating with an equivalent increase in Income Taxes, households with higher incomes would have to absorb the financing of public expenditure, incurring in a high cost.

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