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Aggregate Effects of a Universal Social Insurance Fiscal Reform

Arturo Antón[§] and Julio Leal[‡]

Abstract[†]

This paper analyzes the aggregate effects of a revenue neutral fiscal-cum-social policy reform in a typical developing country that consists of two main changes: (1) the implementation of universal social insurance to replace the current dual social protection system (i.e., a reconfiguration of transfers); and (2) the elimination of the current social security payroll tax to replace it with a generalized VAT (i.e., a reconfiguration of taxes). The authors find that this reform increases productivity by 2 percent and output by 3 percent as it improves the allocation of resources across firms and sectors, and generates a substantial change in occupational choices that favors wage earners. As a result, wages (before transfers) increase for all employees. Also, due to the reconfiguration of transfers, earnings (wages after transfers) for informal employees increase relative to the earnings of formal employees, which decreases inequality. However, we also find that the reform could affect some groups in the population, given the regressive nature of VAT and heterogeneity in the valuation of transfers across workers.

JEL Codes: E62; H550; O170; O470
Keywords: Total factor productivity; Fiscal policy; Social security; Informal labor markets

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1. Introduction

Contributory social insurance (CSI) programs in Latin America have a long-standing tradition. However, after several decades of implementation, there are still large segments of the population that remain without public health services or social security in terms of retirement, to name a couple of the CSI benefits. In this regard, Gasparini and Tornarolli (2009) estimate that approximately 56 percent of wage earners in the region are not registered to receive CSI. However, non-contributory social insurance programs (NCSI) have been extended across the region, over time, in an effort to minimize this problem. This raises concerns that (i) distortions can result by having a dual social insurance (SI) policy and (ii) there becomes a need for an appropriate method to raise the revenue to fund social spending.

The objective of this Working Paper is to evaluate the aggregate effects of alternative revenue-neutral scenarios for implementing and financing SI to entire populations. The scenarios, which will be discussed, are based on Levy's (2008) concept to replace the dual CSI-NCSI policy in favor of a universal social insurance (USI) scheme, financed with revenue from value-added tax (VAT) in lieu of payroll tax. For the purpose of this paper, the term, "fiscal-cum-social policy reform," will be used to reflect this. Of particular interest will be the study of the effects of such a concept on productivity. Given the regressive nature that VAT can have, its impact on inequality will also be significant. Mexico will be used as a benchmark for this study, since a large portion of its population does not fall within Mexico's CSI programs, and given the fact that its NCSI programs are popular, especially during the last years.

Similar to the study of Lucas (1978), a dynamic general-equilibrium, two-sector model with tax evasion and occupational choice is developed. The model includes two sectors to enable the capture of the different VAT rates that Mexico currently has in place.[1]

A household member faces a discrete occupational choice, whether to be: (a) an employee, (b) an entrepreneur operating a one-person firm, or (c) an entrepreneur operating a firm with one or more employees. We refer to the first type of entrepreneurs as "own-account" workers and to the second type as "employers." In this context, goods are produced using capital, labor, and managerial ability by either own-account workers or employers.

[1] Mexico has a complex tax system of differentiated VAT rates. As of 2012, VAT applies to certain goods and services at a rate of 16 percent. VAT is excluded from goods, such as food and medicines, among others. In addition, border states currently pay a lower VAT rate.

Two types of tax, in principle, can be fiscally imposed on firms: AT and CSI (i.e., payroll tax). However, it is assumed that fiscal authority cannot impose taxes on own-account workers, due to the difficulty and cost of monitoring the economic activity of this segment of the workforce. On the other hand, employers are able to only partially evade taxes, since tax enforcement depends on the size of the establishments, which creates a distortion across establishments. In addition, the evasion of CSI tax by employers gives rise to the co-existence of formal and informal employees in equilibrium.[2]

Results suggest that a fiscal-cum-social policy reform with a uniform VAT rate (raised so that government revenue remains constant) will increase aggregate output by 3.2 percent and total factor productivity (TFP) by 2.1 percent. This will occur when the TFP is positively affected by an improvement in the allocation of resources across (i) plants (due to the homogenization of the payroll tax rate); and (ii) sectors (due to the homogenization of the VAT rate). Additionally, reform can affect occupational choice, which increases the average ability of entrepreneurs. In contrast, TFP is negatively affected, as the mass of entrepreneurs shrinks considerably following reform. Consistent with these effects, reform can increase wages (13 and 19 percent for informal and formal workers, respectively) and, thus, raise the incentive to become an employee, once the CSI tax is eliminated. After summing up the positive and negative effects, a net increase in TFP of 2.1 percent occurs. It would seem that the most relevant outcome of this exercise depends on the substantial reallocation of labor across alternative occupations; that is, the share of the employee increases by 9 percent, while employment by own-account workers decreases by 15 percent.

Also taken into account is the fact that prices are endogenously determined in the model to establish the impact of reform on inequality. The model includes an increase of 5 percent in the equilibrium price of the sector that originally faced a zero VAT rate (Sector 1). Since this sector comprises goods such as food and medicine, among others, the effect on the poor by such an increase may be relevant. Given that there is no spending heterogeneity in the model, any effect on low-income earners associated to a price increase in Sector 1 cannot be included in the analysis as an equilibrium result. Nonetheless, an out-of-equilibrium calculation can be made by combining the effects of reform on the real wage of informal workers with the price increase in

[2] As Kanbur (2009) states, "formality" is defined as a regulation which, in terms of social insurance, relates to social security. Accordingly, formal workers are those hired by firms that cover their social insurance payments as dictated by law; all other workers are informal.

Sector 1; for example, assuming that a low-income individual earns the informal wage rate and spends all his/her wage on food, he/she will still gain an 8 percent increase in purchasing power.[3] In Section 6.5, we show that this conclusion is quite sensitive to the assumptions on spending heterogeneity and the valuation of transfers made by workers. For example, when the valuation of social security transfers made by formal employees is high, the change in earnings is negative, because per capita transfers are reduced for this group of workers after the reform**.**

In addition, a revenue-neutral exercise is considered, where the fiscal-cum-social policy reform is implemented and only the VAT rate in the sector already taxed is raised. While the VAT rate in the other sector remains at zero, this reform appears to exacerbate the distortions across sectors, in which aggregate output and TFP increase by 0.6 and 0.4 percent, respectively. In terms of aggregate productivity, this suggests a TFP change five times lower than the previous case. Accordingly, both formal and informal wages rise by a lower magnitude, when compared to the previous exercise.

Finally, the model is used to analyze a policy that sets the same VAT rate in each sector (similar to the revenue-neutral exercise, previously described), but leaves unchanged the dual SI scheme. This policy analysis is relevant, given that spending on NCSI programs increases over time and, thus, there is a need for a stable source of finance. Results suggest that a fiscal reform of this type, with no change in SI spending, will decrease output and TFP by 1.1 and 0.4 percent, respectively. If the additional VAT revenue is used exclusively on transfers to informal workers, output and TFP decrease even further—to 3.6 and 1.8 percent, respectively, relative to the benchmark used in this study. These results yield two relevant policy implications. First, the removal of the dual SI scheme would appear crucial to increase TFP. Second, a government that raises revenue to provide SI to those not currently covered, while leaving in place the dual SI scheme, may end up with lower output and productivity. In other words, a badly designed social policy that further subsidizes informal jobs, without increasing the benefits provided by formal jobs, in fact, may be detrimental to the economy. Our results are in line with those in Alonso-Ortiz and Leal (2012), who show that it is possible to reduce the size of the informal sector by rising extra tax resources, as long as those resources are used as transfers to formal workers.

[3] Of course, this result must be carefully interpreted, since the effect on demand has not been considered. The result may also depend on the elasticity of substitution between goods across sectors.

Fiscal sustainability of the fiscal-cum-social policy reform and its effects on informality has been recently addressed by Antón, Hernandez, and Levy (henceforth, AHL, 2012). The authors presented an equilibrium model, including intermediate goods, tax evasion and exogenous capital, and labor supply statistics, specifically related to the Mexican economy. While they found the reform to be financially sound, they had not taken into account its effect on productivity. The impact of the aforementioned reform on productivity is precisely the purpose of this Working Paper.

Section 1 of this paper will offer an overview of the literature, while Section 2 will briefly characterize the labor market and social policy in Mexico. The model, itself, will be presented in Section 3, with an assessment. Section 5 will discuss the results, and Section 6 will include the conclusions of the study.

2. Literature Overview

Recent literature relating to "development accounting" focuses on explaining the substantial differences in income per capita levels and growth rates across countries (Klenow and Rodriguez-Clare (1997); Hall and Jones (1999); Caselli (2005); and Hsieh and Klenow (2010), among others). These works provide evidence that total factor productivity (TFP) is the leading factor relating to income disparity among countries. For example, Hsieh and Klenow (2010) show that TFP accounts for 50 to 70 percent disparity in income per capita.

As a result of this observation, a large group of authors is attempting to understand the determinants of aggregate TFP. The reasons why TFP can be low are multiple. For example, it could be due to financial constraints, low competition, or idiosyncratic distortions across firms and sectors, among others. In this context, Guner, Ventura, and Xu (2008) have studied how government policies (including those relating to taxation) that impose restrictions on a firm's size may have a substantial effect on productivity. IDB (2010) also highlights the role of resource misallocation across firms in Latin America.

A segment of this literature focuses, in terms of general equilibrium models, on the role that the informal sector plays in relation to low TFP. While there are many distortions associated with the presence of informality, one view that surfaces is that informality acts as an implicit subsidy for low productive activities, creating a misallocation of resources across firms (Lewis, 2004; Farrel, 2004; Cavalcanti and Antunes, 2007; Levy, 2008; Leal, 2013; and Prado, 2011).

Accordingly, minimizing informality will reduce these distortions, improve the allocation of resources and, thus, increase productivity.

3. Mexico's Social Policies and Informality

Currently, the provision of social insurance in Mexico is based on a dual system. On the one hand, firms and workers in a salaried contractual relationship are required to contribute to social insurance. On the other, non-salaried workers (i.e., the own-account and workers in family firms) are not legally bound to contribute to social insurance; instead, they benefit from a set of programs provided by the government, which are financed from general revenue. The existence of this dual design naturally increases the price of salaried labor (relative to non-salaried) and, thus, may incentive informality.

In fact, resources to NCSI in Mexico have increased in recent years in response to the "truncated welfare state" problem, described in AHL (2012), exacerbating the distortion between salaried and non-salaried workers.[4] Recent literature shows that this dual social insurance policy incentives informality (Bosch and Campos, 2010; Hallward-Driemeier, Reyes, and Pagés, 2011; AHL, 2012; among others).

The high rates on CSI and the large subsidies to NCSI may also negatively impact productivity, wages, and the government's fiscal balance. The effects on aggregate productivity originate from the current incentives for firms (especially small ones) to become or remain informal under the CSI + NCSI design. This generates resource misallocation across establishments, leading to low aggregate productivity. The effect on wages arises as a consequence of low productivity. Finally, a large informal sector can have an adverse effect on government revenue, since it decreases the tax base (AHL, 2012).

Levy (2008) argues that (i) CSI (including dismissal regulations) taxes salaried employment, which strongly distorts the labor market and, therefore, creates negative implications relating to social insurance and productivity; (ii) NCSI aggravates the allocation distortions, created by CSI, and erodes the tax base; (iii) informality and evasion are endogenous to the incentive structure generated by the CSI-NCSI dichotomy; and (iv) the (CSI + NCSI) design puts the government in the serious dilemma of whether to extend social benefits to

[4] Over time, Mexico has been implementing social programs for informal workers, aimed to emulate fringe benefits from the formal sector. See Levy (2008) for details.

informal workers, on the one hand, and having to address the fiscal and productivity concerns on the other. The purpose of this Working Paper is to present the quantitative effects of such a reform on productivity.

3.1. A Brief Characterization of Labor Markets in Mexico

According to Mexico's National Survey of Occupation and Employment (Encuesta National de Ocupación y Empleo, or ENOE), the size of its active labor force (LF) during 2008, on average, included 38.4 million workers in the private sector (see Table 1).

Table 1. Total Employees by Sector, 2008

Quarter	Formal	Informal	Total
	N / %	N / %	N / %
Q1	11,615,717	27,005,989	38,621,706
	30.08	69.92	100
Q2	11,593,387	27,575,275	39,168,662
	29.60	70.40	100
Q3	11,637,246	27,345,633	38,982,879
	29.85	70.15	100
Q4	11,565,441	26,776,285	38,341,726
	30.16	69.84	100

Source: National Survey of Occupation and Employment, ENOE (2008).

In this table, the LF has been divided into formal and informal workers. On average, 70 per cent of total LF is informal, while the rest is formal. In general, informal workers are less educated compared to the formal (see Table 2). The majority of informal workers have achieved only secondary level education or less (76 percent), whereas only 9 percent have had a college education. In contrast, 22 percent of formal workers have attended college and only 50 percent have had secondary studies or less. For those workers that have a college education, 51 percent are formal and the remaining 49 are informal.

Table 2. Formal and Informal Workers by Education Level, 2008

Educational level	Formal workers N /% row/% column	Informal workers N /% row/% column	Total N /% row/% column
Middle school or less	5,750,987	20,530,212	26,281,199
	22	78	100
	50	76	68
High school or less	3,344,647	4,189,667	7,534,313
	44	56	100
	29	15	19
College	2,504,269	2,442,544	4,946,812
	51	49	100
	22	9	13
Total	11,599,902	27,162,422	38,762,324
	30	70	100
	100	100	100

Source: ENOE (2008).

Regardless of the level of education, formal workers are higher earners, as noted in Table 3. In each of the formal and informal sectors, the higher the level of education, the higher the earnings are. It is important to emphasize that these earnings neither include social security contributions paid by formal workers, nor the valuation attached by formal and informal workers to social insurance programs. For the analysis herein, we will use the valuations reported in the literature that has performed econometric estimations of these values. Our benchmark will use those reported by Levy (2008).

Table 3. Monthly Average by Sector and Education Level, 2008 (in Mexican pesos)

Level of education	Formal	Informal	Both sectors	Formal / Informal
Secondary education or less	4,523	3,298	3,639	1.37
High school or less	5,387	4,547	5,032	1.18
College	9,462	8,414	8,869	1.12
Average	5,740	4,007		1.43

Source: ENOE (2008).

4. The Model

A two-sector model of occupational choice follows below, relating to capital accumulation, taxes, transfers, evasion, and own-account workers. This is in line with the work of Lucas (1978).

A two-sector economy is assumed to capture the distortions caused by the dual VAT structure in Mexico. Sector 1 relates to the "non-taxed" sector, representing several goods and services in Mexico that are either exempt, or are at a zero VAT rate. In contrast, Sector 2 includes the "taxed" sector. The labels, "taxed" and "non-taxed," refer to the VAT rate only.

A representative household with mass 1 is comprised of a continuum of individuals. There are two types of individuals: Type 1, and Type 2. Each type exists within mass M_j, $j \in \{1,2\}$, and $M_1 + M_2 = 1$. Each household member is endowed with z_j units of managerial ability. Individuals draw their ability from two independent distributions, according to their type. The abilities are distributed exogenously with support $Z_j = [\underline{z}_j, \bar{z}_j]$, distribution functions denoted by $G_j(z_j)$, and corresponding densities $g_j(z_j)$, $j \in \{1,2\}$.

Each individual within a type may have one out of three occupations: employee, own-account worker, or employer. If the individual is an employee, he/she can work either as a formal, or an informal worker. He/she also supplies one unit of labor services to the market. If the individual is a type j employer, he/she has access to the following production function:

$$y_j = {z_j}^{1-\gamma}\big(f(k,l)\big)^{\gamma} = {z_j}^{1-\gamma}(k^{1-\alpha}l^{\alpha})^{\gamma}, \qquad (1)$$

where $\alpha \in [0,1]$, and $\gamma \in [0,1]$, and $j \in \{1,2\}$. Finally, a type j own-account worker has access to the following technology:

$$y_o = A_{oj}{z_j}^{1-\gamma}\big(f(k,l)\big)^{\gamma} = A_{oj}{z_j}^{1-\gamma}(k^{1-\alpha}l^{\alpha})^{\gamma}, \qquad (2)$$

with the restriction $0 \leq l \leq \kappa \leq 1$. The restriction captures the idea that own-account workers lose a fraction (1-κ) of their time allocation, as they have to simultaneously perform managerial activities and provide labor services. Note that the productivity scale factor $A_{oj} > 1$ captures the concept that an own-account worker has more control over the productive unit than employers (as in Gollin, 2008). We denote k_o and l_o as the factor inputs of the own-account.

4.1 Taxes, Transfers, and Evasion

There are two taxes in the model, VAT τ_{yj} and CSI tax τ_l. CSI tax will simply be referred to as labor tax. Note that the VAT is different between sectors, while CSI tax is not. VAT is modeled as an output tax on establishments. In the model, output can be used for consumption or investment; however, the VAT base in the tax law applies only to consumption. Therefore, to capture this feature, investment spending is subsidized in the model at some rate $s_t \in [0, 1)$.

In this model, the tax authorities are unable to enforce the payment of taxes which, in turn, incentives firms to evade them. Own-account workers face a zero probability of being detected and, therefore, evade all taxes, resulting in zero distortion on their production decisions. The rationale is that their scale of production is small and, therefore places a burden on tax authorities to monitor their activities.

Employers on the other hand, may potentially be detected. Two tax enforcement institutions are referred to in this scenario: Mexico's Social Security Institute (Instituto Mexicano de Seguro Social, or IMSS) and its revenue service, Servicio de Administración Tributaria (SAT). IMSS enforces labor taxes, while SAT enforces VAT. The two institutions differ in terms of their respective tax collection efficiency, which influences the trade-off between labor tax and VAT.

Employers can reduce their tax labor burden by hiring informal wage labor (l_I) at the wage rate w_I. IMSS audits employers with probability q_l, and imposes a fine, proportional to the amount evaded, $\sigma_l \tau_l w_I l_I$, with $\sigma_l > 0$. On the other hand, employers can opt to evade all VAT. SAT audits employers with probability q_y, and imposes a fine, proportional to the amount evaded $\sigma_y \tau_y y$, with $\sigma_y > 0$.

Included in the model is the configuration of conditional transfers in Mexico. It is assumed that informal employees, own-account workers, and employers receive social protection transfers T_I, while formal employees receive social security transfers T_F. Additionally, a lump-sum transfer T is allowed, in order to keep the government budget in balance.

4.2 Individual Earnings

If an individual is a formal employee, the earnings consist of a wage and the corresponding transfer $w_F + T_F$. On the other hand, if an employee is in the informal sector, the individual receives $w_I + T_I$. An own-account worker in sector j makes profits according to:

$$\pi_o(w_I, r, p_j, z_j) = \max_{l,k}\{p_j A_{oj} {z_j}^{1-\gamma}\big(f(k,l)\big)^{\gamma} - rk + w_I(\kappa - l)\}, \qquad (3)$$

with the restriction $0 \leq l \leq \kappa \leq 1$. Own-account workers receive the rents from their firms, plus the return to labor not used in their own productive units, and offered to the market $(\kappa - l)$. To keep in mind is the fact that, although not shown, these workers also receive the social protection transfer T_I. For further reference, let

$\Big(l_o(w_I\ , r\ \ , p_j\ , z_j), k_o(w_I\ , r\ \ , p_j\ , z_j)\Big)$ be the optimal input choices of own-account workers.[5]

Employers receive the rents from operating a firm, plus a transfer (not shown). As mentioned above, they face two evasion decisions: evade VAT or not and the number of formal and informal employees to hire. The problem of sector j's employer is to maximize expected profits:

$$\pi(w_I, w_F, r, p_j, z_j) = \max_{l_I, l_F, k}\{(1 - q_y\sigma_y\tau_y)p_j {z_j}^{1-\gamma}\big(f(k, l_I + l_F)\big)^{\gamma} - [1 + \tau_l]w_F l_F$$
$$-[1 + q_l\sigma_l\tau_l]w_I l_I - rk\} \qquad (4)$$

There will be VAT evasion as long as $q_y\sigma_y < 1$, and there will be labor tax evasion as long as $[1 + q_l\sigma_l\tau_l]w_I \leq [1 + \tau_l]w_F$. Therefore, in order to obtain a non-degenerated distribution of informal labor across establishments in equilibrium, the probability q_l will be assumed to be an increasing function of both the ability and the amount of informal workers hired: $q_l(l_I, z_j)$. In general, a full-time manager (employer) will demand both formal and informal workers. However, the functional form for $q_l(l_I, z_j)$ guarantees that a manager with higher ability z_j will demand relatively more formal workers, due to the increased probability of being detected by the authorities.

The probability of the ability of the Mexican IRS to increase its audits is also assumed: $q_y(z_j)$. Therefore, firms with a larger entrepreneurial ability face a higher and non-decreasing

[5] In order to avoid notation cluttering, a sub-index j is not used in the notation for the optimal choices. The argument in input choices z_j indicates both the establishment and the sector.

probability of being detected. This ensures that the VAT evaders will center on small establishments.

For further reference, let $\tau = (\tau_y, \tau_l, T_F, T_I)$ be the vector that summarizes the tax and transfer system, and $\left(l(\tau, w_F, w_I, r, p_j, z_j), k(\tau, w_F, w_I, r, p_j, z_j)\right)$ be the optimal decisions of full-time entrepreneurs. It may be shown that the labor demand function depends negatively on CSI and VAT.

4.3 Household Problem

As mentioned above, an economy is considered with two goods indexed by $j = 1,2$, where Good 2 is the numeraire. The representative household lives forever. It derives utility from the consumption of each goods $j \in \{1,2\}$, C_j. Lifetime utility is represented by

$$\sum_{t=0}^{\infty} \beta^t u(C_{1t}, C_{2t}), \tag{5}$$

where $\beta \in (0,1)$ is the discount factor. The utility function $u(C_{1t}, C_{2t})$ is increasing in both arguments, twice continuously differentiable and concave. In addition, the household is endowed with an initial capital stock K_0, with an income of rental payments $r_t K_t$ in each period from firms. To simplify, it is assumed that Good 1 is non-storable. In contrast, Good 2 may be either consumed or invested. Capital depreciates at a constant rate $\delta \in (0,1)$. Letting I_t denote gross investment, the law of motion of capital can, thus, be written as:

$$K_{t+1} = I_t + (1 - \delta)K_t. \tag{6}$$

The representative household in this economy must choose sequences of consumption and capital, as well as an occupation for each member, in order to maximize total income in each period. The household must also select the formality status of employees. This last choice with $\eta \in (0,1)$ represents the fraction of formal employees; the remaining fraction $1 - \eta$ corresponds to informal employees.

If a household member becomes an employee, he/she receives the wage rate, plus the corresponding transfer (either T_F or T_I). This income should be compared with the after-transfer expected earnings from being an own-account worker, or an employer. The occupational choice problem just described endogenously yields two thresholds for the entrepreneurial ability z in each sector j, denoted as $\hat{z}_{1j}$ and $\hat{z}_{2j}$. The optimizing conditions defining these thresholds are specified further below. Thus, an individual will be an employee if his/her ability z_j is such that

$z_j \in [\underline{z}_j, \hat{z}_{1j})$, suggesting that the earnings from being either an own-account worker, or an employer, are lower than those from wage labor. In contrast, individuals with ability $z_j \in [\hat{z}_{1j}, \hat{z}_{2j})$ become own-account workers, since the income derived from such a case is higher than the income from the other two alternatives. Finally, full-time entrepreneurs are those whose ability is such that $z_j \in [\hat{z}_{2j}, \overline{z}_j]$. These two thresholds are unique because the profit functions $\pi(\cdot, z_j)$ and $\pi_o(\cdot, z_j)$ are sharply increasing in entrepreneurial ability z_j.

Given the discussion above, the budget constraint of the household is as follows:

$$p_{1t}C_{1t} + C_{2t} + (1 - s_t)I_t = T_t + r_t K_t + \sum_{j\in\{1,2\}} \left\{ \int_{\underline{z}_j}^{\hat{z}_{1jt}} [\eta_t (w_{Ft} + T_{Ft}) + (1 - \eta_t)(w_{It} + T_{It})]\, dG(z_j) + \int_{\hat{z}_{1jt}}^{\hat{z}_{2jt}} [\pi_o(w_{It}, r_t, p_{jt}, z_j) + T_{It}] dG(z_j) + \int_{\hat{z}_{2jt}}^{\overline{z}_{jt}} [\pi(w_{It}, w_{Ft}, r_t, p_{jt}, z_{jt}) + T_{It}] dG(z_j) \right\}. \quad (7)$$

4.4 First-order Conditions

The first-order condition with respect to η suggests that the household arbitrages so that employees are indifferent towards allocating labor to formal or informal activities according to:

$$w_{Ft} + T_{Ft} = w_{It} + T_{It}. \quad (8)$$

The equation above resembles a free-labor mobility condition across formal and informal sectors. It also implies that formal and informal wages will differ as long as $T_I \neq T_F$, which depends, in turn, on the fiscal-cum-social policy structure for social insurance, as well as on how each type of worker values such benefits (see below for more details). Note that the fraction η will be undetermined in the household problem. This means that the fraction of informal employees will be entirely determined by the demand side (firms) in equilibrium.

The first-order condition with respect to $\hat{z}_{1jt}$ shows that a household member will be indifferent to being an employee or an own-account worker:

$$w_{It} = \pi_o(\cdot, \hat{z}_{1jt}), j = 1,2. \quad (9)$$

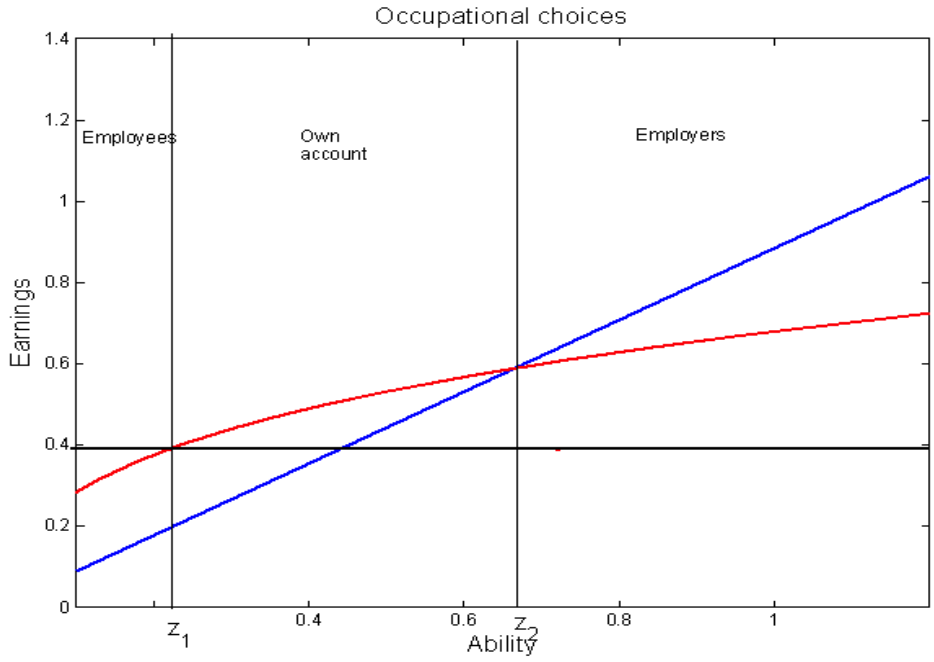
Given that the profit function π_o is strictly increasing in the ability level z_j, equation (9) uniquely defines the threshold level $\hat{z}_{1jt}$.

One member will also be indifferent to being own-account or employer. Threshold level $\hat{z}_{2jt}$ satisfies:

$$\pi_o(\cdot, \hat{z}_{2jt}) = \pi(\cdot, \hat{z}_{2jt}), j = 1,2. \quad (10)$$

Figure 1 presents the earnings profile of each type of worker in sector j. The threshold levels $\hat{z}_{1jt}$ and $\hat{z}_{2jt}$ correspond to the optimality conditions (9) and (10).

Figure 1. Earnings Per Type of Worker in Sector *j*



Source: Authors' elaboration.

Finally, neither the Euler equation, nor the optimality condition for relative consumption is directly affected by tax policy vector τ. However, the Euler equation is affected by the subsidy rate s:

$$\frac{u_2(C_{1t},C_{2t})}{\beta u_2(C_{1t+1},C_{2t+1})} = \frac{(1-\delta)(1-s_{t+1})+r_{t+1}}{1-s_t}, \quad (11)$$

$$\frac{u_1(C_{1t},C_{2t})}{u_2(C_{1t},C_{2t})} = p_{1t}, \quad (12)$$

where $u_x(C_{1t}, C_{2t})$ denotes the derivative with respect to the x-th argument.

4.5 Government

Government budget balance is required:

$$(mass_F)T_F + (mass_I)T_I + (1)T = R_{IMSS} + R_{VAT}. \quad (13)$$

In the equation above, $mass_F$ and $mass_I$ correspond to the total mass of recipients of each transfer. Only formal employees receive the T_F transfer, while informal employees, own-account workers, and employers receive the T_I transfer. Additionally, there is a lump-sum transfer to the representative household that captures all resources not spent on social policies.

In expression (13), R_{VAT} is revenue from VAT, and R_{IMSS} is revenue from CSI tax. Not all firms pay VAT; thus, revenue comes from a set of large firms in equilibrium. Also, it is assumed that social security services are not fully valued. Thus, the per-capita transfer to formal employees will be less than the cost of producing such services: $T_F < \tau_l w_F$. A similar assumption for informal transfers is made.

4.6 Workers' Valuation of Social Transfers

If a household member allocates labor to formal activities, the individual is paid the formal wage w_F and receives CSI benefits T_F that cost $\tau_l w_F$. The value these workers give to such benefits is captured by the parameter $\beta_F \in [0,1]$ and $T_F = \beta_F \tau_l w_F$.[6] The wage rate after transfers is, thus, given by $w_F + T_F = w_F(1 + \beta_F \tau_l)$. The difference between what firms pay per formal worker, $w_F(1 + \tau_l)$, and the benefits received, $w_F(1 + \beta_F \tau_l)$ is, in fact, a "pure tax" (see, for example, Auerbach and Kotlikoff, 1987; Feldstein and Samwick, 1998).

Following Levy (2008) and AHL (2012), it is also assumed that informal workers do not value fully the benefits they obtain from social insurance. These workers are paid the informal wage w_I and receive a lump-sum NCSI benefit. Let $\beta_I \in [0,1]$ capture the value such workers give to NCSI, and τ_{NCSI} the amount the government spends on social insurance per informal worker. Accordingly, the wage rate after transfer is just $w_I + T_I = w_I + \beta_I \tau_{NCSI}$.

The introduction of conditional transfers and workers' incomplete valuation of transfers generates a discrepancy between the cost of informal labor and that of formal labor to firms. The reason for this is that, from the firm's point of view, the marginal cost of an informal employee is $[1 + q_l \sigma_l \tau_l] w_I$ and the marginal cost of a formal employee is $w_F(1 + \tau_l)$. Particularly, for small

[6] Full and null valuation of CSI benefits is represented by $\beta_F = 1$ and $\beta_F = 0$, respectively.

firms, the marginal cost of an informal employee is only w_I because the probability of being detected is close to zero. Second, because of the free mobility condition $w_F + T_F = w_I + T_I \Leftrightarrow w_I = w_F + T_F - T_I$, therefore, $w_I < w_F + T_F$ because T_I is positive. Furthermore, given that workers do not value social security fully, $w_I < w_F + T_F = w_F(1 + \beta_F \tau_l) < w_F(1 + \tau_l)$. This suggests that the cost of informal labor is lower than the cost of formal labor in small firms. The key elements that lead to the existence of the informal sector are this feature in the model, as well as the lack of enforcement to pay taxes ($q < 1$).

4.7 Equilibrium

Market-clearing conditions for the labor, capital, and goods markets are characterized for an equilibrium definition. In terms of equilibrium in the labor market, N_t^* denotes aggregate labor supply, where an $(*)$ over a variable denotes its equilibrium value. Ignoring time subscripts, labor supply is given by:

$$N^* \equiv \sum_j G(\hat{z}_{1j}^*) + \int_{\hat{z}_{1j}^*}^{\hat{z}_{2j}^*} [\kappa - l_o(w_F^*, r^*, p_1^*, z_j)] g_j(z_j) dz_j. \quad (14)$$

The first term on the right side of (14) is the mass of employees, whereas the second term is labor supplied by own-account workers. Here, the optimality condition (8) is used to express the informal wage rate in terms of w_F.

Equilibrium in the labor market, thus, may be written as

$$N^* = \sum_j \left\{ \int_{\hat{z}_{1j}^*}^{\hat{z}_{2j}^*} l_o(w_F^*, r^*, p_1^*, z_j) g_j(z_j) dz_j \right.$$
$$\left. + \int_{\hat{z}_{2j}^*}^{\overline{z}_j} l(\tau, w_F^*, r^*, p_1^*, z_j) g_j(z_j)\, dz_j \right\}. \quad (15)$$

In expression (15), the first and second terms on the right side represent labor demand from the own-account and full-time entrepreneurs, respectively, for each sector j.

In a similar manner, market clearing in the market for capital services may be written as

$$K^* = \sum_j \left\{ \int_{\hat{z}_{1j}^*}^{\hat{z}_{2j}^*} k_o(w_F^*, r^*, p_1^*, z_j) g_j(z_j) dz_j \right.$$
$$\left. + \int_{\hat{z}_{2j}^*}^{\overline{z}_j} k(\tau, w_F^*, r^*, p_1^*, z_j) g_j(z_j)\, dz_j \right\}. \quad (16)$$

Finally, the resource constraint yields the equilibrium condition in the goods market:

$$p_1^* C_1^* + C_2^* + I^* = p_1^* Y_1(w_F^*, r^*, p_1^*) + Y_2(\tau, w_F^*, r^*, p_1^*), \quad (17)$$

where

$$Y_j(\tau, w_F^*, r^*, p_1^*) \equiv \int_{\hat{z}_{1j}^*}^{\hat{z}_{2j}^*} y_o(\cdot, z_j) g_j(z_j) dz_j + \int_{\hat{z}_{2j}^*}^{\overline{z}_j} y(\cdot, z_j) g_j(z_j) dz_j \quad (18)$$

is total output in sector j.

After substituting equation (14) into (15), this new expression, along with (16) and (17), define a three-equation system that solve for the set of prices $\{w_F^*, r^*, p_1^*\}$, given the tax/subsidy policy vector τ and density functions for managerial ability in each sector j.

Formally, a competitive equilibrium is a sequence of quantities $\{C_{jt}^*, K_{t+1}^*\}_{t=0}^{\infty}$ and thresholds $\{\hat{z}_{1jt}^*, \hat{z}_{2jt}^*\}_{t=0}^{\infty}$, for $j = 1,2$; prices $\{w_{Ft}^*, w_{It}^*, r_t^*, p_{1t}^*\}_{t=0}^{\infty}$, and invariant tax/transfer policy $\tau = (\tau_y, \tau_l, T_F, T_I)$, such that:

(i) given prices $\{w_{Ft}^*, w_{It}^*, r_t^*, p_{1t}^*\}_{t=0}^{\infty}$ and the tax policy vector τ, the quantities $\{C_{jt}^*, K_{t+1}^*\}_{t=0}^{\infty}$ and thresholds $\{\hat{z}_{1jt}^*, \hat{z}_{2jt}^*\}_{t=0}^{\infty}$ for $j = 1,2$, solve the household's and firm's problems;

(ii) the labor market clears for all t (equations (14) – (15) hold); and

(iii) the goods market clears for all t (equation (17) holds).

4.8 Productivity Measures

Alternative productivity measures are considered in the results. The first is to average output per employee in sector j, which is defined by

$$\frac{Y_j(\tau, w_F^*, r^*, p_1^*)}{G_j(\hat{z}_{1j}^*)}. \quad (19)$$

Output per establishment, output per full-time manager, and average entrepreneurial and managerial ability are denoted, respectively, as

$$\frac{Y_j(\tau, w_F^*, r^*, p_1^*)}{\int_{\hat{z}_{1j}^*}^{\hat{z}_{2j}^*} g_j(z_j) dz_j + \int_{\hat{z}_{2j}^*}^{\overline{z}_j} g_j(z_j) dz_j}, \quad (20)$$

$$\frac{\int_{\hat{z}_{2j}^*}^{\overline{z}_j} y(\cdot, z_j) g_j(z_j) dz_j}{\int_{\hat{z}_{2j}^*}^{\overline{z}_j} g_j(z_j) dz_j}, \quad (21)$$

$$\frac{\int_{\hat{z}_{1j}^*}^{\overline{z}_j} z_j g_j(z_j) dz_j}{\int_{\hat{z}_{1j}^*}^{\overline{z}_j} g_j(z_j) dz_j}, \quad (22)$$

and

$$\frac{\int_{\hat{z}_{2j}^*}^{\bar{z}_j} z_j g_j(z_j) dz_j}{\int_{\hat{z}_{2j}^*}^{\bar{z}_j} g_j(z_j) dz_j}. \quad (23)$$

Finally, measured total factor productivity (TFP) in sector j is computed as

$$TFP_j = \frac{Y_j^*}{K_j^{*(1-\alpha)\gamma} N_j^{\alpha\gamma}}, \quad (24)$$

where N_j is the exogenous mass of labor force in sector j.

4.9 Universal Social Insurance plus VAT Reform

This section will discuss how the model needs to be adjusted for the universal social insurance (USI) scenario, and how the optimality conditions of both firms and households are affected. The USI proposal, in this case, is to eliminate the dual SI scheme of taxes and transfers, and to replace it with a uniform, lump-sum per-capita transfer τ_{USI} to all workers, regardless of their status, so that SI spending remains constant. To finance USI, VAT rates are increased in order to raise the lost revenue from the CSI taxes.

The lump-sum nature of the transfer τ_{USI} and the elimination of taxes and subsidies to social insurance ($\tau_l = \tau_{NCSI} = 0 \Leftrightarrow T_F = T_I = 0$) suggest that the distortion, currently in place in labor markets, disappears. First, since social insurance policy is the same regardless of labor status, the optimality condition (8) is now:

$$w_{Ft} = w_{It} = w_t. \quad (25)$$

Second, full-time managers do not have to opt to hire either a formal or informal worker. In fact, and according to the definition of informality previously provided, the figure of informal worker no longer holds.

Nonetheless, full-time entrepreneurs remain with the incentive to evade VAT under USI. Their profits may be thus written as:[7]

$$\pi(w, r, p_j, z_j) = \max_{l,k}\{(1 - q_y\sigma\tau_y)p_j {z_j}^{1-\gamma}\big(f(k,l)\big)^{\gamma} - wl - rk\}. \quad (26)$$

The optimal capital-labor ratio, in this case, is given by

$$\frac{k}{l} = \frac{(1-\alpha)w}{\alpha r}. \quad (27)$$

[7] Regarding own-account workers, USI does not directly affect the maximization problem, as these workers do not pay any taxes, by assumption. Thus, equation (3) still holds.

Interestingly, this is exactly the same capital-labor ratio as that for the own-account workers. Thus USI also eliminates the distortion in the capital-labor ratio across establishment types.

Let $\beta_{USI} \in [0,1]$ denote the valuation of USI services by workers. Given that USI is extended to all workers, and such mass is normalized to one, total USI spending by the government is, simply, τ_{USI}, and transfers are given by $T_{USI} = \beta_{USI}\tau_{USI}$. The corresponding budget constraint may be now written as

$$T + T_{USI} = R_{VAT}. \tag{28}$$

5. Calibration

The model is calibrated to match key features in the Mexican data. In order to estimate the aggregate effects of the tax/transfer reform, AHL (2012) is followed, and 2008 is taken as the reference year in the model.

5.1 Dataset

The first issue is to select the dataset to be used for calibration. One important aspect of this model is that it exhibits heterogeneity at the establishment level. There is no data set that includes all establishments in Mexico. However, the 2009 Economic Census captures a significant share of them. The census excludes most one-person firms and any kind of establishment that is not permanently stick to the ground. It also excludes the agriculture sector. One way to measure the coverage of the census is to assess total employment, and compare it to employment data captured by household surveys. The census includes around 21 million workers in the private sector, while the ENOE reports approximately 39 million in 2008, a ratio of 0.54.[8] Similarly, value added in the census is around 40 percent of Mexican gross domestic product (GDP).

Another important aspect of this model relates to one-person establishments or own-account workers. These workers are under-represented in the census, as a large fraction of them do not perform their activities in fixed establishments. For this reason, information from ENOE is used to determine the number of own-account people who do not work in fixed establishments. This figure is aggregated to the data from the 2009 Economic Census. Overall, the data includes

[8] Public sector workers are excluded from the analysis, since the proposed fiscal reform does not take into account these workers. See AHL (2012) for a discussion.

around 25 million workers, who work in establishments that generated a value added equivalent to 43 percent of GDP in 2008. Employment data is presented in Table 4. Note that the allocation of employment in Sectors 1 and 2 are also reported, according to the data.

Table 4. Our Data: Census + ENOE Own-Account Employment, 2008

Workers per establishment	Total	Sector 1	Sector 2
1 to 5	11,912,179	3,717,851	8,194,328
6 to 20	3,007,458	695,037	2,312,421
21 to 50	1,714,635	443,016	1,271,619
51 to 100	1,312,888	339,381	973,507
100+	7,310,837	1,264,621	6,046,216
Total	25,257,997	6,459,906	18,798,091

Source: Economic Census 2009 and ENOE (2008).

A stand needs to be taken regarding VAT revenue. It is believed that most revenue is derived from taxes paid by the establishments captured in the census. VAT revenue represents 8.7 percent of the value added and 3.77 percent of aggregate GDP in the data. Similarly, CSI tax represents 4.3 percent of the value added and 2.3 percent of overall GDP.

5.2 Explicit Functions

What follows is the choice of explicit functions in this model. It is assumed that the utility function $u(C_{1t}, C_{2t})$ satisfies the particular constant elasticity of substitution (CES) form:

$$u(C_{1t}, C_{2t}) = [\nu {C_{1t}}^{\varphi} + (1-\nu){C_{2t}}^{\varphi}]^{1/\varphi}. \quad (29)$$

Here, $\nu \in (0,1)$ is the weight of goods C_1 in the consumption composite, and $1/(1-\varphi)$ is the elasticity of substitution between consumption goods, with $\varphi < 1$. There is no indication of an estimate of the degree of substitution between the goods associated to the taxed and untaxed sectors, but it is believed that the degree of substitution should not be high, given that Sector 1 includes food. The parameter φ is set to zero, which implies the Cobb-Douglas case in equation (29).

A choice should also be made with regard to the distribution of entrepreneurial ability in each sector, assuming for each sector that this ability follows a truncated Pareto distribution of the form

$$G(z_j) = \frac{1-\left(\frac{z_{j,min}}{z_j}\right)^{S_j}}{1-\left(\frac{z_{j,min}}{z_{j,max}}\right)^{S_j}}, \tag{30}$$

where $S_j > 0$ is a shape parameter, associated to the distribution in sector j. Following Leal (2013), $z_{j,min} \equiv \underline{z}_j$ and $z_{j,max} \equiv \overline{z}_j$ is set for each j.

To simplify, the functional forms for the probability of detection in VAT and CSI tax are linear in the ability level z_j. This suggests setting $q_y(z_j) = \overline{\lambda}_j^{VAT} z_j$ and $q_l(L_I, z_j) = \overline{\lambda}_j^{CSI} L_I z_j$, where $\overline{\lambda}_j^{VAT}$ and $\overline{\lambda}_j^{CSI}$ are parameters to be calibrated. In the calibration exercise below, it is assumed that these parameters are the same across sectors, so that $\overline{\lambda}_1^{VAT} = \overline{\lambda}_2^{VAT}$ and $\overline{\lambda}_1^{CSI} = \overline{\lambda}_2^{CSI}$.

5.3 Parameter Values

The parameters required for the calibration of the model include those associated with preferences, technology, enforcement, and distribution of abilities. The parameters are divided into two groups: Group 1 includes all the parameters that can be calibrated independently, while Group 2 includes those that are calibrated jointly. That is, given the value of the parameters in Group 1, the steady-state equilibrium and the value of the parameters in Group 2 are sought, in order to match a set of relevant moments in the Mexican data (see below).

With regard to Group 1, the parameters relating to taxation and transfers are considered first. As Sector 1 represents the "non-taxed" sector of the economy, $\tau_{y1} = 0$ is set. Sector 2 represents the "taxed" sector of the economy and, in 2008, the statutory tax rate on such goods was 15 percent. Therefore, τ_{y2} is set to 0.15.[9] According to Mexican law, the government subsidizes a fraction of the CSI tax τ_l. Let θ denote such fraction. Hence $\tau_l \equiv (1-\theta)\tilde{\tau}_l$, where $\tilde{\tau}_l$ is the gross (i.e., before-subsidy) CSI tax. Based on evidence by Levy (2008), the tax rate on social security contributions $\tilde{\tau}_l$ 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

[9] 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 τ_{y2} at 15 percent. Starting in 2010, the tax rate on taxable items was raised to 16 and 11 percent for non-border and border states, respectively.

contributions. Accordingly, θ is fixed at 0.16. As for the subsidy rate s_t, it is assumed that it is equal to the equilibrium VAT revenue/GDP ratio.

Based on the estimates of Levy (2008), the penalty φ, imposed by the authorities if a firm is found to be evading CSI tax, is set at 150 percent of unpaid contributions. This suggests $\sigma_l = 1.5$. In the case of VAT, the penalty imposed varies considerably, according to Mexico's Federal Fiscal Code. In general, penalties can range between 150 and 170 percent of the amount evaded, but may increase with a payment delay or in the event that there is a previous record of non-compliance. Moreover, the percentage of the penalty could decrease, if paid promptly. Other penalties can occur, which are paid in absolute terms (not in proportion to the amount evaded). Given this complexity, the penalties are simply set at 150 percent of the amount evaded, suggesting $\sigma_y = 1.5$. Taking the estimates from Levy (2008), the parameters related to the valuation of CSI and NCSI services, β_F and β_I are fixed to 0.3 and 0.85, respectively.

The mass of employment in the economy is normalized to 1, and that in Sector 1 is set to 0.256 as per the data. $\kappa = 0.4$ is set, following Gollin (2008); this implies that own-account workers allocate 40 percent of their available time to entrepreneurial abilities. A capital share value of 0.33 is established, which is consistent with the results relating to Mexico (as reported by García-Verdú, 2005), and is a standard value in the models with heterogeneous plants (Restuccia and Rogerson, 2008; Guner, Ventura, and Xu, 2009). In the model in the current Working Paper, the capital share is given by $(1-\alpha)\gamma$. Given a value for γ, α is fixed so that $(1-\alpha)\gamma$ is equal to 0.33.

The depreciation rate δ is set at 0.05, which is well within the values typically used in the literature. The discount factor β is fixed at 0.935, so that the steady-state rate of return (net of depreciation and subsidies) is 7 percent. This rate of return is slightly higher than the 6.5 percent rate for Mexico, used by Mendoza and Smith (2006).

The values of the parameters in Group 2 are selected jointly in the following way. Given the value of Group 1 parameters, the steady-state is solved numerically and set their values in order to match some key features of the Mexican economy. The parameters in this group include the following: γ, ν, $\overline{\lambda}_1^{VAT}$, $\overline{\lambda}_1^{CSI}$, τ^{NCSI}, $A_{o,1}$, $A_{o,2}$, $\bar{z}_1$, $\bar{z}_2$, S_1, S_2. The sequences matched are presented in Table 5 below.

Table 5. Moments to Match

1.	Mean size of establishments in each sector
2.	Fraction of employment in establishments with more than 100 workers in sector 2
3.	Mean size of establishments in firms with more than 100 workers in each sector
4.	Share of own-account workers in each sector
5.	Share of informal salaried workers
6.	VAT revenue as a fraction of value added in our data
7.	Potential VAT revenue in terms of GDP*
8.	Relative NCSI to CSI transfer per worker

*Potential VAT revenue assumes that all establishments (including the own-account) in sector 2 pay the VAT fully.

Source: Authors' elaboration.

The data and results of this calibration strategy are presented in the second and third columns of Table 6. In general, the model is able to replicate the data relatively well, especially those moments sequences not related to the distribution of labor. In fact, once the distribution for managerial ability is established, the parameter of the probability of being detected evading VAT, $q_y(z_j)$ can be calibrated, so that government revenue out of VAT matches the data. Similarly, the parameter in the probability of being detected evading the CSI tax $q_l(L_{i,j}, z_j)$ can be selected, so that the share of informally salaried workers is equal to the data.

Table 6. Comparing Moments in the Model and the Data

Moment	Data	Model
Establishment size and employment distributions		
Mean size sector 1	5.4	5.1
Mean size sector 2	9.0	9.6
Employment share 100+ in sector 2	0.43	0.40
Mean size 100+ sector 1	301	308
Mean size 100+ sector 2	411	410
Informality		
Share of own-account in sector 1	0.26	0.26
Share of own-account in sector 2	0.25	0.25
Share of informal salaried workers	0.39	0.39
Other Aggregates		
VAT Revenue / Y	0.087	0.087
Potential VAT Revenue/Y	0.103	0.103
Ratio of NCSI/CSI subsidies per worker	1.12	1.12

Notes: Mean size is the average number of workers per establishment; employment share 100+ in sector 2 is the fraction of workers in that sector performing activities in establishments with more than 100 workers; the share of own-account in sector j is the fraction of own-account workers in that sector; Y is aggregate output. Potential VAT revenue assumes that all establishments (including the own-account) in sector 2 pay the VAT fully.

Source: Economic Census 2009, ENOE (2008) and authors' calculations.

The value of parameters required to replicate these sequences is presented in Table 7. The parameters that are most closely related to employment size distribution are γ, $\bar{z}_1$, $\bar{z}_2$, S_1 and S_2, while those most related to own-account employment shares are $A_{o,1}$ and $A_{o,2}$. Similarly, the share of informally salaried workers is closely related to τ_{NCSI} and $\overline{\lambda}_1^{CSI}$; the VAT revenue relates directly to $\overline{\lambda}_1^{VAT}$, and the potential VAT revenue out of Sector 2 to ν.

Table 7. Parameter Calibration

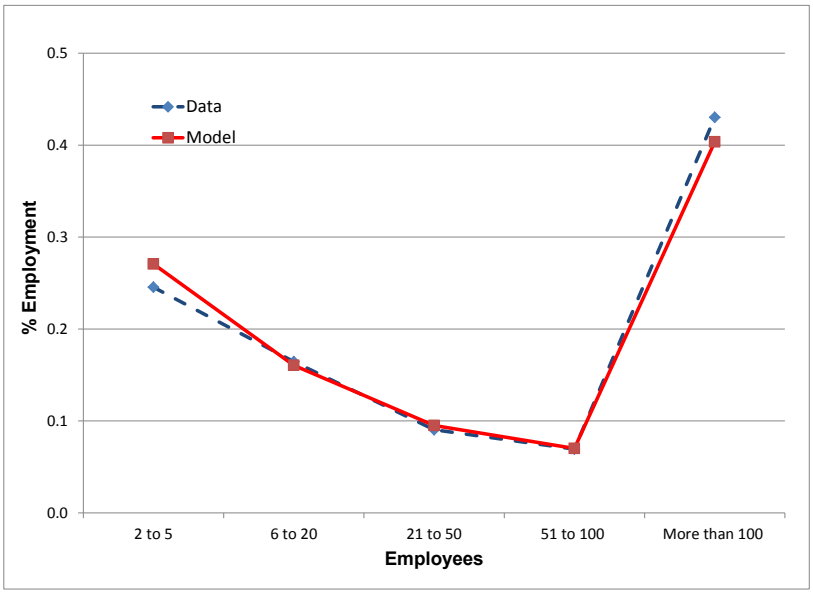
Parameter	Calibrated value
γ	0.71
ν	0.207
$\bar{\Theta}_1^{VAT}$	0.16
$\bar{\Theta}_1^{CSI}$	0.0035
Π^{NCSI}	0.03
$A_{o,1}$	1.04
$A_{o,2}$	1.10
$\bar{z}_1$	5143
$\bar{z}_2$	7215
S_1	1.37
S_2	0.995

Source: Authors' calculations.

Given these parameter values, the question of whether the model can replicate other moments not targeted in the calibration exercise arises. In particular, the model is used to calculate the employment share distribution in taxed and non-taxed sectors for establishments with two or more workers (i.e., excluding the own-account sector). These employment shares are then compared to the data.

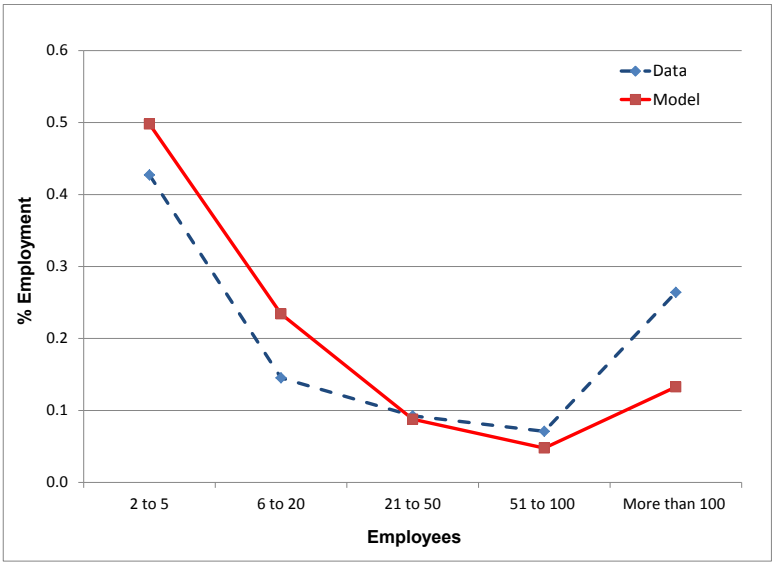
The results are illustrated in Figures 2A and 2B. First, the distribution of employment between sectors is substantially different. Whereas 43 percent of employment concentrates in establishments of more than 100 workers in the taxed sector, only 26 percent of them are allocated to the non-taxed sector. As expected, the model replicates the distribution of employment in the taxed sector, given the moments targeted, according to Table 5. Second, the model replicates relatively well the entire distribution in the non-taxed sector, although it under-estimates the employment share for firms with more than 100 employees. This result could well relate to the restriction imposed, where both sectors share the same "span-of-control" parameter γ, which is important for the allocation of resources across establishments.

Figure 2A. Employment Shares in the Taxed Sector



Source: Economic Census 2009 and authors' calculations.

Figure 2B. Employment Shares in the Non-Taxed Sector



Source: Economic Census 2009 and authors' calculations.

6. Results

This section includes the results of the study, focusing on the aggregate effects caused by a change in the tax and transfer structure. An initial analysis is made of the effects of introducing the key features of the fiscal-cum social policy proposal, discussed above. In the model, this reform consists of homogenizing VAT rates across Sectors 1 and 2, so that the reform is revenue-neutral; setting payroll taxes and subsidies to zero; and homogenizing social insurance transfers across occupations. This exercise will be referred to as Reform 1.

The same steps will apply for the second analysis, Reform 2, except for the VAT rates; in particular, the VAT rate in Sector 1 is maintained at its benchmark value of zero, whereas τ_{y2} is increased, in order to raise the same revenue as previously. In these two analyses, the benchmark will be the calibrated economy, referred to in the previous section, with the value of aggregate variables, associated to the reforms, relative to their benchmark values.

6.1 Revenue-neutral Reform with Uniform VAT Rates (Reform 1)

Here, Reform 1 referred to above, will be maintained and a uniform VAT rate will be selected, so that government revenue at the new steady-state level is the same as that in the benchmark. This sugests setting a VAT rate in each sector of 18.6 percent.[10] The goal of this exercise is to compare the aggregate effects of alternative ways to collect and spend the same amount of resources. The results are shown in the second column of Table 8.

[10] An important word of caution applies here. In their quantitative analysis, AHL (2012) find that the fiscal-cum-social policy reform is financially sound, in the sense that net government revenue increases under a reform with uniform VAT rates set at 16 percent. In their model, the presence of "chain effects," à la de Paula and Scheinkman (2010), has a substantial effect on the increase of VAT revenue, as a higher VAT rate of compliance in the intermediate sector translates into a higher compliance rate in the final sector. In this case, there is no intermediate-final sector model; therefore, chain effects are missing. This explains why a higher VAT rate is needed to raise revenue.

Table 8. Aggregate Effects of Alternative Revenue-neutral VAT Reforms *(relative to benchmark)*

Variable	Uniform VAT rates plus USI	Zero VAT rate in sector 1 plus USI
	Main aggregates	
Y	1.032	1.006
K	1.032	1.006
Total factor productivity (TFP)	1.021	1.004
	Occupational choices	
Employee share	1.087	1.095
Own-account share	0.850	0.836
Full-time entrepreneur share	0.795	0.780
	Earnings	
Informal wage rate (w_I)	1.130	1.092
Formal wage rate (w_F)	1.193	1.153
Avg. earnings own-account	1.135	1.108
Avg. earnings entrepreneurs	1.126	1.117
	Revenue	
VAT revenue	1.49	1.49
CSI revenue	0	0
Total revenue	1.0	1.0
	VAT rates and price of sector 1	
Π_{y1}	0.186	0
Π_{y2}	0.186	0.218
p_1	1.051	0.970

Source: Authors' calculations.

Table 8 above shows that the reform establishes an increase in aggregate output and capital of 3.2 percent, relative to benchmark. The reallocation of resources leads to an increase in TFP of 2.1 percent. There is also a redistribution of labor across occupations. In particular, the share of employees in the economy increases by 8.7 percent, while the share of own-account workers and entrepreneurs decreases. The effect on real wages (before transfers) is also important: a 13-percent increase for informal workers and a 19-percent increase for formal workers.

The main driver of these effects is the large reduction in the CSI tax rate (from 0.38 to 0), which creates a substantial effect on the demand for salaried workers. The increase in the demand for employees is partially offset by an increase in the supply of employees; however, wages increase, despite the netting of these effects. On the other hand, however, the large increase in wages in the formal sector suggests that the incidence of CSI tax relies heavily on employees.

Consistent with the change in occupational choice, the thresholds $\hat{z}_{1j}$ and $\hat{z}_{2j}$, $j\epsilon\{1,2\}$, position themselves to the right. Therefore, average earnings for full-time entrepreneurs and own-account workers increase by 12.6 and 13.5 percent, respectively. However, the change in average earnings of full-time entrepreneurs is also affected by the new tax configuration. In fact, the impact differs across sectors, with a fall of 12.4 percent in Sector 1 employer earnings (not shown), as they now have to pay VAT; and an increase of 23 percent in Sector 2 employer earnings (not shown), because VAT is only slightly higher, while labor tax is now zero. In contrast, own-account earnings increase in both sectors because they are not affected by taxes. Nevertheless, those who most benefit from the reform in terms of earnings (before transfers) are the formally salaried workers. Section 6.5 herein shows that this conclusion is sensitive to the worker's valuation of transfers.

6.2 TFP Effects

There are several changes in the economy that lead to the gain in TFP. In general, TFP is affected by an improvement in the (i) allocation of resources across plants (due to the elimination of the CSI tax rate); (ii) allocation of resources across sectors (due to the homogenization of the VAT rate); and (iii) the occupational choices.

Regarding the allocation of resources across plants, the positive effects emanate from the elimination of idiosyncratic distortions that are associated with the way labor taxes are enforced. In the benchmark, some firms pay CSI tax, while others evade taxes by hiring informal labor; in contrast, under the reform, every establishment faces the same tax rate (zero). Thus, the allocation of resources improves.

The improved allocation of resources across sectors under the reform is a result of the equalization of VAT rates across sectors. The alignment of incentives is not perfect because,

subsequent to reform, there remains VAT evasion; nonetheless, there is a positive resource reallocation effect that passes from Sector 1 to Sector 2.[11]

Finally, the fact that TFP increases due to an improvement in occupational choice is derived from an increase in the share of employees and a decrease in the share of entrepreneurs, as presented in Table 8. The effects on aggregate output can be better understood, using the following equation:[12]

$$Y = (Q\mu)^{1-\gamma} K^{\theta_K} L^{\theta_L},$$

where Q is the mass of firms, μ is average entrepreneurial ability, K is aggregate capital, and L is aggregate labor (employees). Changes in occupational choice affect, simultaneously, Q, μ, and L. In fact, the reform increases labor demand (by reducing labor taxes) and wages, which shifts the equilibrium employee/entrepreneur threshold z_1 to the right. This has the following effects on the above three variables: Q decreases, μ increases, and L increases. Thus, the change in occupational choice has both positive and negative effects on output and productivity: it increases the average ability and the amount of employees, but it reduces the mass of firms.

These positive and negative effects tend to offset each other and, ultimately, a 2.1 percent increase in TFP is obtained. To illustrate this point, while the average entrepreneurial ability goes up by 17 percent, the mass of firms is reduced to a level that is 84 percent of benchmark. Thus, the value of the product $Q\mu$ remains at a level that is 2 percent below benchmark.[13]

This insignificant effect in TFP does not mean that the economy will not experience considerable changes under the reform. To put this result into perspective, some alternative measures of productivity are presented in Table 9.

[11] Also note that since the mass of employment is fixed in each sector, only capital is able to flow across sectors. Subsequent to reform, capital in Sector 1 decreases.

[12] This expression corresponds to the equilibrium value of aggregate output in a version of the model with only one sector, no own-account workers, and no idiosyncratic distortions.

[13] The numbers are only illustrative. A proper decomposition of aggregate output would include two sources of output: own-account and employer output.

Table 9. TFP and Productivity Measures

Variable	Value relative to benchmark
Measured TFP	1.02
Y per establishment	1.23
Y per own-account	1.13
Y per employer	1.31
Y per employee	0.95
Avg. entrepreneurial ability	1.17
Avg. managerial ability	1.26

Source: Authors' calculations.

This table illustrates that output per establishment increases by 23 percent, output per establishment managed by own-account workers increases by 13 percent, and output per establishment managed by employer's increases by 31 percent. This provides a clearer idea of the significant reallocation occurring in the economy after the reform. Also noticed is that output per employee is reduced by 6 percent because the mass of employees increases subsequent to the reform.

6.3 Revenue-neutral Reform with Differentiated VAT Rates (Reform 2)

An alternative revenue-neutral analysis consists of the following: to maintain the VAT rate in Sector 1 at zero and raise the VAT rate in Sector 2 to collect all lost revenue from the elimination of CSI tax. For this reform, a VAT rate of 21.8 percent is required. The results are presented in the last column of Table 8. Here, aggregate output and capital increase by 0.6 percent and TFP rises by only 0.4 percent. This suggests a five-fold difference in TFP effects between the previous and current revenue-neutral scenarios. The explanation for this is that under differentiated VAT rates, distortions are exacerbated, and capital optimally reallocates to the non-taxed sector, which is the least productive sector. Under this reform, capital in Sector 2 decreases; in contrast, under a uniform VAT rate scenario (Reform 1), capital in Sector 2 increases relative to benchmark, leading to an improved allocation of resources and, therefore, a higher TFP.

The share of employees increases as previously, although to a larger extent, relative to the uniform VAT rate scenario. This is due to the large redistribution of employees towards Sector 1: even though the CSI tax is eliminated in both sectors, labor demand is higher in Sector 1 for a given ability z_j, as labor demand depends inversely on the VAT rate. In particular, the share of employees in Sector 1 increases by 18 percent, which is well above the 4.5 percent increase under the uniform VAT rate scenario (not shown). This can also be expressed by stating that Reform 2 generates establishments that are too big in Sector 1, which demand substantial capital and too many employees.

Consistent with the low TFP, the increase in the wage rate for both formal and informal workers is lower, when compared to the previous scenario. The increase in average earnings is also lower for both the own-account workers and full-time entrepreneurs. Finally, the fact that the equilibrium price p_1 falls, relative to its benchmark value, is a natural result of the higher allocation of resources to Sector 1.[14]

6.4 Homogenizing VAT with no Changes in the Dual SI Scheme

In order to isolate the effects of homogenizing VAT, an analysis that consists of setting the VAT rate to 18.6 percent in both sectors is undertaken, while leaving the dual SI scheme in place. The argument is that this a relevant exercise, given the increase in spending by NCSI programs, over time, and the need for a steady source of funding. The exercise is divided into two parts, the first with uniform VAT rates and spending that remains constant on SI programs (Reform 3). This economy faces a higher tax burden by design. The second part assumes that the extra revenue, derived from uniform VAT rates, is expended entirely on non-contributory social programs (Reform 4).

[14] Of course, the change in p_1 is associated to the value of the elasticity of substitution between Sectors 1 and 2.

Table 10. Aggregate Effects of a VAT-Reform with no Change in the Dual Social Insurance Scheme *(relative to benchmark)*

Variable	Uniform VAT rates and dual SI	Uniform VAT rates, dual SI and higher NCSI spending
	Main aggregates	
Y	0.989	0.964
K	0.977	0.943
Total factor productivity (TFP)	0.996	0.982
	Occupational choices	
Employee share	0.929	0.850
Own-account share	1.161	1.346
Full-time entrepreneur share	1.061	1.110
	Earnings	
Informal wage rate (w_I)	0.983	0.930
Formal wage rate (w_F)	0.984	1.023
Avg. earnings own-account	0.989	0.942
Avg. earnings entrepreneurs	0.868	0.822
	Revenue	
VAT revenue	1.34	1.26
CSI revenue	0.87	0.79
Total revenue	1.18	1.11
	VAT rates and price of sector 1	
Π_{y1}	0.186	0.186
Π_{y2}	0.186	0.186
p_1	1.028	1.020

Source: Authors' calculations.

The results are presented in the second and third columns of Table 10. Reform 3 indicates that aggregate output, capital, and TFP drop, relative to benchmark. This result is expected, given that the tax burden is now higher. Interestingly, the fall in output, capital, and TFP is more significant if the extra revenue is allocated to informal workers (Reform 4). This finding reflects the fact that distortions in labor markets are exacerbated by increasing the relative price of formally salaried employees, which would occur under Reform 4. This result also suggests that a fiscal reform that increases VAT rates, but maintains the dual SI structure in place, has a negative effect on output and productivity.

In contrast, there is a large change in occupational choice that moves in a different direction, compared to Reform 1: the share of employees decreases, while the share of own-account and full-time entrepreneurs increase. Interestingly, the segment relating to own-account workers expands significantly as NCSI spending increases (Reform 4) -- and relatively more than full-time entrepreneurs. This suggests a reallocation of resources to the least productive activities, which decreases TFP. By comparing these outcomes to Reform 1, where SI taxes and subsidies are eliminated, results show that it is, in fact, the elimination of the dual SI tax/transfer policy, and its effects on occupational choices, that create a key impact on TFP gains.

Also noted is that a VAT-only reform can decrease wages (before transfers) for both formal and informal employees. To understand this, the demand for salaried workers is inversely dependent on the VAT rate taken into consideration. The increase in this tax lessens the demand for salaried workers, so that wages drop for a given mass of employees. In equilibrium, wages are even lower after taking into account the change in the share of employees. Earnings are also lower for both the own-account workers and entrepreneurs. However, the latter are the most affected, due to the higher VAT rates.

Table 10 also contains important implications for government revenue. The increase in VAT rates reallocates resources towards the own-account sector, which is not taxed by design. As a result, the share of formal employees decreases (not shown), so that CSI revenue falls by 13 percent if social spending is kept constant, and by 21 percent if NCSI spending increases. In net terms, total government revenue increases by 18 and 11 percent only, respectively, once the drop in CSI revenue is taken into account. These outcomes compare to the scenario where the dual SI scheme is replaced by USI (Reform 1) in Table 8. The USI structure generates the own-account sector as smaller, while simultaneously increasing both output and profits for full-time entrepreneurs, on average. These effects increase VAT revenue even further, from 34 percent in Table 10 to 49 percent in Table 8.[15] However, increasing NCSI transfers (Reform 4) erodes the tax base, so that VAT revenue actually falls relative to Reform 3. Thus, the incentive structure created by USI has a positive impact on VAT revenue, an effect that is missing in simple calculations of additional resources that could be collected under a fiscal reform with uniform VAT rates.

[15] A qualitatively similar result is reported in AHL (2012).

6.5 Assessing Distributional Effects

As already mentioned in the Introduction, a major concern of fiscal-cum-social reform policy is the negative impact that it may have on the poor, as they allocate a larger fraction of their income to food, medicine, and other items not currently taxed. On this issue, it should be kept in mind that the model does not explicitly include spending heterogeneity. Therefore, any effect on the poor, associated to a price increase in food, cannot be analyzed appropriately in this context. Nonetheless, this section provides an assessment of the potential distributional effects of reform.

The model provides some references on the effect of reform on the earnings of a representative employee. From the uniform VAT-rate scenario relating to Table 8, it is observed that real wage would increase between 13 and 19 percent after implementation of the reform. On the other hand, the same table shows that the price of Sector 1 goods will increase by 5 percent, given the reallocation of resources to Sector 2. With the representative employee receiving the informal wage rate and, at the same time, spending all his/her income on food (after taking into account the rise in prices, as a result of VAT), this worker would be left with an 8 percent rise in purchasing power. A formal employee, however, is shown to experience a higher increase in purchasing power.

Nonetheless, the discussion above excludes the change in SI transfers after reform, as well as the fact that workers may, indeed, have different valuations (namely, different values for β_F and β_I) of the SI services they receive. At the same time, the share of expenditures on goods not currently taxed varies widely across workers, in practice. Therefore, an analysis of how the purchasing power of workers may change along these three dimensions is required to better illustrate the potential distributional effects of reform.

To evaluate how the purchasing power of employees could be affected under alternative values of β_F and β_I, an examination is made on how formal and informal after-tax-and-transfer wage rates change, subsequent to the implementation of USI. These wage rates are denoted, respectively, by $w_F(1+\beta_F\tilde{\tau}_l)$ and $w_I+\beta_I\tau_{NCSI}$.[16] To account for heterogeneity, let $\beta_{F,n}$ denote the valuation of CSI programs by a formal employee, labeled by n (a similar notation applies to

[16] Given that the government subsidizes a fraction of the CSI tax in Mexico, the valuation of SI services for formal workers is based on the gross (i.e., before-subsidy) CSI tax rate $\tilde{\tau}_l$, rather than on the CSI tax, net of subsidies.

informal employees). Also, let w_{USI} represent the equilibrium wage rate under USI.[17] For a formal employee with valuation $\beta_{F,n}$ of SI services, the change in after-tax-and-transfer wage rates under USI is given by the ratio

$$\frac{w_{USI}+\beta_{USI,n}\tau_{USI}}{w_F(1+\beta_{F,n}\tilde{\tau}_l)},$$

where $\beta_{USI,n}$ is the valuation of USI services by individual n. For the exercises below, $\beta_{USI,n} \equiv \beta_{F,n}$ is assumed, so that any change in after-tax-and-transfer wage rates arises from either equilibrium wages, or SI taxes/transfers (or both), and not from differences in the valuation of SI services.

Applying the same criteria to informal employees, the change in after-tax-and-transfer wage rates under USI is measured by

$$\frac{w_{USI}+\beta_{USI,n}\tau_{USI}}{w_I+\beta_{I,n}\tau_{NCSI}},$$

with the restriction $\beta_{USI,n} \equiv \beta_{I,n}$.

To measure the rise of Sector 1's VAT rate on purchasing power, the increase in prices due to the higher VAT in Sector 1 is subtracted from the change in after-tax-and-transfer wage rates, estimated above. Such increase is estimated as the VAT rate in Sector 1 times the fraction of Sector 1 goods in the consumption basket of the n-th employee. This number is what shall be known as the change in purchasing power after USI.

Results for the exercise described above are presented in Table 11, with Panel A evaluating the hypothetical effects of VAT, plus USI reform on purchasing power for formal employees, while Panel B examines the same issue for informal workers. The exercise considers the revenue-neutral reform with a uniform VAT rate, and results are measured relative to the benchmark economy. The first column in Panel A considers alternative valuations of CSI services, rising from 0 to 1. Alternative values for the share of Sector 1 goods in the consumer basket are presented along the remaining columns.

With regard to the first entry in Panel A, there is a gain in purchasing power solely from wages, which corresponds to the change in the formal wage rate, already reported in Table 8. As β_F is increased, the change in purchasing power becomes lower; that is, the more valuable the SI programs for a formal employee, the lower the net gain in adopting USI. Naturally, as the share of Sector 1 goods in the consumer basket is increased, the lower the gain in purchasing power for

[17] It should be remembered that formal and informal wage rates are equalized under USI.

a given β_F. A worst-case scenario is an employee, who fully values SI and consumes only goods from Sector 1. Under such a scenario, there is a loss of 18.2 percent in purchasing power.

The corresponding changes for informal employees are presented in Panel B of Table 11. Again, a higher share of Sector 1 goods leads to a lower net gain for a given value of β_I. However, the higher the valuation of SI programs, the higher the change in purchasing power for a given share of expenditures in Sector 1. This result reflects the fact that informal workers would benefit the most from the adoption of USI. These workers would receive larger transfers relative to the benchmark case. Accordingly, the most benefited worker would be the one who fully values SI and would not spend on Sector 1 goods, so that the purchasing power increases by 23.3 percent. The least favored worker shows an opposite scenario, with purchasing power falling by 5.6 percent.

Table 11. Effects on Purchasing Power for Alternative Valuations of Social Insurance *(% change)*

A. FORMAL EMPLOYEES					
	Share of sector 1 goods in consumer's basket				
β_F	0	0.3	0.5	0.75	1
0	19.3	13.8	10.0	5.4	0.7
0.3	12.3	6.7	3.0	-1.7	-6.3
0.5	8.4	2.8	-0.9	-5.6	-10.2
0.75	4.1	-1.5	-5.2	-9.9	-14.5
1	0.4	-5.2	-8.9	-13.5	-18.2
B. INFORMAL EMPLOYEES					
	Share of sector 1 goods in consumer's basket				
β_I	0	0.3	0.5	0.75	1
0	13.0	7.4	3.7	-0.9	-5.6
0.3	16.2	10.7	6.9	2.3	-2.4
0.5	18.3	12.7	9.0	4.4	-0.3
0.75	20.8	15.3	11.5	6.9	2.2
1	23.3	17.7	14.0	9.3	4.7

Source: Authors' calculations.

The numbers provided in Table 11 are only illustrative, given that our model does not include spending heterogeneity. In particular, in a model with spending heterogeneity, the increase in the price of food as a result of the increase in the VAT rate might be higher than in our current calibration. This would negatively affect the purchasing power gains in Table 11 and, eventually, optimal choices. However, Table 11 does provide a valuable insight by examining the data. For example, the information from the Household Income and Expenditure Survey indicates that, on average the poorest decile roughly spends about 63 percent of income on goods not currently taxed.[18] This spending share decreases along the income distribution. In contrast, the wealthiest decile spends only 45 percent of income on the same goods. This suggests that even the poorest households do not spend all of their income on non-taxed goods, so the estimations provided in the last column of Table 11 would be hardly observed, in practice.

With reference to the valuation of SI programs, there is some evidence that, on average, workers in Mexico do not fully value SI services. For example, Cazorla and Madero (2007) report that contributions towards SI, perceived by formal workers as valuable, are approximately 58 percent. For this calculation, the authors used data on household surveys to estimate a wage equation through a three-stage least-squares technique. Similarly, Garro, Meléndez, and Rodríguez-Oreggia (2005) report that formal workers value only 73 percent of SI contributions. Finally, the document, *Informe sobre la Seguridad Social en América* (CISS, 2003), puts this number between 35 and 70 percent, even after taking into account the reform to the Mexican pension system in 1997. Overall, the evidence supports values for β_F between 0.35 and 73 percent. No empirical evidence appears to be available for the valuation of non-contributory social insurance programs in Mexico.

Based on the discussion above, the analysis can be narrowed to establish the potential effect of the reform on employee purchasing power. If the household spending share of Sector 1 goods is considered to be somewhere between 50 and 75 percent, and the valuation of CSI programs is between 0.3 and 0.75, Table 11 would suggest that the effects of reform for formal workers would be between 3.0 and -9.9 percent. Without further information on parameter β_I, the change in purchasing power for informal employees would be somewhere between 14 and -0.9 percent. In this regard, it is important to note that the fiscal-cum social reform, detailed in

[18] These goods include the following: food, beverages, and tobacco; health; and transportation. In practice, most beverages, as well as tobacco, are subject to VAT, so the spending share on non-taxed goods provided above is, in fact, lower.

AHL (2012), contemplates a lump-sum, cash transfer to the two poorest deciles of the population to compensate for the increase in VAT. The analysis provided illustrates the relevance of such transfer, in practice. However, it is crucial to provide additional sources of revenue to fund such transfers, since these are not available in our revenue-neutral exercises. The equilibrium distributional effects of these conditional transfers can be better studied in a model with income and expenditure heterogeneity, which is beyond the scope of this paper.

7. Conclusions

This Working Paper has evaluated aggregate, efficiency, and inequality effects of the fiscal-cum-social policy, originally proposed by Levy (2008) and quantitatively examined by AHL (2012). For that purpose, a dynamic, two-sector model with tax evasion and occupational choice was designed, in order to capture the dual VAT rate structure currently in place in Mexico. What has been established is that a revenue-neutral reform, with uniform VAT rates, increases output by 3.2 percent and total factor productivity by 2.1 percent. To put this result into perspective, a similar exercise was affected by only increasing the VAT rate in the sector currently taxed. This showed that aggregate output and TFP increase by only 0.6 and 0.4 percent. In terms of productivity, this suggests a five-fold difference.

This paper also included an analysis, where VAT rates were set uniformly to their revenue-neutral values, but where the dual SI scheme remained. With no change in social spending, output and TFP fell by 1.1 and 0.4 percent, relative to the benchmark economy. This was an expected result, given that the economy faces a higher tax burden. However, it was found that, if the extra revenue were spent exclusively on transfers to informal workers, the fall in output and TFP would be 3 and 4.5 times larger, respectively.

These analyses illustrate that a fiscal-cum-social policy reform that sets uniform VAT rates and, simultaneously, eliminates the dual SI scheme is the one that yields the largest positive effects on both aggregate output and productivity. Perhaps not surprisingly, it also provides the highest increase in after-tax wages, since such a reform would be the most prudent to abate current distortions. As the current paper also suggests, the reform could affect some groups in the population, given the regressive nature of VAT and the differences in valuation of transfers across workers. Models that include spending and income heterogeneity can address this, which requires further research. On the other hand, a policy that increases revenue to finance higher

spending on NCSI programs, without eliminating the dual SI scheme, or without increasing the transfers to formal workers could, in fact, have a negative effect on fiscal accounts, aggregate output, and productivity. This last result suggests the importance of designing social policy incentives appropriately.

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