The Mexican energy reform and its regional effects: a computable model for Tabasco

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Abstract

This paper presents a dynamic computable general equilibrium model for the State of Tabasco, Mexico, calibrated to a social accounting matrix. It analyzes the energy reform in Mexico and its effects on supply and demand in the skilled and unskilled labor force. The paper focuses on two simulations: one called "*la reforma"* where the federal government returns part of the oil sector's profits to the education sector in the form of investment, results in more equality, less poverty and less employment bias of skilled labor. And the other simulation named "*aguas profundas"* that depends on the recovery of the price of crude oil until the value justifies the investment in sophisticated methods of oil extraction; the results offer more profitability, productivity and expansion, but also imply a higher risk on its dependence on the future price of oil.

Resumen

Este trabajo se presenta un modelo dinámico de equilibrio general computable para el estado de Tabasco, México, calibrado a una matriz de contabilidad social, con un análisis de la reforma energética nacional y sus efectos sobre la oferta y la demanda en la mano de obra, calificada y no calificada. El trabajo se centra en dos simulaciones: La primera, denominada "*la reforma*", donde el gobierno federal canaliza parte de las ganancias del sector petrolero al sector educativo en forma de inversión, lo que resulta en mayor igualdad, menor pobreza y menos sesgo en el empleo de mano de obra calificada; la segunda simulación, denominada *"aguas profundas"*, depende de la recuperación del precio del crudo hasta donde su valor justifique la inversión en sofisticados métodos de extracción en aguas profundas, y redunde en mayor rentabilidad, productividad y expansión, aunque implica dependencia en el precio futuro del petróleo.

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1. Introduction

The energy reform in Mexico, strengthened by a constitutional change and the secondary legislation recently defined, comprises a fundamental change in the economic policy. Formerly, the government depended on the taxes and direct payments it received from the state-owned Petróleos Mexicanos (Pemex), which reached about 35% of its total income (Segal, 2011). The industry was nationalized in 1938 with the purpose of making Mexicans the beneficiaries of the nation's resources. Unfortunately, the idea of "making beneficiaries" was not well understood and it happened what the literature calls "the curse of the natural resource", provided the profit obtained through oil distorted the role of the government in the effective allocation of the resources (Bulte, Damania, y Deacon 2004). Segal (2011) indicates the government could use income from oil to eliminate extreme poverty. However, the said resources are deposited into an overall fund of government income without following a specific anti-poverty policy.

The research question is: How to get the resources from the oil sector to generate an increase of the skilled labor force in the regional economy and avoid "the curse of resource"? Thus, this document analyzes the impact of the energy reform as a reagent to increase the supply of skilled labor force through the emerging educational sector in the State of Tabasco, by utilizing of a dynamic computable general equilibrium (CGE) model. As a result, we can draw the conclusion that Tabasco must continue responding to both the "race between technology and education" and "the endless dance of progress and inequality" (Goldin y Katz, 2008; Deaton, 2013).

The contents of the document are as follows: section 2 provides the Social Accounting Matrix (SAM), as an aggregation of Armenta´s SAM (2012)[2]. The purpose of the said matrix is to provide a consistent database to respond appropriately to the research question posed, and implies a fundamental re-organization of the information available. Section three develops a dynamic computable general equilibrium (CGE) model, which in this case is compact given its simplicity, and comprises a mix of the well-known models of Keynes (1936) and Solow (1956) to generate a stable growth path (Heal, 1973)[3]. In section four two simulations are performed: the first one, termed *"la reforma"*, where the federal government allocates part of the profits from the oil sector to the education sector as investment, which in turn results into higher equality, lesser poverty and less bias in the employment of skilled labor force; the second simulation, termed "*aguas profundas*", depends on the recovery of the price of oil up to the point where its value is worth the investment in cutting-edge production methods in deep waters, and results in higher profitability, productivity and growth, even though this implies some dependence on the future price of oil. In the last section it is concluded that, since the price is not defined by a competitive equilibrium but by Kaleck's prices set by the federal government, the state of Tabasco cannot set a pattern which avoids the "curse of the resource".

2. The model and its motivation

To some extent, the energy reform came to Mexico very late. Should a change like this have taken place 20 years ago, Mexico could have benefited from the high price of oil and from the technological advances developed with the collaboration of the multi-national oil companies. The above, certainly, departing from the assumption that the Mexican government had invested in the education sector the

[2] See the methodology in the technical report Gibson and Flaherty (2014).
[3] As of the model 123 published in 1997, the minimalist applied general equilibrium models have played an important role in the formulation of economic policies (Devarajan et al.,1997).

profits deriving from oil production during the said period. Early 2015, when the price of oil dropped to a third of its maximum price, Mexico's scenario would show a large diversification of its exports of non-oil goods and services, which are the product of the accumulation of human capital.

Even before the 80's, it was not seen in Mexico an adequate investment in the education sector to obtain "competitive advantages" from the unskilled and cheap labor force. During this decade, expenditure on education as a percentage of GDP was 2.3, ranked as the 88th out of 103 countries according to a classification made by the World Bank. During the 90's, the said investment increase to achieve the 72nd place and, at the turn of the new millennium, it increased to achieve the 39th position[4]. In 2010, México reported an average expenditure of 6.2% of GDP in education, equivalent to the average of the countries members of the Organization for Economic Co-operation and Development [OECD], (Valle & Gómez, 2013).

In the list of world economies, published by the World Bank in December 2016, taking into consideration the 2015 GDP per capita and calculated with the World Bank Atlas method, Mexico was ranked as an "*upper middle income*" country, with 9,710 dollars. In a study by Kena *et al.* (2016, p. 138), the results of a cross-sectional regression between the income per capita and the 2012 levels of expenditure in education, indicate that Mexico is spending above the average in proportion to its level of income in higher education, and below the average in basic and secondary education. The growth rate of the middle school graduates is high, 3.6% and is higher than the average of the countries members of the OECD, its growth has gone from 3.3% in 2000 to a forecasted 4.9% for the forthcoming years.

[4] Calculations by the authors from data presented at http://hdr.undp.org/en/content/expenditure-education-public-gdp

Several studies claim there is a high correlation between the accumulation of human capital and exports. Using panel data in a regression of 25 countries between 1989 and 2003, to respond to the premise that the investment made on human capital yields significant effects on exports, Contrator & Mudambi (2008) used as a proxy of the investment on human capital the literacy rate of people aged 15 years or more, and the public expenditure on education. They managed to conclude that the public expenditure on education has a highly significant effect ($p < 0.001$) on the exports of goods and commercial services; however, literacy has no significant effects on the exports of services and it has a weak positive effect on the exports of goods. Likewise, in relation to their infrastructure variables, information technologies taken as proxy of installed capacity, the results strongly back up the link among the exports of marketable services, as well as the level of output traffic of telecommunications as a proxy of flows of technological infrastructure. This is a result which is highly consistent with Baldwin (2016), who identifies the flow of the *know-how*, the computing capacity and the advanced communication media as the key elements of the fourth phase of 21st century globalization. As a result, it is concluded that cheap labor force is not the main cause of foreign investment; rather, what is significantly important is the level of skilled labor force, which is reflected by the managers and middle managers, the technicians and all the others.

The unwanted side of the gap in Mexico's progress can be seen in education statistics, as it is demonstrated by the lack of employment opportunities for the graduates from postgraduate level. While it seems that there has been no increase in the number of youngsters who is "Not in Education, Employment or Training" (NEET), as it happens in other OECD countries, a research would show otherwise (NINIs, a term given in Mexico to youngsters who happen to be in this circumstance). The number of women involved in the NEET circumstance, aged between 15 and 29, has dropped from 41% in 2000 to 37.8% in 2011, Valle and Gómez (2013). On the other hand, men have increased

their participation in the NEET circumstance, as well as in drug trafficking or in the informal sector. In this regard, the objectives of Universities in the Tabasco region include the enrollment of a growing proportion of applicants, shown as an indicator of social progress.

In the last 20 years, Tabasco's education system has grown more rapidly than the population. Comparing the natural increase of population, for each one hundred thousand people in school age more than two hundred thousand students have become enrolled in school (PLED, 2012), men and women in their proportions in society, with a high rate of graduates in higher education. As from 1990, illiteracy has dropped 5 percent points and a network of job training has been developed, regardless of the formal education institutions.

3. Social Accounting Matrix (SAM)

Tabasco's economic model is a regional one, therefore there are imports and exports both international and to the rest of the country as well. The 2003 SAM shows four productive sectors: agriculture, oil, manufacturing and services; five social classes, the poorest one is marked with H1 and the richest one with H5; and two levels of labor force: skilled and unskilled. The said Matrix is based on Armenta (2012), though a significant modification was made in its scheme[5] such that the State Gross Domestic Product (PIBE, in Spanish) of the matrix is in accordance with the accounts published by the National Institute of Statistics and Geography (INEGI, in Spanish) for the year 2003, the structure of income per social class is in accordance with the Gini[6] coefficient published for Tabasco (PLED, 2013).

Governmental revenue is regulated by the National System of Fiscal Coordination (SNCF, in

[5] See Gibson and Flaherty (2014) for the details.
[6] Since there is no information about the distribution of income of factors of households, the bi-proportional adjustment method (RAS) was used to make compatible the function-size matrix Gibson and Flaherty (2014).

Mexico)[7]. The local government receives income from the federal government through allocations, termed "*participaciones"*, which are governed by a calculation rule set forth by the SNCF, and it also receives direct taxes from local companies. Because the profits of the oil sector are delivered directly to the federal government, this payment is accounted for as a direct tax of the sector. The state government cannot operate based on its own collection of taxes; hence it requires the transfers from the federal government. Thus, the net flow for the state of Tabasco is the difference between taxes going to the federal government *minus* the transfers the federal government redistributes to the state. In addition to the fiscal exchange, there is direct participation of the federal government in the state.

The following exchanges are identified in the SAM: the federal and state governments can employ local workers and pay them as employees of the public sector; the federal government contributes to the final demand through payments to companies, either as demand of final consumption goods or investment goods; there are also subsidies to companies in order to increase the private added value. Further, the income of households is made from wages, the salaries and the profit from their involvement in the production processes, as well as from the remittances from the rest of Mexico (RDMEX, in Spanish), and from the rest of the world (RDM, in Spanish), and from the remittances they receive from the federal and state governments.

4. An analytical model

Even though Tabasco's model is a regional one, it works as if it was that of a country with important foreign relations, since a regional model has to follow a scheme of international exchange.

Hence, the regional State Gross Domestic Product, PIBE, "*Y"*, is described as:

[7] Among the sources of income we can find the widely applied taxes, such as the Value Added Tax (IVA, in Spanish), the Income Tax (ISR, in Spanish), and the Special Tax on Production and Services (IEPS, in Spanish).

$$Y = C + I + G + N \qquad (1)$$

where $C = \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}$ is the actual consumption of the good *i = 1, 2,..., n*, times the social class *j = 1, 2,..., m*[8].

The actual investment per origin is I, defined as:

$$I = I_p + I_g + I_f \qquad (2)$$

where I_p is the private investment, I_g, is the investment of the local government, and I_f is the federal investment. The actual expenditure of the government, *G*, is defined as:

$$G = G_f + G_g \qquad (3)$$

where G_f is the federal expenditure, and G_g is the state expenditure. The total net actual exports to Mexico, RDMEX, and the rest of the world, RDM, are aggregated to *N*.

The behavioral equation for consumption depends on a linear expenditure system, (LES)[9], in which the total expenditure, E_j, per class, *j*, is defined as:

$$E_j = Y_j(1 - t_j)(1 - s_j) \qquad (4)$$

where *j* indicates that each variable is per class; Y_j is the total income; t_j is the direct tax and s_j is the savings rate. Since the nominal expenditure is constant for each social class, the sub-index *j* will be omitted. The marginal propensities to consume, m_i, which also derive from the SAM are:

[8] In the case of Tabasco's model, *n=4* y *m=5*.

[9] The problem of LES is that it neither takes into account the elasticity of price nor the elasticities of crossed prices which differ from one.

$$m_i = C_i \Big/ \sum_{k=1}^{n} C_k$$

where $\sum_{i=1}^{n} m_i = 1$ for each social class *j* and C_k is the consumption appearing in the SAM. For each type of household *j*, the LES can be described as:

$$p_i C_i = p_i \theta_i + m_i \left[Y_j (1 - t_j)(1 - s_j) - \sum_{k=1}^{n} p_k \theta_k \right] \qquad (5)$$

where p_i is the price to consumer and θ_i is a constant representing the intercept. The intercepts of equation 5 can be calculated using the Frisch coefficient for each class. The Frisch parameters are shown in Table 1.

Table 1. Intercepts[1] and Frisch[2] parameters of the model

		AgPec	Manufacture	Services	Frisch
Poorer	(H1)	230	1,280	1,124	3.00
Less poor	(H2)	283	1,967	1,196	2.50
Middle	(H3)	235	2,262	1,954	2.00
Less rich	(H4)	182	2,017	2,401	1.50
Richer	(H5)	99	1,746	4,419	1.20

Source: Calculation by the authors, based on Armenta (2012) and INEGI (2013).

Notes: [1] The intercept is defined as $\theta_i = C_i(1 - 1/f)$ where f is the Frisch parameter. [2] Since households do not consume oil, in this case $\theta = 0$.

4.1. Income

In order to obtain the income of the function of consumption, it is necessary to see the material balance

$$\boldsymbol{X = AD + C + I + G + N} \qquad (6)$$

where $\boldsymbol{X} = \{x_i\}$, $i = 1, 2, \ldots, n$ is a column vector of the gross value of production and the matrix of input-output coefficients is defined by $\boldsymbol{A} = \{a_{ij}\}$.

If the matrix of coefficients of the internal production is $\boldsymbol{B} = \{b_{ij}\}$ for $i = 1, 2, \ldots, n$ where $b_{ij}x_j$ is the product of the good i of the company j, it can be written

$$\boldsymbol{D} = \boldsymbol{BX}$$

in the understanding that $\boldsymbol{D} = \{d_i\}$ is a column vector of the intermediate demand of the activities.

The cost per unit, C_j in the sector j is

$$C_j = \sum_{i=1}^{4} p_i a_{ij} + w_c l_{cj} + w_n l_{nj} \qquad (7)$$

Where p_i is the price of the good i and a_{ij} is the input-output coefficient, plus the cost of labor force, which is the wage, w_i, times the coefficient of labor force, l_i, for $i = c, n$, where c means skilled labor force and n unskilled labor force. Wages are equal for each sector in the base matrix. The coefficient of private aggregate value, v_j , is:

$$v_j = w_c l_{cj} + w_n l_{nj} + \tau_j C_j$$

In which τ represents the *mark-up* over the costs per unit and is calibrated in the base SAM. Once calibrated, the *mark-up* is kept fixed during the base run. Then the price is:

$$p_j = (1 + \tau_j) C_j + t_j v_j \qquad (8)$$

where t_j is the value added tax. Hence, the income from production, Y_{pj} is defined as:

$$Y_{pj} = v_j D_j (1 + t_j) + t_j^d p_j X_j \qquad (9)$$

in the understanding that $t_j^d X_j$ is the direct tax[10]. Total income includes the direct taxes provided they are part of PIBE. The total expenditure of each company, X_{dj} , is defined as that of the producer:

$$X_{dj} = p_j\left(1 - m_j^c - t_j^d\right)X_j$$

where m_j^c is a marketing margin calibrated from the base SAM. X_{dj} can be identified in an analogous manner to the consumer's expenditure. Instead of consuming goods, the company operates with production processes according to the matrix $\widehat{\boldsymbol{B}} = \{b_{ij}x_j\}$[11].

The incomes of households, Y_h , consist of the payments to the skilled labor force factor, Y_{f1}, and to the unskilled labor force, Y_{f2}, the profits of capital, Y_{f3}, and the transfers, T_{rh}, i.e.:

$$Y_h = \sum_{i=1}^{3} \phi_{hi} Y_{fi} + \sum_{r=1}^{3} T_{rh} \qquad (10)$$

where Y_{fi} is the income of each factor, the ϕ_{hi} are the allocations, *participaciones*, in the income of each class, and T_{rh} is the sum of the three sources of transfers: T_{1h} are the transfer from abroad, T_{2h} are the transfers from the rest of Mexico, and T_{3h} are the transfers of all the components of government.

$$Y_{f1} = \sum_{j=1}^{4} w_c l_{cj} D_j \qquad (11)$$

$$Y_{f2} = \sum_{j=1}^{4} w_n l_{nj} D_j \qquad (12)$$

[10] Note that the value added coefficient, a concept of the economy's activities, was defined implicitly in equation 9 after the taxes to companies $t_j^d p_j X_j$.

[11] In the case of Tabasco's SAM, there is little joint production; in fact, only two sectors, manufacturing and services. Even though the joint production quantity is minimum, the model allows for companies to be able to choose to operate in a combination of processes.

$$Y_{f3} = \sum_{j=1}^{4} \tau_j C_j D_j \qquad (13)$$

The definition of income of households in equation 10 closes the circle of causality in the model, which goes from the definition of the demand for final consumption goods, the income of companies, the aggregate value and returns again to income, that is, to the consumption of goods by each class. The ϕ_{hi} are calibrated in the base SAM, according to table 2.

Table 2. Proportions of income of the production factors

	Labor Force		
	Skilled	Unskilled	Capital
Poorer (H1)	0.03	0.26	0.00
Less poor (H2)	0.11	0.23	0.01
Middle (H3)	0.19	0.18	0.06
Less rich (H4)	0.21	0.16	0.16
Richer (H5)	0.46	0.18	0.77
Total	1.00	1.00	1.00

Source: Calculation by the authors, based on Armenta (2012).

4.2. Investment

It should be noted that investment plays two roles: investment per *origin*, *I*, in equation 1, as a component of the aggregate demand; and the role of capital invested for production, that is, investment per *destination*, I_d, defined in the model by an accelerating ratio. Table 3 shows the two concepts of investment, where it can be seen that the sum of investments is the same, 20 522 million MXN in 2003, and the oil's investment per origin is zero, whereas the investment per destination is 4 218 million MXN

Table 3. Investment per origin and destination.

Total	Per origin	Per destination
Agpec	178	858
Oil	0	4,218
Manufacture	4,036	4,349
Services	16,308	11,097
Total	20,522	20,522

Source: Calculation by the authors, based on Armenta (2012), INEGI (2013)

The accelerating rate which defines the investment per destination, I_{djt}, is defined as:

$$I_{djt} = \left(i_{0j} + \alpha u_{jt}\right)K_{jt-1} \qquad (14)$$

where i_{0j} is a constant, α is the accelerator, and K_{jt-1} is the capital of the previous period. The use of the capacity in period t, u_{jt}, depends on:

$$u_{jt} = Y_{ptj}/Q_{jt} \qquad (15)$$

for the process j and where Y_{pjt} is the income from production in equation 9. In the model, the capacity of production is determined by a Cobb-Douglas function, defined as:

$$Q_j = \mathcal{A}_j {K_j}^{1-\beta_{cj}-\beta_{nj}} L_{cj}^{\beta_{cj}} L_{nj}^{\beta_{nj}} \qquad (16)$$

where $\mathcal{A}_j$ is a constant of calibration and it is a scalar, the production factors are the capital, K_j, and the two types of labor force, skilled L_{cj}, and unskilled $L_{nj,}$ referred above. In the base SAM it is supposed the levels of employment, L_{cj} and L_{nj} are determined by the marginal product. In the traditional growth models, the provision of labor force depends on the available supply of each class. Since there is no information about this supply it is possible to estimate the level of the capacity of production in equation 16 since, through wages, w_c and w_n, it is estimated the provision of skilled and unskilled labor force as:

$$L_{ij} = \left[\left(\beta_{ij} p_j \mathcal{A}_j {K_j}^{1-\beta_{cj}-\beta_{nj}} L_{ij}^{\beta_{ij}}\right)/w_i\right]^{1/(1-\beta_{ij})} \qquad (17)$$

When $i = c$, is skilled, then $\bar{\imath} = n$, is unskilled, and vice versa. This allows to calculate the labor force which makes possible the calculation of the capacity of production in equation 16, the level of use of the capacity in equation 15, and the investment per destination in equation 14.

In this paper, the concept of accelerator is used for the definition of the investment, although its use is not standard, and the use is conceived as a highly subjective concept, that is, that it reflects the expectations of the investor class. Hence, the decision to hire the quantity of labor force required is based on the effective demand and not on considerations over the labor force available. The use, u_{ij}, as it works in equation 15, is not a limit that cannot be exceeded, but an index which indicates to the entrepreneur that it has to consider, perhaps, an enlargement of its capital stock. This is the concept of the "animal spirits"[12] in its most objective form.

The model's assumption in the effective demand is that the coefficients of labor force are the ones which determine the employment in each period:

$$L_{ij} = l_{ij}D_j, \quad i = c,n \qquad (18)$$

are parameters to be estimated in the simulation of section five, where the growth rate of the said coefficient is negative.

We then get to the key point of the model, due to the assumption that Mexico would take advantage of its position as a developing country, since it could import high technology from developed countries without the need to follow a long trajectory to increase its technological change, and that would be reflected on labor force markets. The combination of high technology plus competitive wages and salaries offer a comparable advantage which implies incentives to foreign

[12] It is a concept coined by John Maynard Keynes to describe the impulse of human nature to make spontaneous positive decisions; that is, decisions based more on intuition than on expectations.

investment, without depending on the internal market. On the other hand, it is true that, in the "competition between high technology and education", developing countries have to invest in human capital at very high rates. This gives rise to the need to fund the accumulation of human capital with oil resources, and we can draw the conclusion that the supply had to be enlarged in the same proportion such that the coefficient of the skilled labor force increases. However, the coefficient of the unskilled labor force would drop, which implies that the employment opportunities would have a contraction which, in turn, would lead to high levels of poverty and inequality.

4.3. Adjustment mechanisms

The model achieves equilibrium in each period, given the levels of capital, wages, and all the other variables of "state" which describe the changes of technology and the parameters of the policy.[13] It is here where the structure of SAM of Tabasco's economy enters directly into the model's equations. Particularly, the second sector, the one corresponding to oil, works at full capacity. The increase of capital stock grows mainly as a function of the public investment made by the federal government. The use of the skilled and unskilled labor force depends on how advanced the technology imported is. In this sector, the price is not determined by equation 8, but by the policy of the state, as an *administrative* price.[14] Since there is no intermediate consumption of crude oil, neither final consumption by households, the production is exported entirely to the market of the rest of the country for refining, or to the international market, a division which is defined in the base SAM. For this case, $Q_{2t}=Y_{p2t}$, a particular issue is that when the price drops, so do the investment and production, and this happens because it is a marginal producer with relatively high marginal costs.

[13] See the appendix for the levels of each parameter of the model.

[14] That is to say, the price is not determined by the international price of oil multiplied by the exchange rate.

The adjustment of prices does not take place due to the Walras' Law or to competitive equilibrium. Since it is a general equilibrium model, it is necessary to have a price system to determine the incomes of companies and households. Hence, in the determination of prices there is a *mark-up* over the costs, the Kaleckian prices, which Keynes termed *prime costs*. In this regard, the model is more compatible with Chamberlin and Robison's markets of imperfect competition, where their *mark-ups* are determined by the microeconomic elasticities perceived by companies.

In all the other sectors: agriculture, manufacturing and services, the adjustment mechanism is Keynesian, where the changes in the demanded quantity do not cause changes in the prices. In these sectors, prices are determined by equation 8, which indicates there is a *mark-up* over the unit costs of production. The quantities react to the changes in demand by the consumption of households, the investment goods, the government's expenditure, and net exports. In the oil sector, Tabasco is assumed to be a small country, while in other sectors it is supposed to be a large country, mainly in relation to services and manufacturing. This implies that the competitiveness of the actual exchange rate, along with the production processes, determine the net exports. The equations of LES (5), determine the value of total consumption, whereas the accelerator provides the level of the investment per destination, which is then added to the total investment per origin. The component of the government's expenditure, both state and federal, completes the aggregated demand, and is considered as an exogenous variable of the economic policy[15].

The development cycle proposed in this paper commences when the oil production is exported entirely to the rest of the country and to the rest of the world, then, the profit from oil production return to Tabasco through transfers from the federal government. These transfers are not *quid pro quo*,

[15] See the appendix for the levels of each parameter of the model.

however; the state benefits from its own production in different manners. Once the flows are received, a proportion of them is invested in the education sector in order to increase the supply of skilled labor force, which includes professionals. This increase of skilled graduates increases the supply of the factor, which implies wages are kept at a competitive level. Under the assumption of a "large country", with a competitive exchange rate, the net exports of the private sector can be expanded. The same process is repeated with all the other sectors, agriculture and manufacturing, but the greatest effect takes place in the services sector.

Along this process, net exports grow and this causes the aggregated demand to increase with positive effects on investment and growth in the demand of labor services. However, we can see the increase of investment in the capital stock favors the skilled labor force in detriment of the unskilled labor force, and some negative effects can be seen in the circle since there is an increase in the levels of poverty and a deterioration of the distribution of income, thus reassuring progress in detriment of equality.

The following section investigates, at an empirical level, the implicit *trade-offs* occurring in the "race between technology and education" on the one hand, and "the endless dance of progress and inequality" on the other. It can be seen that the absence of any of the components of the sequence in the entire chain can compromise the fragile process of current development. Likewise, it is clearly seen the profound damage the drop of the international price of oil has caused in both the educational resources and in the set of skilled labor force as well and, finally, in the aggregated demand in the region.

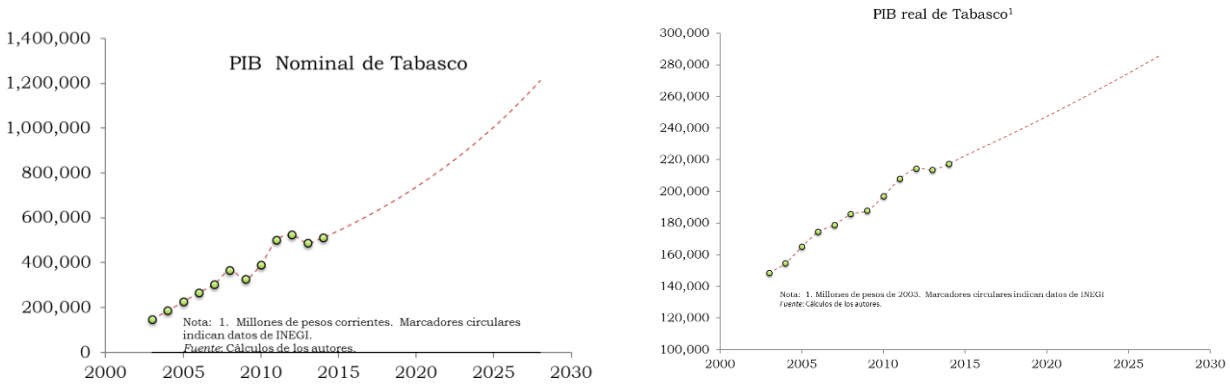
5. The base run

The model is now ready for a base run, where the input is data published by INEGI on Tabasco. In order to ensure the model calibrates the INEGI data for the years 2003-2014, the net exports in equation 6 were adjusted. Figure 1 shows an exact correspondence between the base run and the data published by INEGI.

The implicit deflators published by INEGI in the period 2003 were used. In equation 8, the *mark-ups*, τ_j, were used as adjustment variables, which implies these are not constants. In each sector it is estimated an exponential function for the projections of the years 2015 to 2018 of sectors: agriculture, manufacturing and services[16]. As it can be seen in figure 2, the patterns of the *mark-ups* are not linear; further, the price of the agricultural sector tends to increase in the calibration, whereas the *mark-ups* of manufacturing and services decrease over time. Table 4 shows the calibration of the three sectors and it can be seen that in the manufacturing and services sectors it is just perfect, while the agriculture sector had some issues due to a deep decrease in the level of actual production, as it can be seen in figure 3; therefore, the prices in the sector increased dramatically.

[16] The price of oil is an exogenous variable; therefore, the mark-up has to be estimated.

Figure 1. State Gross Domestic Product in the base run.



(1) Nominal Product and price (b) Actual product

Figure 2: The mark-ups of agriculture, manufacturing and services prices in the base run.

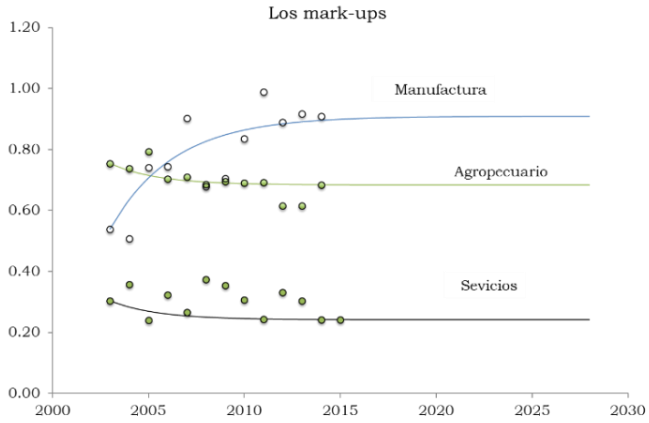
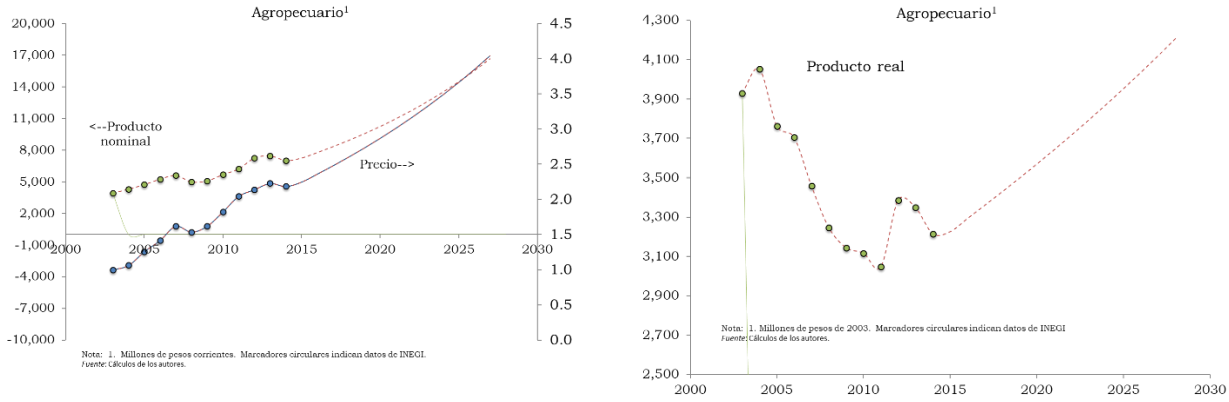


Table 4. Calibration of prices.

	Calibration of SAM base	Average Price 2003-2014	Standard deviation
Agricultural	0.54	0.78	0.15
Manufacturing	0.30	0.30	0.50
Services	0.75	0.70	0.50

Source: Calculation by the authors

Figure 3. Agricultural sector in the base run



(a) Nominal product and prices (b) Actual Product

The production and the price of oil are key exogenous variables in the model. In order to calibrate with the INEGI data, it was necessary to adjust the oil exports. As it has been mentioned, the price of oil is an administrative price, it is not the result of *multiplying the international price times the exchange rate.* In table 5 it can be seen that INEGI systematically underestimates the said prices. Their use as "transfer prices", as they are known, can be justified to transfer the income of the state of Tabasco to the federal government.

The results of the sector's calibration are shown in figure 4, in panel (a), in this scheme, it is assumed an annual growth rate of 3% for the future price of oil, which is very difficult to forecast. Hence, we see there is a perfect match between the price and the INEGI data up to year 2014, with exponential estimations as from 2015. The difference in the behavior of nominal data and the INEGI actual data is due to the dependence of prices on variable *mark ups.* The base run simulation is pessimistic regarding the level of production, i.e., even though exports are growing, the sector's income stagnates due to the increase of the costs of labor force and of intermediate supplies. In figure

4, panel (b), it can be seen that the behavior of the actual aggregated value in the oil sector reflects the negative effect of the increase in the costs.

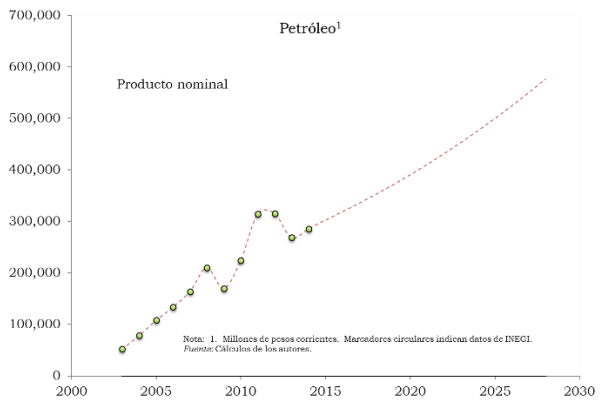
Table 5. Prices of oil

	1 Nominal Exchange rate	2 Index Exchange rate	3 International price Dlls	4 International price MXN	5 Index Local Price	6 Implicit deflator INEGI
2003	10.79	1.00	31.1	31.1	1.00	1.00
2004	11.29	1.05	41.5	43.4	1.40	1.41
2005	10.89	1.01	56.6	57.2	1.84	1.76
2006	10.91	1.01	66.1	66.7	2.15	2.01
2007	10.93	1.01	72.3	73.2	2.36	2.32
2008	11.14	1.03	99.7	102.9	3.31	2.88
2009	13.50	1.25	62.0	77.5	2.49	2.12
2010	12.62	1.17	79.5	93.0	2.99	2.58
2011	12.43	1.15	94.9	109.2	3.51	3.52
2012	13.15	1.22	94.1	114.6	3.69	3.49
2013	12.76	1.18	98.0	115.8	3.73	3.13
2014	13.30	1.23	93.2	114.8	3.69	3.22

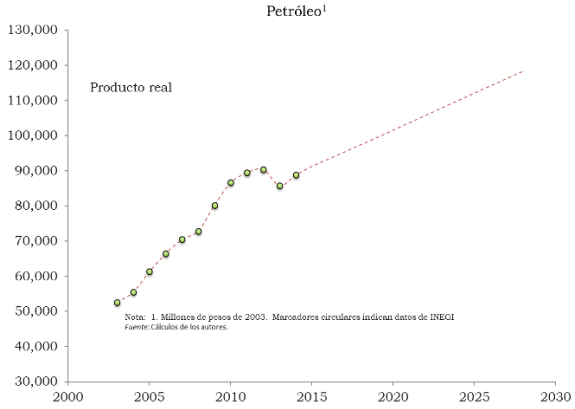
Source: Calculation by the authors based on data from INEGI, Petróleos Mexicanos, and the "*Federal Reserve Bank of St. Louis* (*FRED*)".

The manufacturing sector comprises the aggregation of sectors 31-33 of INEGI, as well as three more sector per utility: metallic and non-metallic mining (212); generation, transmission and distribution of electric power and water supply (22); and construction (33). Figure 5 shows a recession in the years 2008-2009, a time particularly difficult for the sector provided its *mark ups* were dropping, whereas its competitiveness level was growing.

Figure 4. Oil sector in the base run



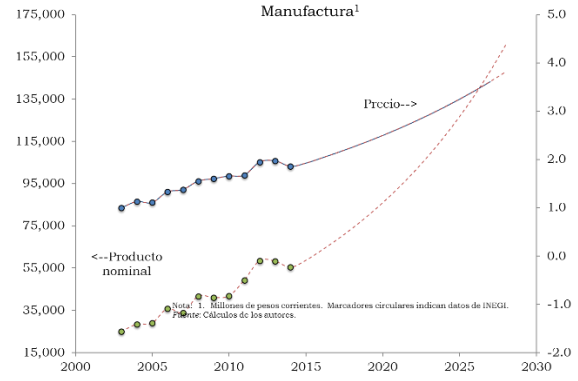
(a) Nominal product and price



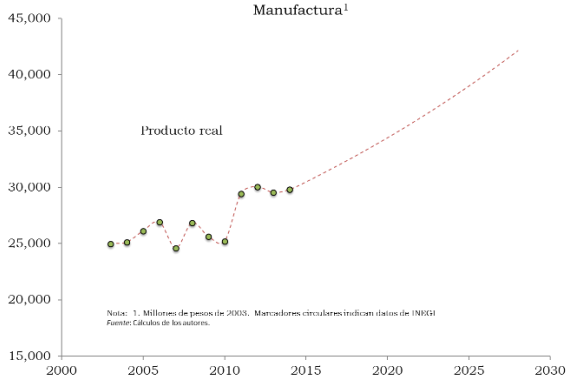
(b) Actual product

(c)

Figure 5. Manufacturing sector in the base run



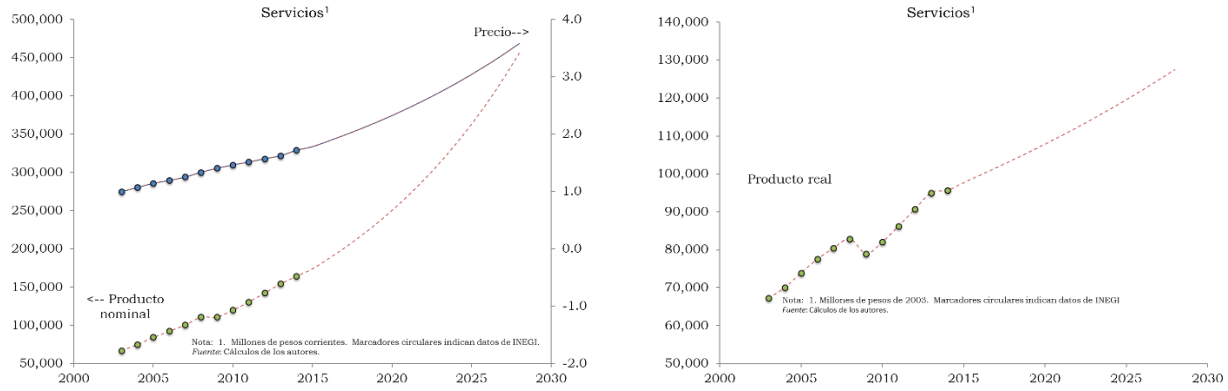
(a) Nominal product and price



(b) Actual product

The services sector has a key importance for the analysis in this paper because it includes the education sector, figure 6 shows a sector which is clearly more stable than the others. Even though the actual sector of services was affected adversely by the recession in 2008-2009, it recovered more quickly than the manufacturing sector.

Figure 6. The services sector in the base run



(a) Nominal product and price (b) Actual product

5.1. Oil, an enclave sector?

In order to understand the role of oil in the economy of the state of Tabasco, it would be appropriate to increase the rate of growth of exports and see its effect on the main macroeconomic indicators. If the said effect is a large one, it can be concluded that oil is an enclave sector. Table 6 presents the results of the simulations: the first line shows the rates of growth of exports for the period 2015-2028; the second line shows the changes expected in the price of oil. The first simulation is the base run with a growth rate of 3% and an increase in the price of oil of 3% as well. The second simulation, termed *"la reforma"* is considered to be successful because production increases to 4%, while the growth of price is kept in a 3%. In the third simulation, termed *"aguas profundas"*, it is discussed, precisely, that exploitation of deep waters requires a more advanced level of technology, which supposes a bigger expenditure and implies a higher price of oil. The increase of production is kept in a 4%, while the price of oil increases to 5%.

Table 6 shows the resulting growth rates in the macroeconomic indicators in the same time period. It can be seen that, compared to the base run, the results of the *"aguas profundas"* simulation are more expansionist than those in *"la reforma"* simulation, since in the third line of the results of the simulation in the rate of growth of actual GDP of "*aguas profundas*" is higher than 1%, with respect to the base run. However, it should be noted the similarity in almost all the indicators as this illustrates a key point in the exercise: the increase of oil exports which occurs is the same for both *"la reforma"* and *"aguas profundas"* cases; however, the increase in the price is higher.

Table 6. Change in the macro-economic indicators resulting from the simulation.

	Base	Energy Reform	Deep waters
Parameter changed			
Oil Exports	0.03	0.04	0.04
Oil price	0.03	0.03	0.05
Results from the simulation			
Nominal oil income	0.0514	0.0616	0.0911
Nominal GDP	0.0633	0.0711	0.0870
Actual GDP	0.0213	0.0285	0.0321
Skilled jobs	0.0176	0.0238	0.0238
Unskilled jobs	0.0170	0.0228	0.0228
Actual consumption	0.0229	0.0276	0.0277
Actual investment	0.0041	0.0057	0.0057
Inflation	0.0411	0.0415	0.0532
Income of local government	0.0021	0.0021	0.0021
Income of federal government	0.0482	0.0583	0.0904
Agricultural Imports	0.0210	0.0266	0.0266
Gini Coefficient	0.0053	0.0060	0.0060

[1] Annual average growth rates: 2015-2028.
Source: Calculation by the authors.

The results of the simulation show that nominal oil income flow directly to the federal government, without having a direct impact in Tabasco's economy, unless the federal government returns resources through any mechanism for the transfer of funds, as defined by the SNCF, that is, all the effect of an increase in the price of oil is over the price system, and not over the quantities.

A generalized idea is that a high price of oil implies bigger employment and a decrease of poverty, but empirical reality indicates that is not so true, and this is clearly reflected in the model. If we analyze that the *backwards linkages* of an increase in the price of oil cause a positive effect on all the other economic aggregates, we forget the fact that it is not the *value* of oil what determines intermediate purchases, but the exogenous injection of investment to increase the level of quantities produced. That is, the price of oil could duplicate and, however, intermediate purchases could remain totally fixed.

There is evidence that in Tabasco's economy the oil sector is, to a large extent, an enclave sector, because there are no important *spillovers*[17] from the production of oil, an issue which can be seen in the last two columns of table 6. The linkages are established by the of input-output coefficients of the labor force contracted by this sector. Even though there is an integration of Tabasco with the rest of the country due to agricultural exports and to a little stimulation to the income of local government, it remains being an enclave sector. This fact can be explained in that the profit from the oil sector go to the federal government in the form of taxes which may exceed the 100%. In order to have a more expansive effect over Tabasco's economy, it would be necessary to increase the expenditure of both local and federal government; even though the expenditure of the federal government would be higher, the expenditure of the local government would take place through the profits withhold from the oil sector, this can be seen in the effects of price and the quantity of production. If we consider the sector to be just like any other sector, an increase in the price would offer higher profits, higher employment and other adjustments in the macroeconomic variables. However, due to the government's intervention through the administrative price, it is not possible to

[17] *Spillover* is an English term which meaning can be taken as flooding or enlargement of the wealth a sector generates over the local economy.

see growth in the quantities bringing positive effects on the local economy, as it happens with other sectors which are truly local. This makes questions arise: who owns the resource? the local government or the central government? However, the purpose of this paper is not to raise such a debate since it is not possible to identify who the potential losers at the national level would be in case Tabasco established proprietary rights on the oil resources in order to have more benefits from production. Even though *"la reforma"* poses more benefits, as long as the state cannot consider the collection of taxes to the federal government, or to the multi-national companies of the sector, it cannot be able to benefit from the tax flows which trigger the process of change in prices and quantities which minimize the impact of an enclave sector, as it is now.

6. Results from the simulations

The energy reform offers two new ways for the state of Tabasco, with an emphasis on the education sector. The differences between the simulations "*la reforma*" and "*aguas profundas*" introduced in the discussion about the oil sector as an enclave, are subtle and require a detailed analysis of the simulations presented in this section.

6.1. Simulation 1: la reforma

In the analysis of section 5, consideration was given to the international price of oil, the administrative price of oil and to the investment of the federal government, through Petróleos Mexicanos, as factors exogenous to the policy of the state of Tabasco. This section of this document indicates some local policies which could potentially enlarge the benefits of the "natural resource, particularly a policy of investment in the education sector which is classified in the services sector[18].

[18] The average of participation of the services sector during the calibration period (2003-2014) is 8.6%, with a standard deviation of 0.22, a stable relation and any stimulation to this sector will be, at the same time, a stimulation to the educational sector.

The assumptions for this simulation are that the investment is dependent on the level of capital, its use and the profit from the productive process. The investment is *per destination* in that growth in the sector's capacity depends on the expectations of the benefits. This investment is different to that which is part of equation 6 of aggregated demand, termed investment *per origin*, which corresponds to the sum of investments per destination of its sectors. It should be noted that the investment pattern will not behave in the same way in the two policy alternatives, "*la reforma*" and "*aguas profundas*". In the second one, consideration is given to the involvement of the federal government, in coordination with the multi-national oil companies, to invest in advanced technology for the production of hydrocarbon resources in the Caribbean Sea. In the first simulation, "*la reforma*", there is no need to invest in petroleum technology, but to take advantage of the opportunity to develop human capital as a form of investment in the education sector. In order to understand the effects in the model it is assumed the total investment per destination has two components: investment by the local government, I_g, and investment by the federal government, I_f. To implement this concept in the model, it is written:

$$I_3 = \left(I_f / I_g\right)^{\eta} I_4 \qquad (19)$$

where I_3 is the investment *per destination* of the manufacturing sector; I_4 is the investment *per destination* of the services sector. The parameter, η, where $1 > \eta > 0$ is the elasticity of the proportion of investment which comes from the manufacturing sector in relation to the services sector.[19] In equation 19, a higher level of investment by the federal government results in an increase in the investment by the manufacturing sector I_3. While a decrease in the federal investment implies an increase in the services sector I_4, the relevant difference is that the investment for the production of

[19] See appendix for the value.

hydrocarbons in the Caribbean Sea is more intensive in production in the manufacturing sector; whereas a policy of investment in education is more intensive in the production of the services sector[20].

Figure 7. Simulation 1: "*la reforma*"

Simulation 1: La reforma

Parameters changed	*Reference equations*
$\hat{I}_g = 0.05 \times \tau_2 C_2 D_2 / p_4$	2 y 13
$\hat{I}_f = 0$	
$\hat{l}_c = 0.01$ manufacturing and services	7
$\hat{l}_n = -0.01$ manufacturing & services	7
$\hat{w}_c = 0.06$	7

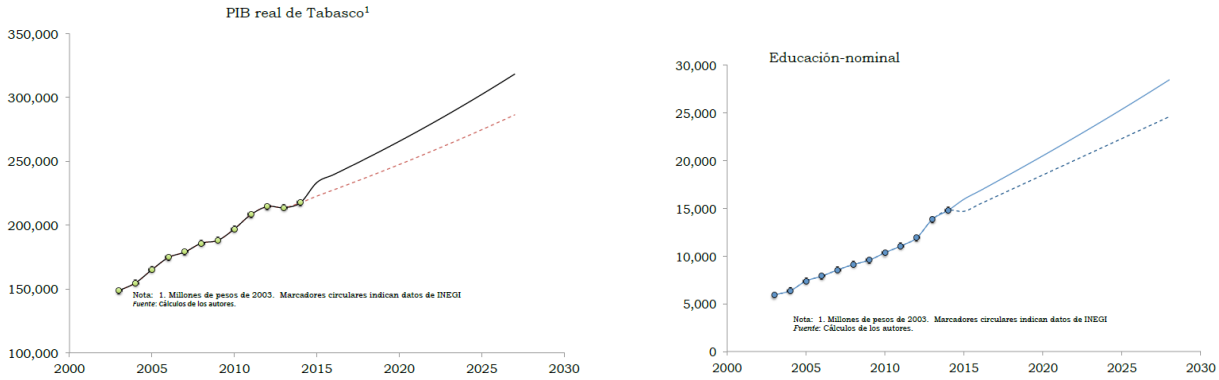
The federal government returns 5% of the profit obtained by the oil sector, in the form of federal investment. The coefficients of skilled labor force increase while those of the unskilled decrease. The investment pattern is constant and the wages of the skilled labor force increase by 1% with respect to the base run. There are no other changes which are different from the assumptions of *la reforma*, $\hat{E}_2 = 0.04$ *and* $\hat{P}_2 = 0.03$

[20] Increasing the educational capacity requires an accumulation of physical capital in facilities, equipment and land, which belong to sector 3, but the production is lower than what is required in a highly capital-intensive sector such as the oil sector; in this regard, the impact is a small one and it does not play a significant role in the simulation, and this is why it is not taken into account.

The idea behind the simulation is that 5% of oil profits of the federal government be allocated as transfers of capital to the local government, in nominal terms[21], to be invested in the education sector, as shown in figure 7, which represents the pseudo-code for the simulation of "*la reforma*". Since it is a transfer of investment to the education sector, there are neither changes in income nor any change in the current expenditure of the local government.

If the oil profits which are left in the state of Tabasco increase by 5%, the actual GDP increases as well. This effect can be seen in panel (a) of figure 8 where the dotted line indicates the base run. The impact on the education sector is presented in panel (b). The simulation displays positive effects in the aggregated demand and also in the skilled and unskilled labor force.

Figure 8. Transfer of resources from oil to education in "*la reforma*"



(a) Tabasco's actual GDP (b) Added value in education

Table 7 shows in a detailed manner the macro-economic results of the simulation such that it can be seen that, while oil income grows 0.88 per cent with respect to the base run, the actual GDP raises to 0.81%. The investment increases due to the effect of the increase of the use of capital

[21] In order to express the profit from oil in real terms, it is necessary to divide by the price of services, p4.

according to equation 14; therefore, the sum of savings of the various sources increases as well, as shown in figure 9, panel (a), where the savings of households are relatively higher than those of the base run. In the same figure, savings of the federal government increase higher than those corresponding to the local government. Since exports get increased by one percent in relation to the base run, foreign savings drop despite the expansionist effects of "*la reforma*"[22].

Table 7. Macro-economic indicators with simulation of local policies 2015-2028[1]

	Base	*The reform*	[	*Deep waters*	]
Parameter changed					
Oil Exports	0.03	**0.04**	0.04	0.04	0.04
Oil price	0.03	0.03	0.04	0.05	0.06
Results from the simulation					
Nominal oil income	0.0514	0.0602	0.0665	0.0825	0.0976
Nominal GDP	0.0633	0.0735	0.0862	0.0941	0.1023
Actual GDP	0.0213	0.0294	0.0278	0.0306	0.0330
Skilled jobs	0.0176	0.0380	0.0402	0.0408	0.0416
Unskilled jobs	0.0170	0.0206	0.0191	0.0198	0.0206
Actual consumption	0.0229	0.0285	0.0276	0.0283	0.0290
Actual investment	0.0041	0.0193	0.0165	0.0195	0.0229
Inflation	0.0411	0.0428	0.0568	0.0617	0.0671
Income of local government	0.0021	0.0021	0.0021	0.0021	0.0021
Income of federal government	0.0482	0.0579	0.0594	0.0780	0.0950
Agricultural Imports	0.0210	0.0280	0.0271	0.0276	0.0282
Gini Coefficient	0.0053	0.0069	0.0093	0.0094	0.0095

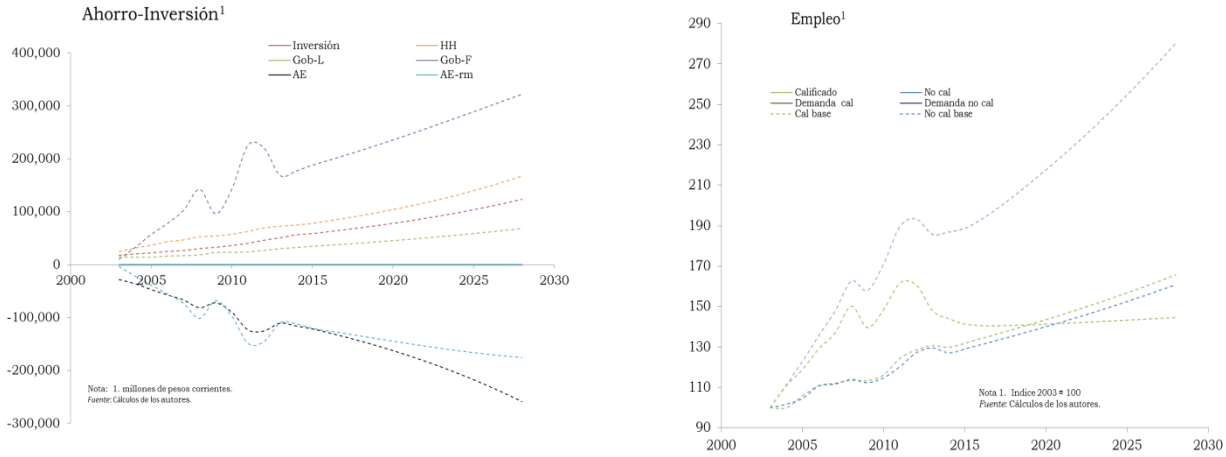
[1] Annual average growth rates: 2015-2028
Source: Calculation by the authors.

Table 7 shows the prominent increase of the employment of skilled labor force (from 1.76% to 3.8%), and a more moderate increase of the unskilled labor force (from 1.7% to 3.8%). This increase can also be seen in figure 9, panel (b). Given the bias towards the employment of skilled labor force which is present in the simulation, it is no surprise that the distribution of income deteriorates. This is

[22] In fact, there is an increase in agricultural exports of 0.7%

also seen in table 6, In the last line, which indicates a positive change with the Gini coefficient of 0.69.

Figure 9. Macro-economic indicators in "*la reforma*".



(a) Savings and investment

(b) Employment of labor force: skilled and unskilled

6.2. Simulation 2: Aguas profundas

"*Aguas profundas*" is the name given to the simulation of a set of changes in the parameters which are shown in figure 10. The analysis of policies under this approach is much more speculative, since these depend on the trajectory of the international price of oil, as well as on the reaction of two actors on the stage: the federal government and multi-national oil companies. There is a strong component of uncertainty in the simulations being presented, which requires a more detailed analysis by considering the sensitivity of the future price of oil. Three variants are presented for each result given the likelihood of an array of growth rates of oil prices of 4, 5 and 6 per cent annually with respect to the base run.

The key assumption is that the federal government will carry out an investment of 5% of profit from the oil sector in order to favor the manufacturing sector with a larger weight, since it is a source of intermediate supplies, it will be in a proportion higher than that of the local government. Furthermore, there will be no increase in the transfers of investment to the local government for the handling of its policies. According to equation 19, the investment per destination in manufacturing will be higher than that of the services sector. Even though the effect is not that large, its implications are quite important.

Figure 10. Simulation 2: "*Aguas profundas*".

Simulation 2: Aguas profundas

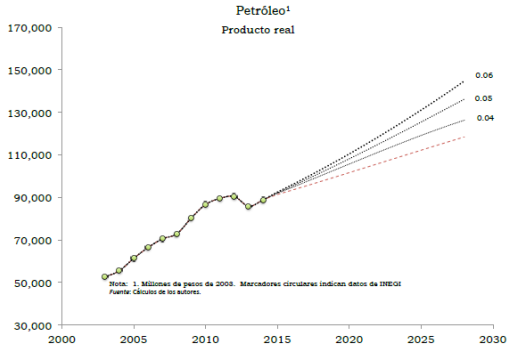
Parameters changed	*Reference equations*
$\hat{\hat{I}}_{gf} = 0.05 \times \tau_2 C_2 D_2 / p_4$	2 y 14
$\hat{\hat{I}}_g = 0$	
$\hat{I}_c = 0.01$ oil, industry and services	7
$\hat{I}_n = -0.01$ oil, industry and services	7
$p_2 = 0.04, 0.05 \ and \ 0.06$	7
$\eta = 0.1$	
$\widehat{w}_c = 0.06$	7

The federal government returns 5% of the profit obtained by the oil sector, in the form of federal investment. The coefficients of skilled labor force increase while those of the unskilled decrease. The investment pattern is constant and the wages of the skilled labor force increase by 1% in the base run. There are no other changes which are different from the assumptions of "*aguas profundas"*, $\hat{E}_2 = 0.04$

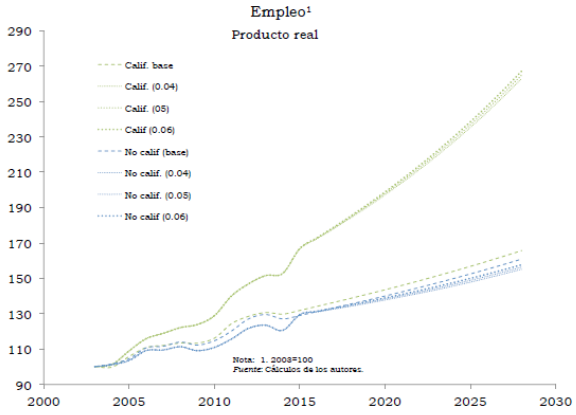
The trajectory followed by this simulation given the 5% increase of investment impacts the actual GDP considerably, as it can be seen in figure 11, panel (a) for each level of projection of prices, 4, 5 and 6 per cent, the added value increases to the extent the investment grows over the dotted line,

which represents the base run. In the third line of results of the simulations of table 7 are shown the values of the actual GDP for "*la reforma*" and "*aguas profundas*", there, it can be seen that in the two cases there is an increase in the actual GDP, but the impact in *"aguas profundas"* is higher only to the extent the price of oil increases. This occurs because oil uses intermediate supplies of the manufacturing and services sectors, and labor force as well, although there is a clear bias over skilled labor force to the detriment of unskilled labor force, with a much higher impact in the simulation of "*aguas profundas*" as shown in figure 11, panel (b). Also, it can be seen that the price of oil has an indirect impact on the economy only through the 5% of oil income.

Figure 11. Oil income and employment in "*aguas profundas*".



(a) Actual GDP of oil



(b) Employment of labor force: skilled and unskilled

In panel (b) of figure 12 it is presented a joint comparison of the policies related to the actual expenditure on education in *"la reformas"* and *"aguas profundas"*, and in the results of the employment of unskilled labor force, and it can be seen that "*la reforma*" dominates "*aguas*

profundas", in all the price levels, though, in general terms, it is much lower than the employment of skilled labor force. According to the above argument, the price of oil has an indirect impact in the local economy only through the recycling of the *petropesos*. The rate of growth of the actual expenditure in education is 3.59% in "*la reforma*"; whereas, in the *"aguas profundas"* simulation, it reaches an expenditure of 3.49%, with the most optimistic increase of price of 6% [23].

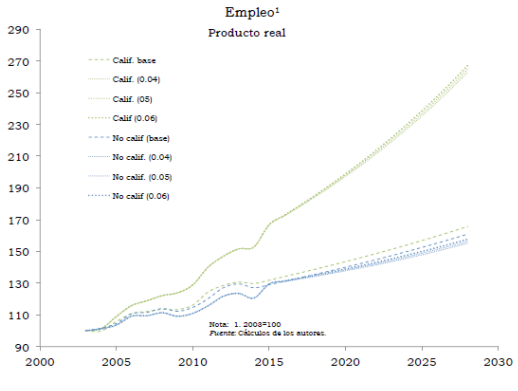
The decision can be a risky or moderate one, depending on the planning for the region. If the uncertainty over the price of oil is high, the best alternative will be "*la reforma*". Table 7 indicates the level of risk inherent in the *"aguas profundas"* strategy. If the price of oil is kept in a rate of growth of 4%, the best option would be "*la reforma*" with a rate of growth of actual GDP of 2.94 instead of 2.78, corresponding to *"aguas profundas*". Even further, the level of inequality is lower in "*la reforma*", since in this simulation the employment of labor force is not kept higher until the price of oil reaches 6%, where it matches *"la reforma".* Therefore, it is possible to consider that the employment of skilled labor force is necessary for a future driven by science and technology, in addition to the fact that investing a large amount of resources only as a function of the price can be considered very risky. The diversification of resources has revealed itself in this work as a solid strategy with many benefits.

More research can be made with other scenarios as the model allows them. In this work, the treatment was the application of a constant level of income to the education sector, given its participation during the period 2003-2014. It is possible to enlarge the scope of the work with more progressive policies which show the benefits of the model. The mechanism is a clear one, attaining a

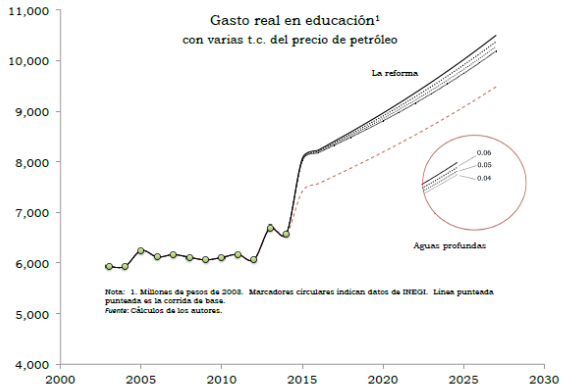
[23] The simulation is complex and includes an assumption that has not been mentioned so far: the percentage of the services sector which is addressed to education in the calibration period 2003-2014, varies between 8.8 and 6.9, with a negative slope and standard deviation of 0.007. In the simulation for figure 12, it is supposed the average of the calibration period is applied to the forecast period.

larger number of graduates leaving college upon examination increases the total supply of skilled labor force in the labor market. Under the competitive conditions of the international market, this result offers a more competitive position for Mexican exports.

Figure 12. Comparison of the simulations *"la reforma"* vs *"aguas profundas"* in unskilled labor force.



(a) Actual GDP



(b) Employment of unskilled labor force: "*la reforma"* vs "*aguas profundas"*

7. Conclusions

The purpose of this work is to discuss two economic policies. In the first one, consideration is given to leave a small portion of the mineral wealth which is generated in the state of Tabasco through the simulation of an increase in the federal government's investment in the education sector, in order to see with clarity the advantages and disadvantages of the policy chosen. In the second one, consideration is given to the exploitation of hydrocarbons in *"aguas profundas"*, which requires some investment in cutting-edge technologies and investment in new human capital who will participate in this phase to produce the resources, which is considered as a more profitable and productive alternative which leads to expansion.

The drop in the price of oil has had very negative effects on the southeastern part of Mexico, not only in terms of income and production, but also in future plans, as a consequence of the so called "the curse of natural resource". The constitutional reform provides a scheme to improve and enlarge the advantages of hydrocarbon reservoirs and so prevent the "the curse of resource" which is visible in a productive structure which is not so diversified and is anchored in the natural resource; hence, encouraging the abandonment of land and agriculture.

The simulations show that the state is involved in the quantity and price of oil and this is not solved by a market equilibrium. By assuming that the local economy accepts the administrative price and the amount of investment chosen by the governmental political structure, it could choose a counterpart policy only if the flows of resources returned.

Likewise, the results of the two simulations show that *"la reforma"* results in higher equality, less poverty and less bias in the skilled labor force; whereas the *"aguas profundas"* simulation is a more profitable and productive alternative which promotes expansion. There is not a clearly winning party since the results yield different benefits, but these are not comparable. As a redistribution policy, it is clear *"la reforma"* is more profitable. As an expansion policy oriented to long-term goals, the *"aguas profundas'"* is the one. However, the latter maintains the risk relative to the future price of oil.

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Appendix

Name[1]	Value: 2003-14	2014-28
Wage of skilled labor force	7	7
Wage of unskilled labor force	4	4
Actual investment of local government	0	†[2]
Actual investment of federal government	15	0
Constant (I_{d0}) in the investment equation	0	0
Elasticity (β_c y β_n) in the production function	†[2]	
Technological change in the production function (t_{ci})	-1	-1
Agricultural	-1	-1
Oil	-1	-1
Manufacture	1	1
Services	1	1
Exports of agricultural goods (E_1, E_{m1})	†[3]	†[4]
Oil exports (E_2,E_{m2})	†[3]	1
Exports of manufactured goods (E_3, E_{m3})	†[3]	†[5]
Exports of services (E_4, E_{m4})	†[3]	†[6]
Nominal transfers from		
Local government to households (t_{rl})	5	5
Federal government to households (t_{rf})	5	5
Rest of Mexico to households[7] (t_{rh})	5	5
Production coefficient (b_{ii})		
Agricultural (b_{11})	-5	0
Oil (b_{22})	0	0
Manufacture (b_{33})	-1	0
Services (b_{44})	-1	0.3
Personal savings rate (s_h)		
Poorer (h_1)	1.5	-1.5
Less poor (h_2)	1.5	-1.5
Middle (h_3)	1.5	-1.5
Rich (h_4)	-1	0
Richer (h_5)	-1	0.03
Labor force coefficients[2]		
Agricultural (l_1)	-0.5	-0.5
Oil (l_2)	0.5	-0.5
Industry (l_3)	0.5	-0.5
Services (l_4)	0.5	-0.5
Elasticity (η) of investment per origin of the manufacturing sector with respect to the services sector (I_3/I_4)	0	0.1

[1] Annual growth rates. [2] According to simulation.

[3] Used to calibrate the sector's actual product.

[4] Regression: 1580.1 + 70.1*t.*

[5] Regression: 997.97 - 292.7 *t.*

[6] Regression: 2661.7 - 2245.97*t*.

The fifth quintile has a level of transfers from the rest of Mexico different with respect to the others, in the SAM such that it shows more realistic saving rates (Gibson & Flaherty, 2014), in which case a growth rate of -25% is assigned. This offers a more reasonable pattern of total transfers; that is, the model actually captures the idea that in the years of the oil boom the population of Tabasco subsidizes the rest of Mexico.

Source: Calculations by the authors.