Preliminary

Social Security Contributions as Consumption Taxes: The case of Mexico

By

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There is an old and popular adage that characterizes Mexico as a "two-country" country: one rich, modern and prosperous, and another poor, anachronistic and informal. Today the first generates about 25 per cent of the –formal- employment and 40 percent of GDP, while the second generates more than 40 percent of - mostly informal- employment and contribute with less than 25 per cent to GDP[2]. What is more, the second one is growing relative to the first, a fact that has deterred the rise of productivity over time (Levy, 2008).

Thus understanding why the second one is growing is vital to understand why Mexico –or other LA countries- presents a persistent low average rate of economic growth over the last thirty years. This paper argues that one key element to explain this phenomenon is the distortion that fiscal and social policies have introduced on labor and good and service markets. Furthermore, we argue that, under the current framework, the high rates on social security contributions (SSCs) that must be paid -the price of remaining formal- has large negative effects on wages in the formal sector. Such distortion in turn has an effect on worker's income qualitatively similar to the standard effect of a consumption tax. Hence removing SSC would increase disposable income while promoting formality.

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[2] The rest is generated by small and medium firms.

On the one hand, social expenditures in the form of social protection policy have increased as informality is growing in Mexico over time, generating a vicious circle.[3] On the other hand, this has put pressure on tax policy and on SSCs as the first fosters evasion and the latter lowers personal income and thus purchasing power. Hence, our approach is to show that should social protection policy be universalized removing SSCs and financed by general consumption taxes (henceforth, the *social security reform*), formal wages would increase as firms and workers behavior would change dramatically. In turn this would promote formality.

For this we construct a static, general equilibrium model to have an understanding of how firms may change their behavior in a tax evasion framework. The model has three sectors: an intermediate, a final, and a self-employed sector. Intermediate goods are produced with labor and a fixed factor whereas the self-employed sector only requires labor to produce goods. The final good sector simply aggregates the intermediate goods, so labor is not required in such sector. The fiscal authority may impose three different taxes on firms: social security contributions (labor taxes), value-added, and income taxes. Firms in the intermediate sector may face different value-added tax rates. The motivation for this assumption is that special tax treatments under the current Mexican law cause that a large fraction of goods do not pay value-added taxes in practice.

Firms are price takers and maximize profits in the usual fashion. However, firms have an incentive to evade all taxes in general. If firms evade any of these taxes, they face an endogenous probability of being detected by the authority. Such probability depends positively on firm's size. As a result, firms in the intermediate sector must choose whether to pay labor taxes. In this paper, labor is labeled as informal if the firm

[3] Mexico is unique in the sense that it has been introducing social programs for the informal workers aimed to emulate fringe benefits from the formal sector.

decides not to cover social security contributions, and formal otherwise. Thus such firms end up hiring a mix of formal and informal workers in general. In contrast, the probability of detection in the self-employed sector is small in practice, given its small size to conduct business. Thus this sector does not pay any of the three taxes by assumption.

The intermediate-final good structure in the model gives place to a transmission mechanism of tax evasion between sectors, as in de Paula and Scheinkman (2010). In particular, the value-added tax is collected by the credit method. In such scheme, the tax rate is applied to each sale, but firms may claim a credit to the fiscal authority for the amount of taxes paid in the previous stages of production. Since tax credits cannot be generated from informal suppliers and tax payments from formal suppliers cannot be used by informal buyers, there is an incentive for informal firms to conduct business with other informal firms. This scheme thus predicts that tax evasion of a firm in the final good sector is correlated to the tax evasion of firms from which it buys intermediate goods.[4]

The endogenous probability of detection allows the rates of compliance (i.e., the inverse of tax evasion) for each tax and firm to be endogenous. In the model, a change in any of these taxes not only directly affects its own rate of compliance by each firm but also indirectly affects the rate of compliance for other taxes. For the case of VAT, the credit method framework also allows to translate the change in rates of compliance from intermediate to final good firms. Given such correlation, the social security reform here proposed has a significant effect on tax compliance by firms in the model as a result of eliminating distortions in both labor and goods markets. Thus the reform raises government revenue in the model not only due to the elimination of special tax treatments and other distortions, but also as a result of an increase in tax compliance.

[4] de Paula and Sheinkman (2010) present empirical evidence supporting this idea.

In this document we report that, abstracting from changes in firm's behavior, data from national accounts indicates that the elimination of special tax treatments in the VAT structure would increase VAT revenue from its current level of 3.8 percent to 6.8 per cent of GDP. Once tax evasion behavior by firms is taken into account, the model finds that a fiscal reform that simultaneously imposes a 15 percent tax on all goods and eliminates social security contributions (i.e., Levy's proposal) would increase the VAT revenue/GDP ratio to 6.61 percent. Taking into account the revenue from corporate income taxes and the lost revenue from social security contributions, the net effect of such proposal on total government revenue as a share of GDP would be around 1.5 percent; that is, this reform more than compensates the loss of total SSCs, and still removes labor market distortions. On the other hand, the effects of such fiscal reform on wages might be large. In particular, the model suggests that real wages would increase by 21 percent, mainly as a result of the large increase in labor demand due to the elimination of social security contributions.

There is a growing strand of the literature focusing on policies that hinge on firm's size that may result in resource misallocations (see, among others, Gollin, 2006; Restuccia and Rogerson, 2008; Guner et al., 2008; Hsieh and Klenow, 2009a, 2009b; and Leal, 2009). The class of resource misallocations studied here arises from differences in VAT rates between sectors and from tax evasion behavior by firms that end up in differentiated tax rates on labor. A paper related to this work is Fortin et al. (1997), where the effects of taxation in a general equilibrium model with wage controls and an informal sector are studied. Such framework assumes a one sector model so the transmission mechanism of tax evasion studied here is absent. However, the closest paper to ours is Leal (2009). The author presents a one sector, general equilibrium framework of occupational choice and capital accumulation with limited tax

enforcement. His model is calibrated to Mexico in order to study the effects of full enforcement in income taxes on output and labor productivity. In contrast to Leal (2009), here we are interested in alternative tax reform scenarios and their effects on government revenue and on formal sector wages to evaluate the social security reform mentioned earlier.

This paper is organized as follows. Section 2 presents a brief discussion on Mexican fiscal and social policies. Section 3 builds the GE model while its simulation is executed and discussed in section 4. Section 5 concludes.

2. A brief discussion on Mexican fiscal and social policies

A brief description of Mexican Fiscal Issues

The country of Mexico is a Federal Republic consisting of three levels of government: one central government; 32 local entities (which include 31 states and the federal district), and 2,477 municipalities. Like many countries, revenue collection is very centralized as most important taxes (corporate and income, value added, foreign trade and most excise taxes) are levied and collected by the federal government (approximately, 96% of total tax revenue). The structure, however, is highly complex as there are plenty special treatments in both consumption and corporate/personal income taxes.

In the case of corporate taxes, some sectors particularly agriculture, transportation, education, some financial activities and cultural services are taxed under different favorable schemes. With respect to VAT, which rate now is 16 per cent, there are as well some special treatments: food and medicines are zero-taxed while other services are tax-exempted (education, cultural activities, private medical expenses, some financial services, books and magazines). Furthermore, VAT rates at border zones are different (currently set at 11 per cent).

These features combined with a set of other factors, namely, the existence of high levels of informality, the ideal environment for tax evasion/avoidance (à la de Paula and Scheinkman, 2010); deficient rule of law (Laporta et al 1999 & WB doing business, 2010); low public expenditure quality (Scott, 2010, for social expenditure, WB-IPER, 2006, for public infrastructure); and inefficient tax collection authority in the presence of some corruption (see mandatory public evaluations at www.sat.gob.mx for different taxes) have induced high levels of tax evasion.

Since our intention is to show that SSCs may be seen analogously as a consumption tax in terms of its effects on disposable income, we concentrate on the VAT only. Antón and Hernández (2010) estimate that average VAT evasion for the period 2003-2008 is around 30 per cent of potential revenue.

In short, tax evasion may be related to a much broader set of circumstances. Here we concentrate on its relation to the informal sector and hence on SSCs.

Characterization of Social Policy

Social policy in Mexico is organized in a dual scheme (see Levy, 2008). On the one hand, there is a social security structure for the formal workers which include health, disability, work-risk and life insurances; day care for workers' children, retirement pensions (contributive system) and housing loans. To obtain these benefits, a SSC is paid while being and remaining in formality. This can also be seen as a tax on salaried labor which in turn reduces salaried employment.

On the other, social protection benefits are offered using public revenues to non-salaried (i.e., self-employed) and salaried informal workers in the form of social programs. These include health services provided by

Federal and State governments, subsidies for housing, day care, and pension provided by Oportunidades and State programs (DF, Edo Mex, Michoacán). These can all be seen as a subsidy to both non-salaried and informal workers.

This coexistence clearly incentives formal workers to become informal, thus lowering productivity and pressuring public finances. Levy (2008) has proposed a major change on the expenditure and revenue sides. In particular, he argues that social policy should dramatically be modified to be able to provide a universal health care system together with an unemployment insurance. At the same time, the proposal aims at eliminating social security contributions in order to eliminate distortions in the labor market and promote formality. This calls for an adequate financial source. In this work we estimate the potential government revenue collection to finance this proposal, taking into account general equilibrium effects in a context of coexistence of formality and informality. Here, the latter is defined in terms of tax evasion on social security contributions.

3. The model

The purpose of the model is to have an understanding of how firms may change their behavior should a social security reform be implemented in a tax evasion context. The model presented below is a three sector model: an intermediate, a final, and a self-employed sector. The final good is the numeraire. To simplify the analysis, all these goods are internationally traded and the economy is small in world markets. This implies that prices of goods are exogenously given.

Intermediate goods are produced with two inputs: labor and a fixed factor, which it may be interpreted as capital. The final good sector simply aggregates the intermediate goods according to a CES production function. Thus labor is not required to produce the final good. In contrast, the self-

employed sector uses labor as its only input. Labor endowment in the model is constant and equal to $\bar{L}$.

The government may impose three different taxes on firms: value added taxes (VAT), corporate taxes (CT), and social security contributions (SSC). In the model, firms have an incentive to evade taxes, and the probability of being detected in such practices by the authority is size-dependent. In particular, relatively large firms do not evade taxes as the probability of being detected is one. This captures the idea that it is easier for the authority to identify such firms. In contrast, the self-employed sector can evade all taxes since the size of such firms is relatively small.

For convenience, a firm is labeled as informal if it evades social security contributions. Similarly, a firm is labeled as illegal if it evades value added taxes, corporate taxes, or both. This implies that if SSCs are eliminated, all firms automatically become formal even though they may be classified as illegal if they still avoid VAT or corporate taxes.

3.1 The intermediate good sector

There are two types of intermediate goods M_z, indexed by $z = i, j$, and a large number of firms in each sector z that behave in a competitive fashion. Firms sell their good to the final good producer at the exogenous price p_z. Each good is produced by a Cobb-Douglas technology of the form

$$M_z = A_z L_z^{\alpha} K_z^{1-\alpha}, \tag{1}$$

where A_z, L_z and K_z denote the level of technology, labor and capital in sector z necessary to produce the intermediate good z, respectively. The parameter α satisfies $0 < \alpha < 1$. Physical capital K_z is a fixed factor, so that the representative firm makes positive profits in equilibrium.[5] Capital K_z is continuous and distributed exogenously among firms according to a

[5] Alternatively, K_z may be interpreted as entrepreneurship's ability as in Lucas (1978).

distribution function $F(K_z)$ with support $k_z = \left[\underline{K_z}, \overline{K_z}\right]$. The corresponding density is denoted by $f(K_z)$. Capital endowment in the economy is given by $\overline{K}$. Accordingly, the capital resource constraint may be written as

$$\overline{K} = \int_{\underline{K_i}}^{\overline{K_i}} K_i f(K_i) dK_i + \int_{\underline{K_j}}^{\overline{K_j}} K_j f\left(K_j\right) dK_j. \quad (2)$$

Labor in sector z is composed of both formal and informal labor, denoted respectively by $L_{f,z}$ and $L_{nf,z}$. Formal and informal labor are perfect substitutes. Thus total labor in intermediate sector z is just

$$L_z = L_{f,z} + L_{nf,z}.$$

There is perfect mobility of labor across sectors. This implies that wages in the formal sector must be the same in both sectors i and j. A similar assumption applies to wages in the informal sector.

From the employer's perspective, the difference between formal and informal labor is established in terms of contributions to social security programs. Let τ_n and w_f denote the SSC rate and the nominal wage (net of SSCs) per unit of labor in the formal sector, respectively. If government subsidizes a fraction η of total contributions, the unit cost of formal labor to the firm is just $w_f + (1-\eta)\tau_n w_f$. In contrast, informal labor does not face labor costs out of social security contributions by definition. In such a case, the cost per unit of labor is simply given by the wage rate w_{nf}, which denotes the nominal wage in the informal sector. Firms have an incentive to evade such taxes as SSCs constitute an important share of total wages in Mexico (Levy, 2008).

If a firm in sector z chooses to evade such contributions, there is an endogenous probability $\lambda_{ssc,z}\left(L_{nf,z}, K_z\right)$ for the firm being discovered by the authority (Levy, 2008). This probability is proportional to firm's size as measured by both the amount of informal labor employed and the firm's level of capital. For example, if the firm is relatively small (say, the amount of labor demanded to conduct business is relatively low), the probability

that such firm is discovered evading social security contributions is near zero. In contrast, if the size of the firm is such that it requires hiring too many workers, the firm will have an incentive to hire mostly formal workers as the probability of being discovered by the authority evading taxes is high.

Based on this idea, the probability of detection $\lambda_{ssc,z}(L_{nf,z}, K_z)$ is assumed increasing in both arguments with the additional property $\partial^2 \lambda_{ssc,z}(\cdot)/\partial L_{nf,z}^2 > 0$. This means that firms with a large demand for informal workers face a higher probability of detection, with such probability increasing at a higher rate. In general, a firm will demand both formal and informal workers. However, larger firms (i.e., firms with more capital endowment) will demand relatively more formal workers due to the higher probability of being detected by the authority.[6]

If a firm is caught by the authority evading social security contributions, it faces a penalty θ per unit of labor. Such penalty must be relatively high in order to dissuade firms from evading these contributions. According to the Mexican law, the penalty is greater than the amount of contributions not paid. In such a case, the penalty θ is given by $\sigma_{ssc}(1-\eta)\tau_n w_{nf}$, where $\sigma_{ssc} > 1$. Thus the average expected cost of hiring informal labor is given by $w_{nf} + \theta \lambda_{ssc,z}(L_{nf,z}, K_z)$.

In the model, workers can move freely between the informal and formal sectors. According to Levy (2008), such mobility suggests that workers are indifferent between the wages they can earn in either the formal or informal sector, once the valuation they give to either social security or social protection services is included. Let T_{nf} denote social protection expenditures per unit of informal labor financed by the government. Also, let $\{\beta_f, \beta_{nf}\}$ denote the (exogenous) parameters indicating

[6] The optimal mix of formal and informal workers is characterized below.

how workers valuate social security and social protection services, respectively, with $0 \leq \beta_f, \beta_{nf} \leq 1$.[7] Hence perfect labor mobility between the formal and informal sectors implies

$$(1 + \beta_f \tau_n) w_f = w_{nf} + \beta_{nf} T_{nf}. \quad (3)$$

Firms in the intermediate good sector z must also pay corporate income and value-added taxes. The corresponding tax rates are denoted respectively by $\tau_{vat,z}$ and τ_{ct}. This specification implies that firms in each sector face the same corporate income tax, but the value-added tax may be different in each sector. Similar to the case of social security contributions, firms have an incentive to evade income and value-added taxes. In particular, firms face an endogenous probability $\lambda(K_z)$ of being detected by the authority evading such taxes. To simplify, such probability is only a function of the physical capital level K_z of the firm.[8]

The probability of detection $\lambda(K_z)$ satisfies $\lambda_K(K_z) > 0$ and $\lambda_{KK}(K_z) \geq 0$, so that firms with a larger amount of capital face a higher and non-decreasing probability of being detected. A function satisfying such properties is given by $\lambda(K_z) = \hat{\lambda} K_z / \overline{K}_z$, where $\hat{\lambda} > 1$ is a shift parameter. This specification implies that relatively large firms (that is, firms with a capital size $K_z \geq \overline{K}_z / \hat{\lambda}$) face a probability of detection equal to one.

If a firm is detected evading such taxes, it does not only have to cover the amount of taxes evaded in full but also it faces a penalty proportional to such amount. Let σ_{vat} and σ_{ct} denote the penalty shares if a firm is detected evading VAT and corporate income taxes, respectively, where σ_{vat}, $\sigma_{ct} > 1$. Thus the expected VAT payment if a firm is caught by

[7] For example, full valuation of social protection services is represented by $\beta_{nf} = 1$, whereas null valuation of such services may be written as $\beta_{nf} = 0$.

[8] This assumption captures the idea that tax collections from social security contributions and value-added/income taxes are performed by different government agencies (as it is the case in Mexico). However, the fact that each probability of detection depends on the amount of capital allows for some correlation between them.

the authority is given by $\sigma_{vat}\tau_{vat,z}\lambda(K_z)VA(K_z)$, where $VA(K_z)$ denotes value added for a firm of capital size K_z. Similarly, the corresponding expected tax payment out of corporate taxes is just $\sigma_{ct}\tau_{ct}\lambda(K_z)\widehat{\Pi}(K_z)$, where $\widehat{\Pi}(K_z)$ is the gross profit for a firm of capital size K_z. For simplicity, along the paper it is assumed $\sigma_{vat} = \sigma_{ct} = \sigma$.

Once expected VAT and corporate tax payments are specified, the rate of compliance for a given firm with capital size K_z may be defined as the ratio of the amount of taxes effectively paid over the amount of taxes that must be paid by law. Let $\xi_{vat,z}(K_z)$ denote the VAT rate of compliance for a firm in the intermediate sector z, such that $0 < \xi_{vat,z}(K_z) \leq 1$. Accordingly, $\xi_{vat,z}(K_z)$ may be written as

$$\xi_{vat,z}(K_z) = \frac{\min\{\sigma\tau_{vat,z}\lambda(K_z)VA(K_z),\ \tau_{vat,z}VA(K_z)\}}{\tau_{vat,z}VA(K_z)}. \quad (4)$$

Similarly, the corporate tax rate of compliance for a firm with capital size K_z is defined as

$$\xi_{ct,z}(K_z) = \frac{\min\{\sigma\tau_{ct}\lambda(K_z)\widehat{\Pi}(K_z),\ \tau_{ct}\widehat{\Pi}(K_z)\}}{\tau_{ct}\widehat{\Pi}(K_z)}. \quad (5)$$

Under such specification, the tax rates *effectively paid* by a firm of size K_z in general may be denoted as $\tau_{vat,z}\xi_{vat,z}(K_z)$ and $\tau_{ct}\xi_{ct,z}(K_z)$. Notice that expressions (4) and (5) indicate that there must be a level of capital K_z^+ at which the rates of compliance are one, that is $\xi_{vat,z}(K_z^+) = \xi_{ct,z}(K_z^+) = 1$. Given the specification for $\lambda(K_z)$, such condition implies $K_z^+ = \frac{\overline{K}_z}{\sigma\widehat{\lambda}}$. For firms with a relatively large capital endowment ($K_z \geq K_z^+$), their rates of compliance are equal to one so their corresponding effective tax rates are just $\tau_{vat,z}$ and τ_{ct}. In such a case, these firms fully comply with VAT and income taxes even though they have incentive to evade their payment.

Given the rates of compliance for a particular firm with capital size K_z, a measure for the *aggregate* rate of compliance for each sector z

and tax can be constructed. Let $VA_{fc,z}(K_z)$ and $\widehat{\Pi}_{fc,z}(K_z)$ denote value added and gross profits for a full compliant firm in sector z, respectively. For the value added tax, the aggregate rate of compliance in sector z, $\hat{\xi}_{vat,z}$, may be defined as

$$\hat{\xi}_{vat,z} = \frac{\tau_{vat,z}\int_{\underline{K}_z}^{\bar{K}_z}\xi_{vat,z}(K_z)VA(K_z)f(K_z)dK_z}{\tau_{vat,z}\int_{\underline{K}_z}^{\bar{K}_z}VA_{fc,z}(K_z)f(K_z)dK_z},$$

whereas the aggregate rate of compliance for the corporate tax in sector z, $\hat{\xi}_{ct,z}$, is given by

$$\hat{\xi}_{ct,z} = \frac{\tau_{ct}\int_{\underline{K}_z}^{\bar{K}_z}\xi_{ct,z}(K_z)\widehat{\Pi}(K_z)f(K_z)dK_z}{\tau_{ct}\int_{\underline{K}_z}^{\bar{K}_z}\widehat{\Pi}_{fc,z}(K_z)f(K_z)dK_z}.$$

In both cases, the rates of compliance are estimated relative to potential revenue. Such revenue is defined as the revenue obtained should all firms fully comply with their tax obligations, regardless of size. This assumption explains the terms $VA_{fc,z}(K_z)$ and $\widehat{\Pi}_{fc,z}(K_z)$ in the denominator of each expression.

Finally, the problem of a representative firm in the intermediate good sector z for given capital K_z may be defined. In particular, each firm must choose the amount of formal and informal labor, $\{L_z, L_{nf,z}\}$, to maximize expected profits

$$\Pi_z^{int} = \left[1-\tau_{ct}\xi_{ct,z}(K_z)\right]\{\left[1-\tau_{vat}\xi_{vat,z}(K_z)\right]p_z A_z L_z^{\alpha}K_z^{1-\alpha} - [1+\ (1-\eta)\tau_n]w_f L_{f,z} - \left[w_{nf}+\theta\lambda_{ssc,z}\left(L_{nf,z},K_z\right)\right]L_{nf,z}\}, \quad (6)$$

subject to $L_z = L_{f,z} + L_{nf,z}$, given a set of prices $\{p_z, w_f, w_{nf}\}$ and taxes $\{\tau_n, \tau_{vat,z}, \tau_{ct}\}$.

3.2 The final good sector

The final good sector is composed of a large number of representative firms that behave in a competitive fashion. Since the economy is small in international markets, the price of the final good is taken as given in the model. Firms use the intermediate good M in combination with a fixed factor A_m to produce their goods. The production function is of the Cobb-Douglas type:

$$Y_m = \left[M\left(m_i, m_j\right)\right]^{\alpha_m} A_m^{1-\alpha_m}, \tag{7}$$

where $0 < \alpha_m < 1$. The function $M\left(m_i, m_j\right)$ is given by a composite of intermediate goods $\left\{m_i, m_j\right\}$ according to the following CES technology:

$$M\left(m_i, m_j\right) = \left[\gamma (m_i)^{\mu} + (1-\gamma)\left(m_j\right)^{\mu}\right]^{1/\mu}, \tag{8}$$

with restrictions $-\infty \leq \mu \leq 1$ and $0 \leq \gamma \leq 1$. The parameter γ represents the weight of intermediate good m_i in the production of M. The elasticity of substitution between intermediate goods m_i and m_j is given by $1/(\mu - 1)$.

Firms in the final good sector must pay corporate income and value-added taxes. Let $\tau_{vat,m}$ denote the VAT rate faced by firms in this sector. To simplify, such rate is assumed as a weighted average of the tax rates faced by intermediate good firms, such that $\tau_{vat,m} \equiv \gamma \tau_{vat,i} + (1-\gamma)\tau_{vat,j}$. On the other hand, the corporate tax rate is exactly the same as in the intermediate good sector.

Similar to firms in each sector z, final good firms also have an incentive to evade taxes. Define $\xi_{vat,m}$ and $\xi_{ct,m}$ as the rates of compliance for value-added and corporate income taxes in the final good sector, respectively. These rates are assumed to be a weighted average of their corresponding aggregate rates of compliance in the intermediate good sector. This implies $\xi_{vat,m} \equiv \gamma \hat{\xi}_{vat,i} + (1-\gamma)\hat{\xi}_{vat,j}$ and $\xi_{ct,m} \equiv \gamma \hat{\xi}_{ct,i} + (1-\gamma)\hat{\xi}_{ct,j}$. Such assumption captures the idea that tax evasion of a firm in the final good sector is related to the tax evasion behavior of firms from which

it buys intermediate goods, as in de Paula and Sheinkman (2010). Thus the model assumes a transmission channel of tax evasion, originated in the intermediate good sector and translated to the final good sector. In such context, the tax rates effectively paid by firms in the final sector may be defined as $\tau_{vat,m}\xi_{vat,m}$ and $\tau_{ct}\xi_{ct,m}$.

Value-added taxes in the model are collected by the credit method: the tax applies to each sale, and each firm in the final good sector is allowed to receive a credit for the amount of taxes paid in the previous stage of production. Hence if the cost of the intermediate good (before taxes) is $p_z m_z$, the firm in the final good sector receives a tax credit by the amount $\tau_{vat,z}\hat{\xi}_{vat,z}p_z m_z$. Thus tax evasion in the intermediate good sector z implies a trade-off for firms in the final good sector. On the one hand, a lower rate of compliance (i.e., higher evasion) in the intermediate good sector implies that taxes effectively paid by firms in the final good sector are lower. On the other hand, a lower rate of compliance in the intermediate good sector translates into a lower tax credit claim by final good firms. In the extreme case where tax evasion in the intermediate good sector is zero, the rate of compliance in the final good sector is one and such firms have the right to a full tax claim.

In such context, the problem of a representative firm in the final good sector is thus to choose the intermediate goods $\{m_i, m_j\}$ to maximize expected profits

$$\Pi^{fin} = \left(1-\tau_{ct}\xi_{ct,m}\right)\{\left(1-\tau_{vat,m}\xi_{vat,m}\right)\left[M\left(m_i,m_j\right)\right]^{\alpha_m}A_m^{1-\alpha_m} - \left(1-\tau_{vat,i}\hat{\xi}_{vat,i}\right)p_i m_i - \left(1-\tau_{vat,j}\hat{\xi}_{vat,j}\right)p_j m_j\}, \quad (9)$$

taking prices $\{p_i, p_j\}$, taxes $\{\tau_{ct,}\tau_{vat,i},\tau_{vat,j}\}$, and rates of compliance $\{\hat{\xi}_{vat,z},\hat{\xi}_{ct,z}\}_{z=i,j}$ as given. Note that, under the standard case where tax evasion rates are zero (i.e., $\hat{\xi}_{vat,z} = \hat{\xi}_{ct,z} = 1$ for all $z = i,j$), and VAT rates

are identical between sectors (i.e., $\tau_{vat,i} = \tau_{vat,j} = \tau_{vat}$), the profit function (9) is reduced to $\Pi^{fin} = (1 - \tau_{ct})(1 - \tau_{vat})\{[M(m_i, m_j)]^{\alpha_m} A_m^{1-\alpha_m} - p_i m_i - p_j m_j\}$.

3.3 The self-employed sector

Workers in this sector only require labor L_{ae} to produce goods, which can be sold at the exogenous price p_{ae}. The production function has decreasing returns to scale in labor as given by

$$Y_{ae} = A_{ae} {L_{ae}}^{\alpha},$$

where A_{ae} represents the technology level in the self-employed sector.

There is perfect mobility of labor between the informal and self-employed sectors. Accordingly, the cost per unit of work in this sector is just w_{nf}. Given that own-account workers do not pay any of the three taxes in the model, their profit function may be simply written as

$$\Pi^{ae} = p_{ae} A_{ae} {L_{ae}}^{\alpha} - w_{nf} L_{ae}. \quad (10)$$

Hence, workers in this sector must choose the quantity of labor L_{ae} that maximizes (10), taking prices $\{p_{ae}, w_{nf}\}$ as given. Accordingly, optimal labor demand is given by $L_{ae} = \left(\alpha p_{ae} A_{ae} / w_{nf}\right)^{1/(1-\alpha)}$.

3.4 The government

In this model, the government has four revenue sources and three expenditure sources. Revenue sources arise from value-added taxes (R_{vat}^{g}), social security contributions (R_{ssc}^{g}), corporate income taxes (R_{ct}^{g}), and other sources R_{others}^{g}.[9] In terms of the model, only the first three sources are endogenous. Expressions corresponding to the endogenous revenue sources are detailed in Appendix 1.

[9] In Mexico, "other" income sources mostly refer to oil revenues.

For convenience, expenditure sources are divided in non-social expenditures (G_{ns}), social expenditures excluding social security and social protection expenditures (G_{s,no_ss}), and social expenditures on social security and social protection programs ($G_{s,ss/ps}$). In particular, these expenditures are given by social protection expenditures on informal and self-employed workers, and social security expenditures on formal workers. According to the model, this implies $G_{s,ss/ps} = T_{nf}(L_{nf} + L_{ae}) + \eta\tau_n w_f L_f$, where L_{nf}, L_{ae} and L_f stand for the total amount of informal, self-employed, and formal labor in the economy, respectively. Thus $G_{s,ss/ps}$ is the only endogenous component of government expenditures.

Let D^g denote the primary public deficit. Thus the government budget constraint may be written as

$$\overline{G}_{ns} + \overline{G}_{s,no\_ss} + G_{s,ss/ps} + D^g = R^g_{vat} + R^g_{ssc} + R^g_{ct} + \overline{R}^g_{others}, \qquad (11)$$

where a "bar" over a variable denotes that it is exogenous in the model.

3.5 Solution

The solution of the model begins by considering the intermediate good sector first. The maximization problem (6) implies that labor demand is a function of the rate of compliance $\xi_{vat,z}(K_z)$. In particular, it may be shown that total labor demand, $L_z(K_z) \equiv L_{nf,z}(K_z) + L_{f,z}(K_z)$, for a firm with capital size K_z is given by

$$L_z(K_z) = \left(\frac{\left(1-\tau_{vat,z}\xi_{vat,z}(K_z)\right)\alpha A_z p_z}{[1+(1-\eta)\tau_n]w_f}\right)^{1/(1-\alpha)} K_z, \qquad K_z \in \left[\underline{K}_z, \overline{K}_z\right]. \qquad (12)$$

To determine the optimal mix of formal and informal workers, a particular function for the probability of detection $\lambda_{ssc,z}\left(L_{nf,z}, K_z\right)$ is needed.

In particular, a function satisfying the properties aforementioned is the following:

$$\lambda_{ssc,z}\left(L_{nf,z}, K_z\right) = \hat{\lambda}_{ssc} K_z^{\upsilon} L_{nf,z}^2,$$

where $\hat{\lambda}_{ssc}$ is a shift parameter, and $\gamma > 0$. From the maximization problem (6), it may be shown that informal labor $L_{nf,z}(K_z)$ may be expressed as

$$L_{nf,z}(K_z) = \left\{\left[\frac{[1+(1-\eta)\tau_n]w_f - w_{nf}}{3\theta\hat{\lambda}_{ssc}}\right]\left(\frac{1}{K_z^{\gamma}}\right)\right\}^{1/2}. \tag{13}$$

It may be noticed from (12) and (13) that $L_{nf,z}(K_z) > L_z(K_z)$ for relatively small values of K_z, implying a negative labor demand for formal workers. To avoid such scenario, define K_z^- as the level of capital that uniquely solves

$$L_z(K_z^-) = L_{nf,z}(K_z^-).$$

This implies that firms with a capital level $\left[\underline{K}_z, K_z^-\right]$ will hire informal workers only, according to the demand equation (12). On the other hand, firms with a capital level $\left(K_z^-, \overline{K}_z\right]$ will demand a mix of formal and informal workers whose total amount is also given by (12). In such a case, informal labor is determined by (13) whereas formal labor is given by the residual $L_{f,z}(K_z) = L_z(K_z) - L_{nf,z}(K_z)$. These functional forms imply that the fraction of formal workers relative to total labor increases as the size of capital is larger.

For illustrative purposes, the upper diagram in Figure 1 shows total labor demand as a function of the capital level K_z. The lower diagram in Figure 1 shows the corresponding size of informal labor relative to total labor, that is $L_{nf,z}/L_z$, as a function of capital size.

The next step is to specify the equilibrium condition in the labor market. Given that $\bar{L}$ denotes total labor endowment in the economy, it must be the case that $\overline{L} = L_i + L_j + L_{ae}$. Thus

$$\overline{L} = \sum_z \left\{ \left[\frac{\alpha A_z p_z}{[1+(1-\eta)\tau_n] w_f^*} \right]^{\frac{1}{1-\alpha}} \int_{\underline{K_z}}^{\overline{K}_z} \left[1 - \tau_{vat,z} \xi_{vat,z}(K_z) \right]^{\frac{1}{1-\alpha}} K_z f(K_z) dK_z \right\}$$

$$+ \left(\alpha p_{ae} A_{ae} / w_{nf}^* \right)^{1/(1-\alpha)}, \tag{14}$$

where w_f^* and w_{nf}^* represent the equilibrium wages in the formal and non-formal sectors, respectively. Finally, equation (14) plus condition (3) evaluated at equilibrium, that is $w_{nf}^* + \beta_{nf} T_{nf} = \left(1 + \beta_f \tau_n\right) w_f^*$, solve for equilibrium wages $\{w_f^*, w_{nf}^*\}$.

Consider now the maximization problem of firms in the final good sector, as denoted by expression (9). It may be shown that the relative demand of intermediate goods may be written as

$$\frac{m_i}{m_j} = \left[\left(\frac{\gamma}{1-\gamma} \right) \left(\frac{1-\tau_{vat,j} \hat{\xi}_{vat,j}}{1-\tau_{vat,i} \hat{\xi}_{vat,i}} \right) \left(\frac{p_j}{p_i} \right) \right]^{1/(1-\mu)}. \tag{15}$$

Expression (16) indicates that the effective tax rates $\tau_{vat,z} \hat{\xi}_{vat,z}$ cause a distortion in the relative demand of intermediate goods. Such distortion arises not only because of the presence of different VAT rates in the model but also because of differences in their rates of compliance. Under such perspective, a fiscal reform aimed at setting the same VAT rates partially mitigates such distortion. On the other hand, equation (15) denotes how aggregate rates of compliance in the intermediate sector affect the relative demand of inputs faced by final good firms.

GDP in this economy may be defined as the sum of value added out of each sector. Namely,

$$GDP = \sum_z p_z A_z \left\{ \int_{\underline{K_z}}^{\overline{K}_z} [L_z(K_z)]^{\alpha} {K_z}^{1-\alpha} f(K_z) dK_z \right\}$$

$$+\left\{\left[M\left(m_i, m_j\right)\right]^{\alpha_m} {A_m}^{1-\alpha_m} - p_i m_i - p_j m_j\right\} + p_{ae} A_{ae} {L_{ae}}^{\alpha}. \quad (16)$$

In the above expression, the first term represents value added from intermediate sectors $\{i, j\}$, where labor demand is given by equation (12). The remaining terms represent value added in the final good and self-employed sectors, respectively.

Finally, it remains to define a price level P for this economy. Let p_m represent the price level of intermediate good M. As shown in Appendix 2, p_m may be written as

$$p_m = \left[\left(\frac{\tilde{p}_i{}^{\mu}}{\gamma}\right)^{\frac{1}{\mu-1}} + \left(\frac{\tilde{p}_j{}^{\mu}}{1-\gamma}\right)^{\frac{1}{\mu-1}}\right]^{\frac{\mu-1}{\mu}}, \quad (17)$$

where $\tilde{p}_z \equiv \left(1 + \tau_{vat,z}\hat{\xi}_{vat,z}\right)p_z$ denotes the "gross" price for intermediate good $z = i, j$. Expression (18) indicates that the price level p_m is a weighted average of gross prices. Next, the price level P is defined as $P = (p_m C_m + p_{ae} C_{ae})/(C_m + C_{ae})$, where C_m and C_{ae} denote consumption of the final good m and consumption of the good produced by the self-employed sector, respectively. Let $\delta \equiv C_m/(C_m + C_{ae})$ represent the consumption share of the final good m. Thus the price level P is given by

$$P = \delta p_m + (1 - \delta)p_{ae}. \quad (18)$$

From (17) and (18) it may be inferred that an economy with a greater informality/illegality exhibits a lower price level.

4. Simulating the model

This section evaluates the effects of the social security reform proposed by Levy (2008). The simulations use the model described earlier to analyze how changes in tax rates τ_n and $\tau_{vat,z}$ may affect relevant variables. In particular, the exercises consider an elimination of social security contributions as well as an increase in the VAT rate from zero to

15 percent to those goods not currently taxed. The model is useful in the sense that it allows firms to change their optimal decisions in a context of tax evasion. Furthermore, the model provides information on how equilibrium wage rates are affected under such tax reform.

4.1 Calibration

Whenever possible, parameters of the model are calibrated to replicate some features of Mexican data. As detailed below, the reference year for some variables in the model is 2008. For convenience, parameter values for the benchmark calibration are listed in Table 1.

Consider first the parameters related to taxation. In terms of the model, the intermediate good sector i represents the "non-taxed" sector of the economy. This implies setting $\tau_{vat,i} = 0$. On the other hand, the intermediate good sector j in the model represents the "taxed" sector of the economy. In 2008, the statutory tax rate in such goods was 15 percent. Therefore, $\tau_{vat,j}$ is set to 0.15.[10] The income tax rate τ_{ct} works like a lump-sum tax in the model. Its value is calibrated so that government revenue out of this tax replicates the data. This implies setting $\tau_{ct} = 0.106$.[11] Based on evidence by Levy (2008), the tax rate on social security contributions, τ_n, is set to 38 percent of the wage rate in the formal sector. Out of this tax, Levy (2008) reports that the government subsidizes about 16 percent of total contributions. Accordingly, η is fixed to 0.165.

Based on the estimates of Levy (2008), the penalty θ imposed by the authority if a firm is caught evading social security contributions is set to 150 percent of unpaid contributions. This implies $\sigma_{ssc} = 1.5$. For the case of VAT and corporate taxes, the amount of the penalty imposed varies

[10] The statutory tax for such goods in the border Mexican states was 10 percent in 2008. The model abstracts from this geographical dimension and simply sets $\tau_{vat,j}$ to 15 percent. Starting 2010, the tax rate on taxable items was raised to 16 and 11 percent for non-border and border states, respectively.

[11] As a reference, the statutory income tax rate was 0.28 in 2008. Starting 2010, such tax rate was increased to 30 percent.

considerably according to the Federal Fiscal Code. In general, the penalties range between 150 and 170 percent of the amount evaded, but they may increase if either they are paid with a delay or there is a previous record of non-compliance with the law. Moreover, the percentage of the penalty may decrease if it is paid promptly. There are also other penalties that are paid in absolute terms (not proportional to the amount evaded). Given the complexity of such scheme, penalties are simply set to 150 percent of the amount evaded, implying $\sigma = 1.5$.

For the government budget constraint, data for 2008 at current prices is considered. The exogenous components of equation (11) are calibrated so that the model matches the data under the benchmark. To simplify, Table 1 only reports total exogenous expenditures, namely $\overline{G} \equiv \overline{G}_{ns} + \overline{G}_{s,no\_ss}$.

The shift parameter $\hat{\lambda}$ in the probability of detection function $\lambda(K_z)$ is fixed to 1.97 so that government revenue out of value added taxes roughly matches the data. Similarly, values for ν and the shift parameter $\hat{\lambda}_{ssc}$ in the probability of detection function $\lambda_{ssc,z}(L_{nf,z}, K_z)$ are chosen so that government revenue out of social security contributions is close to data.

Parameters related to the equilibrium condition (3) in labor markets are set as follows. Data for 2008 indicates that the amount of social protection expenditures by the government per unit of non-formal labor (T_{nf}) is \$5,768 pesos per year. Accordingly, T_{nf} is set to 5.75. The parameters of valuation of social security and social protection services, β_f and β_{nf} are arbitrarily fixed to 0.3 and 0.85, respectively. This parametrization implies that workers roughly value three times more social protection services relative to social security services.

Calibration of prices and the price level is relatively simple. As p_i, p_j and p_{ae} are exogenous, they are arbitrarily set to $1/3$ each. The weight

parameter δ in the price level equation (18) is fixed to 0.9. This implies that relative consumption of the self-employment sector, $1-\delta$, is roughly consistent with the share of the household informal sector in total output, according to national accounts.

The next series of parameters are related to technology. For the case of intermediate and self-employed goods, a is set to 0.65. This value for the labor share is consistent with the results for Mexico provided by García-Verdú (2005). For the technology in the final good sector, the parameter α_m is set to 0.48. This is the average share of intermediate goods in gross output once the production of the household informal sector is taken into account, according to data reported by the National Statistics Office (INEGI) for the period 2003 – 2007.

The number of workers in each sector must be constructed so that the levels of technology A_i, A_j, and A_{ae} can be chosen to match the data. Data from the National Survey of Occupation and Employment indicates that there were 43.86 million workers during the second quarter of 2008. As the model considers profit maximizing firms, government employees and people engaged in religious activities must be excluded from the sample. The 2009 Economic Census reports 4.83 million workers involved in such activities. This leaves 39.03 million workers which according to the model must be distributed among the intermediate and self-employed sectors.

At the same time, employment shares as a function of firm's size in the "taxed" and "non-taxed" sectors must be collected from the data in order to calibrate the distribution of capital across firms (see below). These shares are constructed using data from the Economic Census 2009 (see Figures 2 and 3).[12] Unfortunately, the Census only takes into account

[12] It is important to remark that the Economic Census 2009 misses some important features of economic activity in Mexico. In particular, the census excludes all activities in rural areas, activities from public

20.12 million workers, once government employees and people engaged in religious activities are excluded. In terms of the model, this implies that 20.12 million workers must be distributed between the "taxed" and "non-taxed" sectors, as there is no capital available in the self-employed sector. This leaves 18.91 million workers (=39.03 - 20.12) in the self-employed sector, which account for 41.6 percent of the economically active population.[13]

In addition, the 20.12 million workers included in the Economic Census must be classified as either formal or informal. Registries from the Social Security Office (IMSS) report 14.18 million workers affiliated to IMSS during 2008. However, as the Economic Census does not include workers in agricultural, hunting, livestock and forestry activities among others, employees in such sectors must be excluded from the IMSS registries. This leaves a total of 12.76 million workers registered in IMSS, which account for the total of formal workers in the model. The remaining workers (7.36 million) are thus classified as informal. Given these numbers, values for A_i, A_j, and A_{ae} are chosen to roughly replicate the total of formal, informal, and self-employed workers. Once these values are chosen, the technology level in the final sector, A_m, is fixed to replicate the level of GDP in the data.

In national accounts data, the "non-taxed" sector represents about 27 percent of total consumption of intermediate goods. Such number corresponds to parameter γ in equation (8). To round up, γ is simply set to 0.30. To the best of our knowledge, there are no estimates available in the literature for the elasticity of substitution between "taxed" and "non-taxed"

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organizations providing health and social assistance services, and urban transportation activities in mobile units like taxis and buses, among others. Also it excludes all firms that carry out their activities in an ambulatory fashion or with installations not permanently fixed to the ground. This means that commercial activities performed by firms in the streets are not included. For this reason, presumably the shares of employment for small-scale firms reported in Figures 1 and 2 below might be underestimated

[13] Levy (2008) reports that 39.8 percent of the economically active population was composed of self-employed workers in 2006, using a different methodology.

intermediate goods. Presumably, this elasticity of substitution is relatively low. For the benchmark parameterization, μ is set to –4 so that the corresponding elasticity of substitution is –0.20.

Finally, a distribution function for capital K_z in each sector is needed. This is important as such distribution is crucial to determine government revenue (see Appendix 1) and the distribution of labor across firms of different sizes. As labor demand in the intermediate good sector is a function of capital, it is possible to derive employment shares from the model given a distribution function for capital in each sector. These functions must be chosen so that employment shares from the model can roughly match the corresponding shares in the data for each sector.

For such purpose, a method similar to Guner et al. (2008) and Leal (2009) is followed. In particular, capital is assumed to follow a truncated Pareto distribution of the form

$$F(K_z) = \frac{1-\left(\frac{K_{z,min}}{K_z}\right)^{s_z}}{1-\left(\frac{K_{z,min}}{K_{z,max}}\right)^{s_z}}, \tag{19}$$

where $s_z > 0$ is a shape parameter associated to the distribution in sector z, with $K_{z,min} \equiv \underline{K_z}$ and $K_{z,max} \equiv \overline{K}_z$. The shape parameter is allowed to differ between sectors in order to better replicate the data. As it turns out, the distribution (19) is able to explain most of the employment in each intermediate sector z, with a total mass $1 - f_{z,max}$. The remaining employment (which corresponds to the right tail of the distribution with mass $f_{z,max}$) may be obtained by selecting an arbitrary value $K_{z,top} > \overline{K}_z$. Hence, the distribution of capital has two parts: the bottom side, which accounts for most of the employment, is defined by a truncated Pareto distribution. In contrast, the top side is captured by an extreme value of physical capital. This approach helps to better replicate the share of employment in the upper tail of the distribution. Under the benchmark,

the corresponding mass $f_{z,max}$ in both "non-taxed" and "taxed" sectors is 7.8e-06 and 4.8e-05, respectively.

Figures 2 and 3 compare the employment shares obtained from the model to those observed in the data under the benchmark economy. The shape parameter values are fixed to $s_i = 0.9$ and $s_j = 0.75$ along the paper. In general, the model does a fair job in replicating the employment shares found in the data, including the values at the tail of each distribution.

4.3 Results

Table 2 presents a comparison of the actual data versus the one obtained through the model. As it can easily be seen, the model fits extraordinarily well. This result suggests that the results presented in this section are very reliable and that our inferences regarding the modification of the social and fiscal policies would work well in reality.

Table 3 presents our results for alternative scenarios. Column A contains those for the benchmark economy in which the model's variables such as nominal GDP, budget restriction components and formal/informal workers in 2008 are adjusted so that the data is replicated. Total workers are distributed in the following way: 12.70 millions are formal, 8.35 millions are informal, and 17.98 millions are self-employed. Thus, adjusting from government employees and workers involved in religious organizations, the total labor force yields 39.03 million people. Equilibrium conditions (3) and (14) evaluated at the benchmark economy yield an annual wage rate of $79,522 in the formal sector, and of $83,700 in the informal sector.

For simplicity, that table presents two relevant indexes. Firstly we have the real GDP index defined, as referred in the benchmark economy, as the ratio GDP/P. And second, the formal salary index which is defined with the w_f/P ratio. Both are set equal to one in column A.

The first set of simulations assumes an increase in the VAT rate in the "non-taxed" sector from zero to 15 percent, keeping constant the rest of the parameters. These results are reported in column B. Under this scenario, real GDP falls 2 percent, which can be explained by both the rise in the price level and a fall in nominal GDP. The number of both informal/illegal and self-employed workers increases in absolute terms at the expense of the formal ones. The relative salary w_f/w_{nf} remains unchanged even though the real salary shrinks by 3 percent.

With respect to government's budget restriction components, these do not change significantly when compared to column A, with the only exception of VAT collection, which soars up from 3.78 to 6.37 percent of GDP. Hence government balances improve to obtain a surplus of 0.77 percent coming from a deficit of -0.14.

For the next set of simulations, the previous VAT rate increase is combined with the elimination of SSCs. This time results are presented in column C and may be interpreted the following way. Real GDP slightly goes up with respect to the one in column B, provided that labor taxes were removed; salaried informal workers disappear by definition whereas self-employed goes down to 13.67 millions, a decrease of 25 per cent. In contrast, the number of formal workers expands by 13 millions. Remaining illegal come from those firms that still evade VAT and corporate taxes. As a result of this workers' reassignment, the relative salary w_f/w_{nf} raises up by 10 percent, whereas the real one in the formal sector augments by 22 percent in relation to our benchmark economy.

Naturally the smaller number of self-employed workers produces a decrease in public social protection expenditure by 75 billions equivalent to 0.6 percent of GDP. In addition, with the elimination of SSCs, public expenditures shrink approximately to 23.3 percent of GDP. It is important to pinpoint that VAT collection expands to 6.61 percent of GDP,

contributing to a total tax collection growth to 24 percent of GDP, notwithstanding the removal of SSCs. As a result, a government budget surplus is also obtained (0.8 percent of GDP).

Our final exercise examines the reaction of the variables under study to the hypothetical case in which corporate and VAT rates of evasion are set to zero, under the situation described in column C. Results are presented in column D. In this hypothetical case, real GDP diminishes by 8 percent in relation to our benchmark economy. This reflects the fact that in this type of models greater effective tax rates cause a decrease in firms' production. Equally important, the number of formal workers almost doubles, from 12.70 to about 23.06 millions, and the real salary soars up by 6 percentage points in relation to the benchmark economy case but decreases with respect to situation C; this is so because nominal salary goes down, and to the rise of price level.

Government fiscal balances also change: public social protection expenditures diminish to 0.75 percent of GDP. This is still positive due to the existence of self-employed and "comisionistas". However, total public expenditures slightly goes up because of the GDP reduction. With respect to public revenues, column D reports that the maximum VAT and corporate collection in GDP terms would be approximately 12.3 and 5.6, respectively, a situation which causes a budget surplus equivalent to 8.3 percent of GDP.

In short, the amount that would be collected under a tax evasion environment should the VAT be applied to all goods and services and SSCs remove considering a change in agents' behavior is about 6.61 percent. That is, an additional 2.83 percentage points of GDP. Next the question is, how much does the proposed reform cost? This is briefly answer in the following section.

5. The cost of Universal health and pension cost: a first approximation

Estimating this cost is complex and a detailed dynamic study is needed to consider the demographic and epidemiological aspects. However, it is possible to have an idea about the cost at a certain point in time, the same used to model the generalization of the VAT.

Health IMSS-like and universal pension system

Universality implies health servicing total labor force just as the IMSS does currently with formal workers. IMSS provides a health insurance through two programs, namely, Illness and Maternity (Enfermedad y Maternidad) and Health for the family (Salud para la Familia). The idea under this scheme is to provide all these health services to all workers (formal or informal), hence the universe is the economically active population (EAP).

Calculating this cost over time would imply an actuarial study which would take into account the dynamics of demographic and epidemiological behavior. This is out of the scope of this study. Here we simply estimate the figures for a single year and do not take into consideration such features. We make this in order to have an idea of the financing requirements for this scheme. In short, we are only interested in having an idea of the cost to in turn be able to estimate the sources of financing the scheme.

Table 1 presents some figures needed to calculate the cost such as the economically active population, minimum wage and population 65 years old and older.

Target Population

Number of IMSS affiliates Dec 2008_/1	13,774,185
Economically Active Population, Dec 2008_/2	**41,064,469**
Not affiliated to IMSS, 2008	27,290,284
Daily Minimum Wage, 2008_/3	52.59
Population 65 years old or older, Dec 2008_/2	1,803,207

1- Source: IMSS
2- Source: own calculation based on CONAPO and Economic Census, 2009: TLF (45894469 people) excluding bureaucracy (4830000 people)

3- Source: Conasamin

Next we present the health provision cost per IMSS affiliate. Recall that it is needed because the proposed scheme is IMSS-like. Thus the total cost is this cost times the total labor force (EAP). As it may be noted, the total cost for a universal health program of the IMSS-type is around 621.8 billion pesos.

Universal Health Expenditure for 2008

	Current Expenditure	*Annual Expenditure per head*	*Total Expenditure on EAP_/1*
Health Insurance	175,277,000.00	12,725.04	522,546,846.36
Illness & Maternity	169,767,000.00		
Family Practice	5,510,000.00		
Life & Disability Insurance	11,342,000.00	823.42	33,813,485.69
TOTAL			556,360,332.05

_/1 Expenditure per head times EAP excluding bureaucracy (41,064,469 people)

Source: Own calculations

Next we need to calculate the pension system cost. Levy (2008) has proposed a universal pension system. This implies depositing the equivalent of 8.5 per cent of an annual wage of two times the minimum

wage[14] in the individual retirement savings account of 41.4 million workers, ensuring that all workers retire with a pension higher than the currently guaranteed minimum.

Alternatively, for simplicity, we evaluate one consisting of two monthly minimum wages for all adults 65 or older. In table 1 we reported the daily minimum wage (52.59 pesos) as well as the target population (1,803,207 people). Table 3 presents these estimates. Please observe that the total cost for 2008 is 68.2 billion pesos.

Proposed Pension System for 2008 (in thousands of pesos)

	Number of Retirees	Annual Expenditure per head	Total Expenditure on EAP
Retirement pension Levy's Proposal		3,218.5	132,166,321.99
Retirement Pension 2 min. Wages	1,803,207	37,864.8	68,278,072.41

_/1: daily minimum wage times 30

Source: Own calculations

We are now in the position to find out the total cost of a universal health and pension system as proposed by Levy. Table 4 presents this calculation for the year 2008. Note that the total cost reaches 690 billion pesos equivalent to 5.7 percent of GDP.

Alternative A: Total Cost of Universal Health and Pension System, 2008

Universal Health System IMSS-like	556,360,332.05
Levy's Universal Pension system	132,166,321.99
Total Cost	***688,526,654.04***
Total Cost in % of GDP	***5.69%***

Source: Own calculations based on Tables 2 and 3

[14] Originally, Levy's proposal is three times minimum wage, but to be able to compare with our alternative scenario, we use two minimum wages.

Alternative B: Total Cost of Universal Health and Pension System, 2008	
Universal Health System IMSS-like	556,360,332.05
Universal Pension system (2 mw)	68,278,072.41
Total Cost	***624,638,404.46***
Total Cost in % of GDP	***5.16%***

Source: Own calculations based on Tables 2 and 3

These two alternatives are different and both have advantages and disadvantages. The first one (A) releases future public finance pressures as it is funded based on a definite contribution. The main disadvantage is that is more costly today. What is more, it is necessary to additionally include the two guaranteed minimum wage to those in retirement -or close to- that are in the informal sector[15].

On the other hand, the alternative B considers only all the formal and informal workers that are 65 or older, hence is much cheaper as the government is not depositing any money in individual accounts to the rest of workers. This, however, would put pressure to public finances in the future if one considers the demographic curve. Again this section ignores dynamics of population, as we intend to illustrate the problem only.

Based on the above, next it is necessary to substract the amount that the federal government already spends on these items. Table 5 contains such figures.

How much is already spent? (2008, in thousands of pesos)	
Social Protection	
Imss Oportunidades	6,370,722.9
Health Funds transferred to states	48,480,421.4
States' health expenditures	24,715,075.0
Popular Health Insurance	36,250,635.0
Fonhapo_/8	2,342,231.6

[15] It is out of the scope of this paper.

Habitat_/9	1,887,399.4
CONAVI_/9	4,984,370.0
Programa Universal de Guarderías_/10	1,711,029.7
Federal Transfers to National Helath Institutes	12,416,613.8
First Generation Program	1,699,724.5
Elderly Program (older than 70)	9,536,677.1
Federal contributions to Social Security	
Riesgos de Trabajo	5,523,793.18
Guarderías y prestaciones sociales	2,541,856.83
Health	29,639,302.01
Family Practice	303,071.62
Life & Disability Insurance	7,737,976.36
Sub total	*196,140,900.3*
Pensions (government contribution to pensions)	17,539,500.63
	213,680,400.962000

Source: Cuenta de la Hacienda Pública Federal, 2008, IMSS (estadod e resultados)

Finally, with all these calculations it is possible to estimate the amount needed to implement the universal health and pension system in both scenarios. Table 6 presents the two alternatives. As it may be appreciated the amount needed in terms of GDP is 3.92% and 3.39%, respectively.

Amount Needed to implement proposed Universal Scheme in 2008 (in thousands of pesos)

	Alternative A	**Alternative B**
Total Cost of universal Health & Pension System	688,526,654.04	624,638,404.46
Current Federal Government expenditure on health and pensions	213,680,400.96	213,680,400.96
Amount Needed	**474,846,253.08**	**410,958,003.50**
Amount Needed in % GDP	3.92%	3.39%

Source: Own Calculation

Considering the extra revenues of 2.83% of GDP coming from VAT collection, the alternative A (Levy's) would be short of 1.09 percent of GDP, while B (2 minimum wages to all 65 or older) would be short of 0.56 percent. Needless to say that a more detailed study is required and that the schemes can be modified so as to minimize this amount.

It is important to pinpoint that the exercise here was made considering a uniform 15 percent VAT rate. Should this raise to 16 percent an extra of 0.8% is obtained. Thus alternative A would be short of 0.29 percent of GDP while B even gets a surplus of 0.24 percent of GDP.

6. Conclusions

This paper has shown that informality in Mexico is a result of a dual fiscal –public expenditure side- policy. Under tax evasion environment current social protection scheme promotes informality. Thus removing SSCs and levying a general VAT on all goods and services, public revenues would increase by 1.5 percent of GDP, a figure that more than compensates the SSCs elimination. VAT revenues would increase to 6.61percent of GDP. Furthermore, real wages increase.

In short, a generalization of VAT combined with a SSCs removal would make workers better off. It is in this sense that we argue that SSCs may actually be seen as a consumption tax, at least more burdensome than a generalization of VAT. Even in the case of still being short of sources of finance, some extra financial resources can be found. The distortions however would have been removed completely.

References

de Paula, Áureo and José A. Sheinkman (2010), "Value Added Taxes, Chain Effects and Informality", *American Economic Journal: Macroeconomics* 2 (4), 195 - 221.

Fortin, Bernard, Nicolas Marceau, and Luc Savard (1997), "Taxation, Wage Controls and the Informal Sector", *Journal of Public Economics* 66, 293 – 312.

García-Verdú, Rodrigo (2005), "Factor Shares from Household Survey Data", *Working Paper* 2005-05, Banco de México.

Gollin, Douglas (2006), "Do Taxes on Large Firms Impede Growth? Evidence from Ghana", *manuscript*, Williams College.

Guner, Nezih, Gustavo Ventura and Yi Xu (2008), "Macroeconomic Implications of Size-Dependent Policies", *Review of Economic Dynamics* 11, 721 – 744.

Hsieh, Chang-Tai, and Peter J. Klenow (2009a), "Misallocation and Manufacturing TFP in China and India", *Quarterly Journal of Economics* 124 (4), 1403 – 1448.

Hsieh, Chang-Tai, and Peter J. Klenow (2009b), "Resource Misallocation in Mexico", *manuscript*.

Laporta, R. F. López de Silanes, A. Shleiffer and R Vishny. (1999) "Law and Finance" Journal of Political Economy.

Leal, Julio (2009), "Effects of Incomplete Enforcement on Labor Productivity", *manuscript*, Arizona State University.

Levy, Santiago (2008), *Good Intentions, Bad Outcomes: Social Policy, Informality and Economic Growth in Mexico*, Brookings Institution Press.

Lucas, Robert E., (1978), "On the Size Distribution of Business Firms", *Bell Journal of Economics* 9 (2), 508 - 523.

Restuccia, Diego, and Richard Rogerson (2008), "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments", *Review of Economic Dynamics* 11 (4), 707 – 720.

Scott, John (2010). The Failure of the Mexican Revolution. Documento de Trabajo CIDE, México.

World Bank. (2006) Infrastructure Public Expenditure Review. Washington, DC.

World Bank (2011). Doing Business Report 2010. Washington DC. www.worldbank.org

Appendix 1. Government revenue

This appendix presents expressions for the endogenous sources of government revenue in the model. Consider first revenue out of value added taxes. In the intermediate good sector, value added is given by equation (1). Accordingly, the revenue collected $R_{vat}^{g,int}$ may be written as

$$R_{vat}^{g,int} = \sum_z \left\{ \tau_{vat,z} A_z p_z \int_{\underline{K_z}}^{\overline{K_z}} \xi_{vat,z}(K_z) [L_z(K_z)]^{\alpha} {K_z}^{1-\alpha} f(K_z) dK_z \right\},$$

where the labor demand function $L_z(K_z)$ is given by equation (12) in the main text. In terms of the final good sector, government revenue $R_{vat}^{g,fin}$ is just

$$R_{vat}^{g,fin} = \tau_{vat,m} \xi_{vat,m} \left[M(m_i, m_j) \right]^{\alpha_m} {A_m}^{1-\alpha_m} - \sum_z \tau_{vat,z} \hat{\xi}_{vat,z} p_z m_z.$$

Hence, government revenue out of VAT is given by $R_{vat}^{g} = R_{vat}^{g,int} + R_{vat}^{g,fin}$.

Consider now government revenue out of corporate income taxes. Denote $\widehat{\Pi}_z(K_z)$ as gross profits (that is, profits before corporate taxes) for a firm with capital size K_z. Thus the corresponding revenue collected $R_{ct}^{g,int}$ is just

$$R_{ct}^{g,int} = \sum_z \left\{ \int_{\underline{K_z}}^{\overline{K_z}} \xi_{ct,z}(K_z) \widehat{\Pi}_z(K_z) f(K_z) dK_z \right\}.$$

As for the final sector, it may be shown that government revenue $R_{ct}^{g,fin}$ may be written as

$$R_{ct}^{g,fin} = \tau_{ct} \xi_{ct,m} \left(1 - \tau_{vat,m} \xi_{vat,m}\right) (1 - \alpha_m) \left[M(m_i, m_j) \right]^{\alpha_m} {A_m}^{1-\alpha_m}.$$

Hence, government revenue out of corporate taxes is defined as $R_{ct}^{g} = R_{ct}^{g,int} + R_{ct}^{g,fin}$.

Finally, it remains to specify revenue from social security contributions which only applies to firms in the intermediate good sector. Such revenue is defined as

$$R_{ssc}^{g} = (1-\eta)\tau_n w_f{}^{*} \sum_z \left\{ \int_{K_z^-}^{\overline{K}_z} L_{f,z}(K_z) f(K_z) dK_z \right\},$$

where the labor demand function $L_{f,z}(K_z)$ is defined in the main text.

Appendix 2. Determination of p_m

Consider the following cost minimization problem for a representative consumer:

$$\min_{\{m_i, m_j\}} \left[p_i \left(1 + \tau_{vat,i} \hat{\xi}_{vat,i}\right) m_i + p_j \left(1 + \tau_{vat,j} \hat{\xi}_{vat,j}\right) m_j \right]$$

subject to $\left[\gamma (m_i)^{\mu} + (1-\gamma)\left(m_j\right)^{\mu}\right]^{1/\mu} = M$.

Let $\tilde{p}_z \equiv (1 + \tau_{vat,z} \hat{\xi}_{vat,z}) p_z$ denote the "gross" price for intermediate good $z = i, j$. The corresponding demand functions may be expressed as

$$m_i = \left[\frac{\gamma \kappa}{\tilde{p}_i}\right]^{\frac{1}{1-\mu}} M, \quad \text{and} \quad m_j = \left[\frac{(1-\gamma)\kappa}{\tilde{p}_j}\right]^{\frac{1}{1-\mu}} M,$$

where κ is the lagrange multiplier. After substituting these two functions into the expression for M, the price index p_m may be obtained:

$$p_m = \left[\left(\frac{\tilde{p}_i{}^{\mu}}{\gamma}\right)^{\frac{1}{\mu-1}} + \left(\frac{\tilde{p}_j{}^{\mu}}{1-\gamma}\right)^{\frac{1}{\mu-1}} \right]^{\frac{\mu-1}{\mu}}.$$

This is just equation (17) in the main text.

Figure 1

Labor demand in the intermediate good sector z

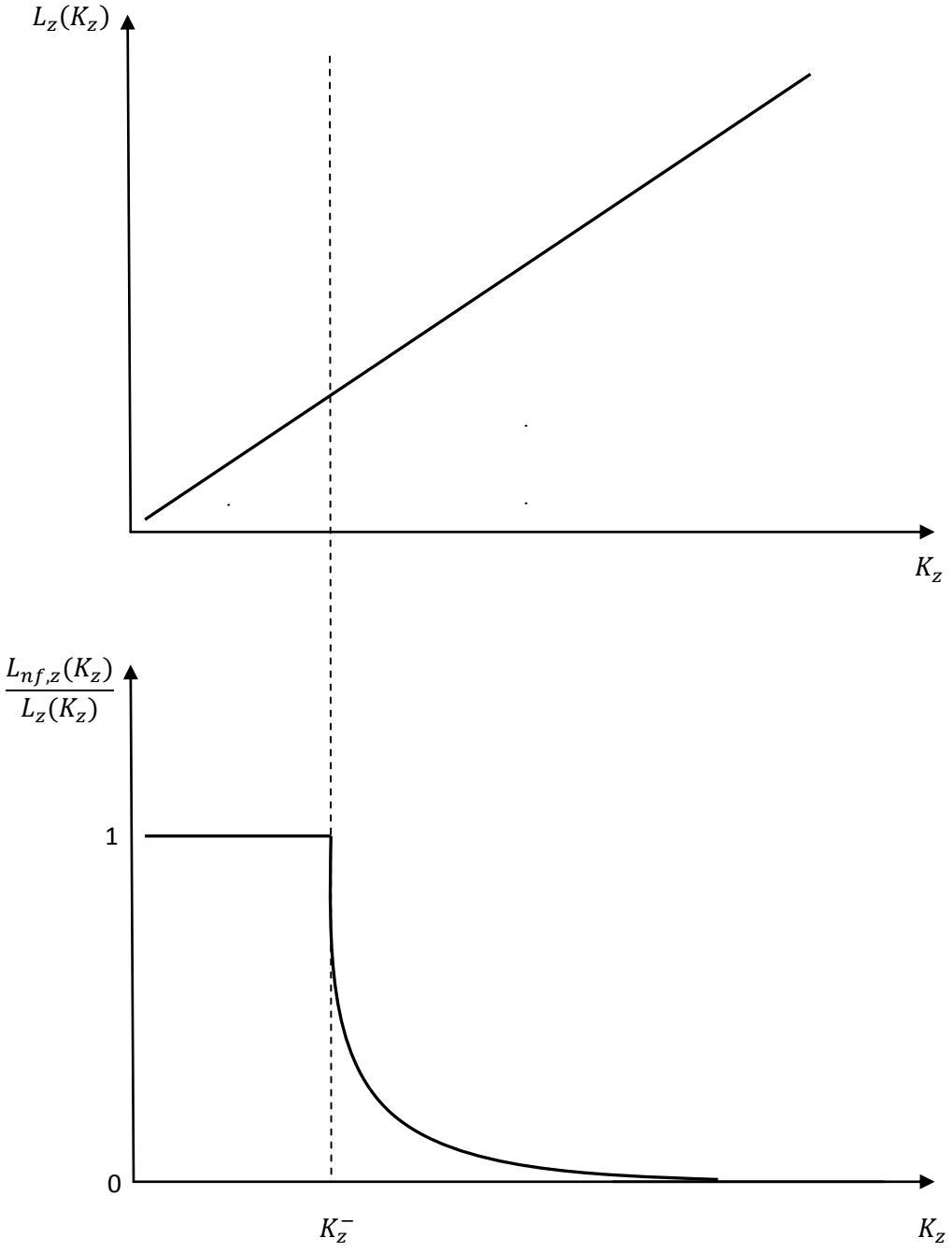
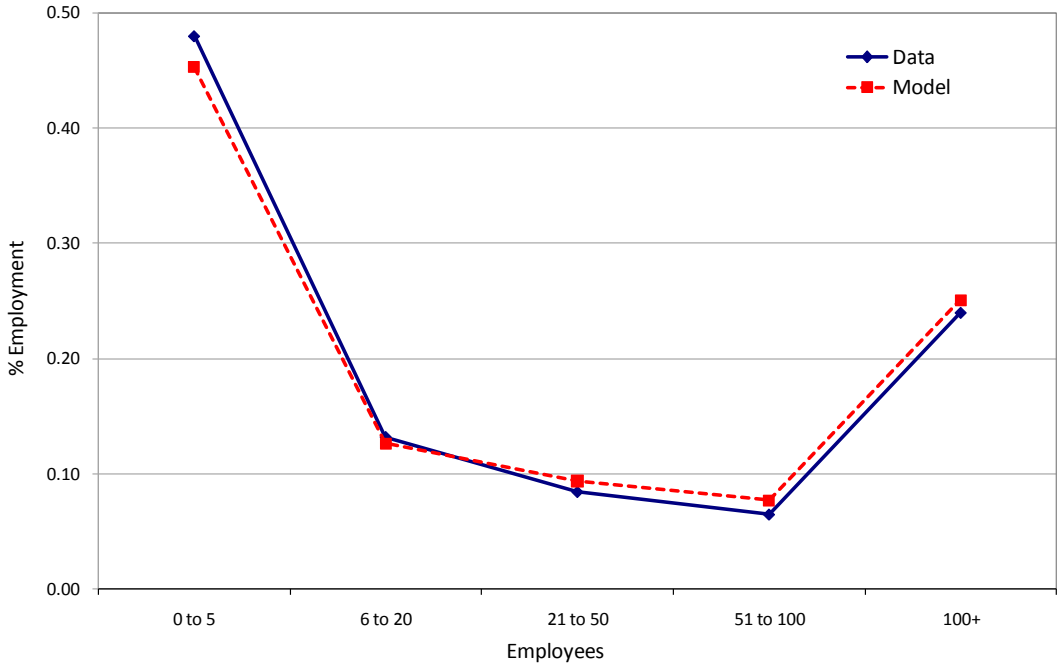
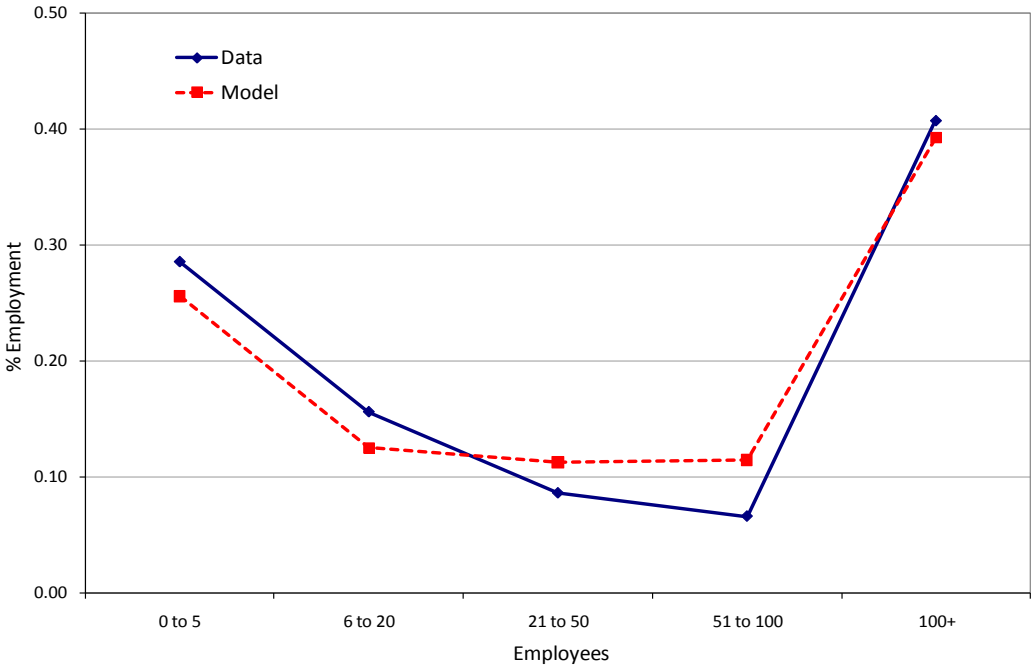


Figure 2
Employment shares in the "non-taxed" sector



Source: Economic Census 2009, INEGI.

Figure 3
Employment shares in the "taxed" sector



Source: Economic Census 2009, INEGI.

Table 1
Parameter calibration

Parameter		Value
VAT rate in ”non-taxed” sector	$\tau_{vat,i}$	0
VAT rate in ”taxed” sector	$\tau_{vat,j}$	0.15
Income tax	τ_{ct}	0.106
Tax rate on social security contributions (SSCs)	τ_n	0.38
Share of government subsidy to SSCs	η	0.165
Percentage of penalty for evading SSCs	σ_{ssc}	1.5
Percentage of penalty for evading VAT/income tax	σ	1.5
Exogenous government expenditures	$\bar{G}$	26.79
Exogenous government revenue	$\bar{R}$	16.96
Shift parameter in probability of detection for VAT	$\hat{\lambda}$	1.97
Shift parameter in probability of detection for SSCs	$\hat{\lambda}_{ssc}$	0.009
Capital parameter in probability of detection for SSCs	υ	0.1
Subsidy to social protection expenditures	T_{nf}	5.75
Valuation of social security programs	β_f	0.3
Valuation of social protection programs	β_{nf}	0.85
Price of intermediate good $z = i, j$	p_z	1/3
Price of self-employment good	p_{ae}	1/3
Weight parameter in price index P	δ	0.90
Labor share in intermediate/self-employed sector	α	0.65
Intermediate good share in final good sector	α_m	0.48
Technology level in “non-taxed” sector	A_i	1874.2
Technology level in “taxed” sector	A_j	1837.5
Technology level in self-employed sector	A_{ae}	211.9
Technology level in final good sector	A_m	158.1
Share of “non-taxed” good in intermediate sector	γ	0.30
Parameter related to the elasticity of substitution in intermediate sector	μ	-4

Table 2

Actual versus Calibrated Data

	Actual Data (2008)	Model's calibrated data
GDP (in billion pesos)	12,110,555	12,088,727
Public Revenues and Expenditures (in billion pesos)		
Social Protection Expenditures	151,510	151,392
Social Security Expenditures	63,787	63,327
Other Exogenous Expenses	2,679,509	2,679,509
VAT Revenues	457,248	457,266
Corporate Tax Revenues	393,000	393,293
SSCs	155,659	169,531
Other Exogenous Revenues	1,696,374	1,696,374
Budget balance	-192,525	-177,765
Labor Market (in milliion workers)		
Formal Workers	12.76	12.70
Informal workers	7.36	8.35
Self-Employed	18.91	17.98
Total Workers	39.03	39.03
Firm's size Distribution ("special treatment sector"		
0 to 5 workers	2.53	2.48
6 to 20 workers	0.70	0.69
21 to 50 workers	0.44	0.51
51 to 100 workers	0.34	0.42
101 + workers	1.26	1.37
Total workers	5.27	5.47
Firm's size Distribution ("taxed sector")		
0 to 5 workers	4.24	3.99
6 to 20 workers	2.31	1.95
21 to 50 workers	1.27	1.75
51 to 100 workers	0.97	1.78
101 + workers	6.05	6.11
Total workers	14.84	15.58

Source: Own estimation based on Economic Census, 2009, National Account System (2008), INEGI.and Cuenta de la Hacienda Pública Federal, Secretaría de Hacienda y Crédito Público, 2008.

Table 3

	Benchmark Economy (A)	General VAT @15% (B)	(B) + SSCs elimination (C)	(C) + no tax evasion (D)
Nominal GDP	12,088,727	12,080,590	12,176,442	12,157,742
Price Index	1.00	1.02	1.02	1.09
Real GDP Index	1.00	0.98	0.99	0.92
Labor Market				
Salaried informal workers	8.35	8.46	0.00	0.00
Salaried formal workers	12.70	12.26	25.36	23.06
Self-employed	17.98	18.31	13.67	15.97
Total Workers	39.03	39.03	39.03	39.03
Formal sector salary	79,522	79,044	97,013	92,143
Informal sector salary	83,700	83,167	92,125	87,255
wf/wnf	0.95	0.95	1.05	1.06
Real formal salary index	1.00	0.97	1.19	1.06
Public Balance Restriction				
Total Expenditures	2,894,229	2,952,373.2	2,816,293.4	3,016,953.3
Social Protection Exp.	151,392	153,909.0	78,606.3	91,801.6
SS Expenditure	63,327	60,777.0	0.0	0.0
Other exp.	2,679,509	2,737,687.1	2,737,687.1	2,925,151.6
Total Revenue	2,716,464	3,046,336.6	2,922,320.4	4,034,300.7
VAT Collection	457,266	769,976.8	805,244.0	1,502,182.3
Corporate Tax Collection	393,293	380,449.9	383,870.3	680,230.2
SSCs	169,531	162,703.8	0.0	0.0
Other revenues	1,696,374	1,733,206.1	1,733,206.1	1,851,888.2
Budget Balance	-177,765	93,963.4	106,027.0	1,017,347.4

Note: Nominal GDP in billions of pesos. Price level, P, is defined in text as equation (19). The price index is the ratio P/P^{ref}, donde P^{ref} is the price level under the benchmark economy. The GDP index is defined as GDP/P in relation to benchmark economy. Workers figures are in millions. The real formal wage index is defined as w_f/P also in relation to benchmark economy. SSC is referred as the social security contribution.