Taxing Labor Income in an Economy with High Employment Informality[†]

Arturo Antón

Banco de Mexico
Av. Cinco de Mayo 18, Mexico City, 06000, Mexico
e-mail: arturo.anton@banxico.org.mx

and

Alejandro Rasteletti

Inter-American Development Bank
Carrera 7 #71-21, Torre B Piso 19, Edificio Avenida Chile, Bogotá, Colombia
e-mail: arasteletti@iadb.org

Abstract

This paper develops a static general equilibrium model of occupational choice with heterogeneity in both labor and entrepreneurial skills that generates high levels of employment informality. The model uses a detailed structure of personal income taxes (PITs) and subsidies to formal workers to capture the labor wedges present in many countries. These features enable the model to assess how changes in PITs and subsidies affect labor-market outcomes and the government's fiscal accounts. The model is calibrated for Mexico, which like many developing countries has high levels of labor informality. The model's simulations shed light on the impact of a series of reforms to PITs and subsidy schemes aimed at increasing labor formality among low-income workers. The results suggest that adjusting the current structure of the formal employment subsidy combined with PIT exemptions for low-income workers could reduce informality while marginally improving the government's fiscal balance.

Keywords: informal employment; personal income tax; employment subsidy; fiscal accounts.

JEL codes: H24, H30, J24, J46, O17.

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1. Introduction

High levels of informal employment are common in developing countries. Worldwide, almost 70% of employment in emerging and developing countries is estimated to be informal, compared to less than 20% in advanced economies (International Labor Organization, 2018). Numerous studies have suggested that high labor taxes may be partially responsible for high levels of informal employment (see, e.g., Fortin et al., 1997; Levy, 2008; Saracoglu, 2008; Albrecht et al., 2009; Bosch and Esteban-Pretel, 2012, 2015; Galiani and Weinschelbaum, 2012; and Ulyssea, 2018).[1] A study by the Inter-American Development Bank, the Inter-American Center of Tax Administrations and the Organization for Economic Cooperation and Development (OECD / CIAT / IDB, 2016) estimates that labor taxes in Latin America and the Caribbean (LAC) are equivalent to 21.7% of workers' average incomes. Though below the OECD average of 35.9%, the substantial share of labor taxes in average income, especially among low-income workers, may encourage informal employment.

This paper uses a static general equilibrium model with heterogeneous taxes and subsidies to analyze how changes in the labor-taxation profile affect informal employment and the government finances. The model includes fixed shares of entrepreneurs and workers, who behave rationally. Entrepreneurs and workers are endowed with heterogeneous managerial and labor ability, respectively (cfr. Jovanovic, 1994; Allub and Erosa, 2019). Heterogenous labor ability is treated as the basis for income distribution. The latter property is important, as the distribution of labor taxes and subsidies across formal workers is largely determined by their income level.

To quantitatively assess the role of heterogeneous taxes and subsidies in accounting for informality, the model is calibrated for Mexico, which exhibits the high levels of informal employment typical of many developing countries. According to the ILO (2018), 53.4% of total employment in Mexico is informal. However, unlike in

[1] Throughout this paper, the term labor taxation is used in a broad sense to refer not only to taxes on personal income, but also to mandatory social security contributions.

many other developing countries, low-income formal workers in Mexico are entitled to a government subsidy that may be credited against their income-tax liability. This subsidy is based on income level and is progressive. Understanding how changes in the subsidy affect informal employment and the fiscal accounts in Mexico may offer relevant insights for policymakers in other developing countries.

After calibrating the model, the paper analyzes a series of changes to the personal income tax (PIT) and to the subsidy for formal employment (SUFE). These changes are intended to increase labor formality, especially among low-income workers, without imposing a major fiscal cost. The model suggests that changes to the SUFE and PIT may have large positive effects on labor formalization. Specifically, redesigning the SUFE and including PIT exemptions for low-income workers may boost the rate of labor formality by between 7.0 and 11.9 percentage points. Moreover, rather than entailing a fiscal cost, these measures improve the government's fiscal balance by 0.34% of GDP via their effect on economic formalization. Various sensitivity exercises using alternative values for the model's parameters indicate that these results are robust.

In the model, each entrepreneur receives a managerial ability endowment and runs a single firm. Entrepreneurs use their skills and effective labor to produce a homogeneous good in a competitive context. They must pay a corporate income tax (CIT) and cover the social security contributions (SSCs) of their workers. The CIT is paid in full, and thus these firms are labeled as formal. However, the entrepreneur can hire a salaried worker either formally (i.e., paying the mandatory SSCs and fringe benefits established by law) or informally (i.e., evading such payments). If a worker is hired informally, the entrepreneur faces a probability of being detected and fined by the authorities. This probability is modeled as an increasing function of the firm's size. Therefore, small firms facing a low probability of being fined mostly hire informal workers. For midsized firms, labor is optimally composed of both formal and informal workers. This feature of the model gives rise to an intensive margin of informality as in Ulyssea (2018). As detailed below, the intensity of labor informality within a firm

depends on the level of managerial ability and on the relative costs of formal and informal labor.

The model's workers receive a labor-ability endowment and must choose to work on their own or as formal or informal salaried employees.[2] Both own-account and informal salaried workers pay no taxes on their income and do not contribute to social security, but they receive lump-sum transfers from the government. Each own-account worker runs her own firm without hiring salaried workers. Because these firms do not pay taxes, they are classified as informal.[3] By contrast, each formal salaried worker pays income taxes and contributes to social security. If she is a low-income earner, she also receives a government subsidy that she may credit against her income-tax liability. This scheme of taxes, subsidies and transfers determines net earnings for workers in each occupation. Given her ability and assessment of the social security services to which she is entitled, each worker optimally chooses the occupation that yields the highest total earnings.

The large effects on labor formalization found in the quantitative exercises are explained by changes in the net earnings profile of low-income formal workers resulting from variations in the tax and subsidy code. The simulated reform to the SUFE scheme effectively increases the subsidy for formal workers earning between 1.3 and 2.1 times the minimum wage (MW). Meanwhile, the simulated PIT reform provides a tax exemption for formal workers earning up to 1.8 times the MW. In Mexico, approximately 50% of employees in the private sector earn up to 2 times the MW, and nearly 75% of these workers are informal. Therefore, a reform to the tax

[2] Bobba et al. (2021) and Narita (2020) also make a distinction between self-employed/own-account and informal salaried workers. Self-employment is an important feature of the workforce in developing countries (Perry et al., 2007; Gollin, 2008). In Latin America, it comprises more than 30% of the workforce.

[3] Accordingly, formal firms require managerial ability as an input, but informal firms do not. Note that the model structure implies that no entrepreneur operates an informal firm. As a result, there are no informal firms hiring informal salaried workers. Evidence from Mexico and Brazil (Samaniego, 2016; Ulyssea, 2018) indicates that between 40 and 44% of informal employees work for a formal firm, and the remaining work for an informal firm. In this regard, the model implies that the intensive margin accounts for 100% of informal salaried workers, which is at odds with data.

and subsidy code that increases the earnings of low-income formal workers would significantly alter incentives to formalize.

This paper relates to two broad branches of the literature. The first involves the family of occupational-choice models, which is part of a long tradition in economics (see, e.g., Lucas, 1978; Jovanovic, 1994; Gollin 2008; and Allub and Erosa, 2019). These models have been used to study how economic agents move between the formal and informal sectors (see, e.g., Rauch, 1991; Pratap and Quintin, 2008; De Paula and Scheinkman, 2010; Leal, 2014; and Lopez, 2017). The second branch explores the effects of labor-market institutions on informal employment (see, e.g., Zenou, 2008; Albrecht et al., 2009; Ulyssea, 2010, 2018; Bosch and Esteban-Pretel, 2012, 2015; Galiani and Weinschelbaum, 2012; Margolis et al., 2014; and Meghir et al., 2015).

Our model differs from those used in the literature in two important respects. First, we consider heterogeneity in terms of both entrepreneurial and labor abilities. All the works on occupational choice and informality cited above include either heterogeneous entrepreneurial or labor skills, but not both.[4] In our model, the heterogenous distribution of labor skills allows us to build a heterogenous income distribution, which enables us to simulate tax and subsidy policies that depend on workers' income levels. Similarly, heterogeneous entrepreneurial ability plays a key role in determining the intensity of informality within firms in developing countries (Leal, 2014). Our model's second distinguishing feature is its focus on how PIT and subsidy policies for formal workers affect informal employment. The studies cited above examine how labor-market policies such as SSCs, unemployment benefits, and restrictions on hiring and firing contribute to informal employment, but none examine how PITs and subsidies for formal workers impact informality.

The rest of the paper is organized as follows. Section 2 presents the model. Section 3 describes the data used and the calibration of the model's parameters.

[4] Jovanovic (1994) and Allub and Erosa (2019) present frameworks with heterogeneity in both managerial and labor skills, and Poschke (2013) uses a model in which both individual ability and firm productivity are heterogenous. However, none of these models incorporate informality.

Section 4 uses comparative statics to illustrate how changes in tax and subsidy schemes affect labor markets and the public finances. Section 5 presents the sensitivity analysis, which corroborates the robustness of the results. Section 6 concludes the paper.

2. The model

2.1 Description of the model

The analytical framework is a static general equilibrium model of occupational choice with heterogeneous agents. The economy is composed of two types of agents, entrepreneurs, and workers, both of which are independently distributed in fixed proportions. A continuum of managerial and labor abilities is represented by a probability distribution. At the beginning of the period, each entrepreneur is assigned exogenous managerial ability z, which affects the productivity of her firm, while each worker is assigned exogenous labor ability e, which affects her labor earnings. The cumulative distributions of managerial and labor abilities are represented by $\Phi_z(z)$ and $\Phi_e(e)$, respectively.

Each entrepreneur owns a firm that aims to maximize profits based on technology and the structure of taxes and transfers. Firms produce a single good in a competitive context, and each employer hires formal and informal salaried workers in a competitive labor market. When a worker is hired formally, the firm must pay all nonwage labor costs. Alternatively, the firm may avoid these costs by hiring a worker informally. Firms that hire informal workers face a size-dependent probability of being detected and fined by the authorities. All firms pay CIT at a flat rate, which cannot be avoided.

Based on her ability level, a worker must select among three possible occupation types: (1) own-account; (2) informal salaried employment; or (3) formal salaried employment. Workers in the first two occupation types are informal because they pay no taxes or SSCs, and they receive lump-sum transfers from the government. Workers in the third occupation type, formal salaried employment, must pay PIT, but they receive social security benefits and, depending on their income level, they may receive a government subsidy (i.e., the SUFE). When selecting an

occupation, the worker compares the amounts of labor income that she would receive in each of the three occupation types given her skill level, the equilibrium wage, and the structure of taxes and transfers.

Our model distinguishes between formal firms and formal workers: a firm is formal if it pays the CIT whereas a worker is formal if her employer covers the contributions to social security. In our model, all entrepreneurs operate formal firms, but own-account workers run informal firms that pay no CIT. They are also informal workers because they do not pay SSC. All other informal workers are employed by formal firms that do not cover their SSC. This oversimplification does not allow for informal firms hiring salaried workers.

Table 1 details the different types of occupations considered in the model.

Table 1: Occupation Types and Formal Status

Occupation	a)	Entrepreneur	Formal firm with formal and informal employees
	b)	Worker	b1) Formal salaried worker b2) Informal salaried worker b3) Own-account (informal firm)

2.2. The entrepreneur's problem

To produce goods, an employer with ability z must hire salaried workers either formally or informally. The relevant input for the firm is effective labor. Let l_F and l_I represent the number of formal and informal workers, respectively. Recalling that e denotes the worker's level of ability, $h_F \equiv el_F$ and $h_I \equiv el_I$ represent the effective labor of formal and informal workers, respectively.

Sorting between employers and salaried workers is represented by the function $e = v(z)$, indicating which employer of ability z is matched with which worker of ability e. We assume positive assortative matching between employers and workers, namely $v'(z) > 0$. This assumption implies that high-ability employers are matched with high-ability workers, while low-ability employers are matched with low-ability workers.

Technology is represented by the production function:

$$Y(z) = AzH(z)^{\gamma}, \tag{1}$$

where A is a technology parameter and $\gamma \in (0,1)$ is the Lucas (1978) "span-of-control" parameter. In equation (1), the scale of production (and thus firm size) increases in relation to managerial ability z. Similarly, $H(z)$ represents the total units of effective labor, as determined according to the following CES function:[5,6]

$$H(z) = \left\{q(z){h_F}^{\psi} + [1 - q(z)]{h_I}^{\psi}\right\}^{1/\psi}. \tag{2}$$

In equation (2), the term $q(z)$ determines the relative importance of formal labor in the production process for a given level of managerial ability z. To capture the empirical fact that larger firms in developing countries demand more formal workers (Leal, 2014), we assume that the function $q(z)$ satisfies $q'(z) > 0$. The elasticity of substitution between formal and informal labor in (2) is given by $\frac{1}{1-\psi}$, with $\psi < 1$.

The entrepreneur must pay an output tax at the flat rate τ_Y. She must also cover the wage rate w_F and the corresponding nonwage cost $\tau(z)$ of her formal workers expressed as a share of the wage cost. Nonwage costs include SSCs, state-level payroll taxes, and fringe benefits. The employer may also receive a tax deduction $D(z)$ per formal worker hired that is proportional to the wage cost.[7] Therefore, $\tau_L(z) \equiv \tau(z) - D(z)$ denotes the cost of hiring a formal worker net of deductions, and the net cost of hiring an effective unit of formal labor may be expressed as $C_F(z) \equiv [1 + \tau_L(z)]w_F$. Alternatively, the entrepreneur may hire workers informally at the

[5] This CES specification is reminiscent of the canonical model of skill differentials developed by Acemoglu and Autor (2011), where a distinction is made between high- and low-skill workers. Equation (2) assumes that effective units of formal and informal labor are imperfect substitutes.

[6] Expression (2) and the assumption $q'(z) > 0$ may be justified by a model where physical capital is more complementary to formal labor than to informal labor. Accordingly, equation (2) may be interpreted as a reduced-form expression consistent with a capital-skill complementarity model. We thank an anonymous referee for pointing out this interpretation.

[7] Typically, non-wage costs and deductions faced by firms are determined as a function of workers' income. In the model, the income span to set taxes and deductions is generated by multiplying the vector of either managerial or labor skills times a scalar. To save on notation, these variables are expressed as a function of ability only. Given the sorting function $e = v(z)$ between employers and workers, non-wage costs and deductions faced by firms may be expressed in terms of ability z.

wage rate w_I. If the authorities discover that the entrepreneur is hiring workers informally, she must pay a penalty $\sigma > 1$ on the evaded labor taxes, from which she may take no deductions. Let $V(m) \in [0,1]$ represent the probability of a firm of size m being caught hiring an informal worker with $V'(m) > 0$. This property captures the idea that larger firms face a higher probability of being audited and thus fined by the authorities. Accordingly, the expected cost of hiring an effective unit of informal labor is $C_I(z) \equiv [1 + \sigma V(m)\tau(z)]w_I$.

Given the information above, the expected net profits for an entrepreneur with ability z may be expressed as:

$$\Pi(z) = (1 - \tau_Y)Y(z) - C_F(z)h_F - C_I(z)h_I. \tag{3}$$

Accordingly, the employer must choose $\{h_F, h_I\}$ to maximize her expected net profits (3) subject to the technologies represented by (1) and (2), taking wages and tax rates as given. After substituting first-order conditions into equation (2), units of effective labor are given by:

$$H(z) = [(1 - \tau_Y)A\gamma z]^{\frac{1}{1-\gamma}} C(z)^{\frac{1-\psi}{\psi(1-\gamma)}}, \tag{4}$$

where

$$C(z) \equiv \left[\frac{q(z)}{C_F(z)^{\psi}}\right]^{\frac{1}{1-\psi}} + \left[\frac{1-q(z)}{C_I(z)^{\psi}}\right]^{\frac{1}{1-\psi}}. \tag{5}$$

Adding equation (4) back into the first-order conditions yields the optimal demand for formal and informal labor:

$$h_F(z) = [(1 - \tau_Y)A\gamma z]^{\frac{1}{1-\gamma}} \left[\frac{q(z)}{C_F(z)}\right]^{\frac{1}{1-\psi}} C(z)^{\frac{\gamma-\psi}{\psi(1-\gamma)}}, \tag{6}$$

$$h_I(z) = [(1 - \tau_Y)A\gamma z]^{\frac{1}{1-\gamma}} \left[\frac{1-q(z)}{C_I(z)}\right]^{\frac{1}{1-\psi}} C(z)^{\frac{\gamma-\psi}{\psi(1-\gamma)}}. \tag{7}$$

Equations (6) and (7) yield the optimal h_F/h_I ratio. Because the effective labor of formal and informal workers may be rewritten as $h_F \equiv el_F = \upsilon(z)l_F$ and $h_I \equiv el_I = \upsilon(z)l_I$, the ratio of formal to informal workers is given by:

$$\frac{l_F}{l_I} = \left\{\left[\frac{q(z)}{1-q(z)}\right]\frac{[1+\sigma V(m)\tau(z)]w_I}{[1+\tau_L(z)]w_F}\right\}^{\frac{1}{1-\psi}},$$

which indicates that such ratio increases with firm size m, given the assumption $V'(m) > 0$. This pattern is consistent with data for developing countries, where smaller firms are more likely to hire informal workers relative to larger firms, but larger firms still employ a substantial share of all informal workers (Leal, 2014).

2.3. The worker's problem

2.3.1 *The earnings of formal salaried workers*

As described above, each worker is assigned exogenous labor ability e. When a worker chooses to become a formal salaried employee, she receives wage earnings represented by the function $W_F(w_F, e)$ and may be entitled to a subsidy $S(e)$ from the government. She must also pay PIT in the amount of $\tau_W(e)$. Accordingly, her after-tax income $I_F(e)$ is:

$$I_F(e) = W_F(w_F, e) + S(e) - \tau_W(e). \quad (8)$$

Each formal worker is automatically enrolled in the social security system. If $\tau_{SS}(e)$ denotes the tax rate on SSCs, the contribution paid by an employer for a worker with ability e is $\tau_{SS}(e)W_F(w_F, e)$. Formal workers are entitled to receive social security services such as healthcare and pensions, but not all services may be fully valued by workers (see Summers, 1989). Let $\beta_F > 0$ denote the valuation made by formal workers of such services. Therefore, the monetized value of social services is expressed as $\beta_F\tau_{SS}(e)W_F(w_F, e)$.[8] Formal workers also receive fringe benefits, which are denoted as a fraction κ of wage earnings $W_F(w_F, e)$. The valuation of these benefits by workers is expressed by parameter $\beta_S > 0$.

Based on the above specifications, the net earnings of formal salaried employment for a worker with ability e may be expressed as:

[8] When $\beta_F < 1$, SSCs are a tax in net terms. See Summers (1989).

$$E_{W,F}(e) = I_F(e) + [\beta_F \tau_{SS}(e) + \beta_S \kappa] W_F(w_F, e), \quad (9)$$

where $I_F(e)$ is given by equation (8). Each worker must compare these earnings to those generated by other occupation types.

2.3.2 *Earnings of informal salaried workers*

The wage earnings of an informal salaried worker are represented by the function $W_I(w_I, e)$. As is noted above, informal workers pay no PIT, receive no subsidy $S(e)$, and are not entitled to social security or other nonwage employment benefits. However, they receive a non-contributory social security transfer T_{NC} from the government. The valuation of such transfers by workers is captured by parameter $\beta_I > 0$.

Therefore, the total earnings of an informal worker $E_{W,I}(e)$ are given by:

$$E_{W,I}(e) = W_I(w_I, e) + \beta_I T_{NC}. \quad (10)$$

Empirical evidence suggests that the returns to education are higher for formal workers than for informal workers (see, e.g., Gong and van Soest, 2002; Günther and Launov, 2012). If education levels efficiently signal worker ability, the earning function of formal workers should exhibit higher returns to scale in ability e relative to the earning function of informal workers. For simplicity, the wage-earnings function $W_F(w_F, e)$ in equation (8) is set to exhibit constant returns to scale: $W_F(w_F, e) = w_F e$. Accordingly, the earnings function of informal workers in equation (10) is determined by $W_I(w_F, e) = w_I e^{\alpha}$ with parameter $\alpha \in (0,1)$.

2.3.3 *Own-account*

In our model, own-account workers produce the same goods as entrepreneurs but use slightly different technology, which is represented by the production function $Y_O = A_O h_O^{\gamma_O}$. In this equation, A_O is a technology parameter, $\gamma_O \in (0,1)$ captures the returns to scale in production, and h_O denotes effective units of labor given by $h_O \equiv e l_O$. Because own-account workers pay no taxes and make no SSCs, profits Π_O (before transfers) may be simply written as $\Pi_O(h_O) = A_O h_O^{\gamma_O}$.

Own-account workers are also recipients of non-contributory social security transfers T_{NC}. Assuming that $\beta_I > 0$ captures the valuation of such transfers, own-account earnings are written as:

$$E_O(e) = A_O h_O^{\gamma_O} + \beta_I T_{NC}. \quad (11)$$

2.3.4 *The worker's occupational-choice problem*

After explaining the earnings of each type of worker, we proceed to define the occupational-choice problem of a worker with ability e. In general, this problem is written as:

$$\max_c u(c)$$

subject to

$$c = I(e),$$

where c denotes consumption and $I(e)$ is the income of a worker with ability e defined by the following equation:

$$I(e) = \max\{E_O(e), E_{W,I}(e), E_{W,F}(e)\}. \quad (12)$$

The terms shown on the right-hand side of (12) are specified by equations (9), (10) and (11). To simplify, the utility function $u(c)$ is assumed to be linear in consumption, and thus $u(c) = c$. As a result, the utility of each occupation is equivalent to the earnings received (cfr. Galiani and Weinschelbaum, 2012; and D'Erasmo et al., 2014).

Based on this framework, we define the sets of own-account ($\mathcal{A}$), informal salaried ($\mathcal{B}$), and formal salaried workers ($\mathcal{C}$) as follows:

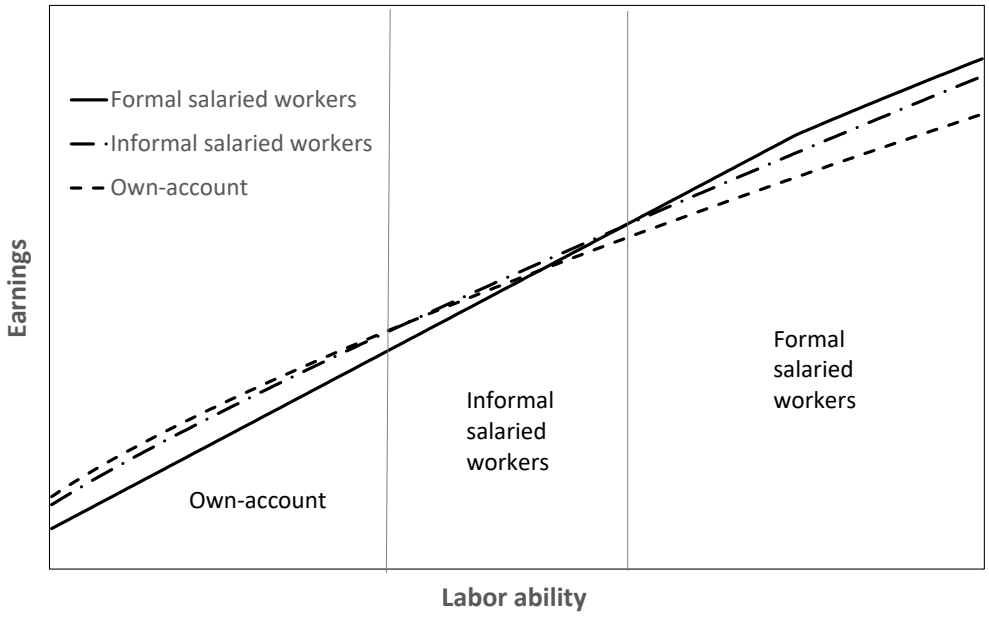
$$\mathcal{A} = \{e | I(e) = E_O(e)\}, \quad (13)$$

$$\mathcal{B} = \{e | I(e) = E_{W,I}(e)\}, \quad (14)$$

$$\mathcal{C} = \{e | I(e) = E_{W,F}(e)\}. \quad (15)$$

For illustrative purposes, Figure 1 shows a hypothetical earnings profile for each type of worker and the corresponding occupational choice made as a function of labor ability e. In this case, own-account employment provides the highest earnings for less-skilled workers. At moderate levels of labor ability, the worker optimally chooses informally salaried employment, and when labor ability is sufficiently high the worker chooses formal salaried employment. Equations (9), (10) and (11) show that changes in the structures of taxes, subsidies and transfers may affect occupational choices.

Figure 1. Earnings and occupational choices



The reform simulations presented in section 4 below involve changes in the subsidy and income-tax profiles $S(e)$ and $\tau_W(e)$ in equation (8), based on the distribution of managerial and labor abilities. Such changes affect after-tax income and thus the net earnings profile $E_{W,F}(e)$ of formal workers. Consequently, occupational choices may also change. For example, increase in the subsidy $S(e)$ to low-income formal workers would cause a corresponding increase in net earnings $E_{W,F}(e)$, incentivizing those workers who were initially indifferent between formal and informal salaried employment to prefer the former. As a result, the share of formal workers in the economy would increase. Reducing income taxes on low-income workers would yield a similar outcome. While general equilibrium effects must also

be incorporated into the analysis, it is important to clarify that changes in $S(e)$ or $\tau_W(e)$ or both will drive the results in the simulations below.

Now let $L_O = \int_{\mathcal{A}} d\Phi_e(e), L_I = \int_{\mathcal{B}} d\Phi_e(e)$ and $L_F = \int_{\mathcal{C}} d\Phi_e(e)$ denote the total number of own-account, informal salaried workers, and formal salaried workers, respectively. Given that the total number of workers $\bar{L}$ is fixed, the following must hold:

$$L_O + L_I + L_F = \bar{L}. \tag{16}$$

Equation (16) shows that changes to the fiscal structure do not alter the number of workers $\bar{L}$. However, such changes may affect the relative share of workers in each type of occupation.

2.4 Equilibrium

In equilibrium, the demand for informal salaried workers (measured in units of effective labor) must equal their supply. The same is true for formal salaried workers. The labor supply of these two occupation types is determined by the occupational-choice problem described above. Therefore, equilibrium conditions for formal and informal salaried workers may be expressed as:

$$\int_z h_I(z, w_F^*, w_I^*) d\Phi_z(z) = \int_{\mathcal{B}} e d\Phi_e(e), \tag{17}$$

$$\int_z h_F(z, w_F^*, w_I^*) d\Phi_z(z) = \int_{\mathcal{C}} e d\Phi_e(e). \tag{18}$$

Accordingly, equations (17) and (18) solve for equilibrium wages $\{w_F^*, w_I^*\}$.

3. Calibration

3.1 Data

In this section, we calibrate the model using data for Mexico to quantitatively assess how changes in PIT and subsidies to formal workers may affect formal employment and the government's budget balance. According to the ILO (2018),

informal employment accounts for 53.4% of total employment in Mexico, broadly in line with the average for LAC economies.

Our quantitative exercise incorporates detailed information on Mexico's PIT and SUFE schemes. The Mexican PIT is progressive, with statutory marginal tax rates starting at 1.92% and gradually increasing to a maximum rate of 35%. As noted in the introduction, the SUFE is a progressive subsidy provided to formal low-income workers to decrease their income-tax burden. Further information on the PIT and SUFE schemes can be found in Appendix A.[9]

The data sources used to calibrate the model are detailed in Appendix B. In 2017, CIT and PIT revenues each amounted to 3.1% of GDP, and transfers via the SUFE were equivalent to 0.2% of GDP. Between 2003 and 2016, SSCs from workers and employers averaged 3.1% of GDP, but no data are available on their relative shares. The Mexican government also finances social security for formal workers, and in 2017 its contribution was valued at 0.53% of GDP. By law, only a fraction of SSCs must be allocated to health insurance, and in 2017 these contributions fell short of the government's total health expenditures. Therefore, potential increases in formal employment imply additional financial commitments by the government, which we estimate at $13,503 Mexican pesos per formal worker on an annual basis based on the official data. These commitments are referred to as "extra operating expenditures" in the analysis below.

Labor-market information is provided by Mexico's National Occupation and Employment Survey (*Encuesta Nacional de Ocupación y Empleo*, ENOE). All calculations exclude public-sector employment (encompassing employment by government agencies, state-owned enterprises, and public institutions) because government workers have their own social security scheme and receive benefits that are not comparable to those of private-sector workers. The ENOE distinguishes between workers who are affiliated with the CSS scheme (i.e., formal workers) and

[9] The model is also calibrated to replicate the Mexican CSS scheme, in which contributions are partially income-based, and benefits include healthcare, pensions, life insurance, housing, and daycare. For a thorough description of Mexico's CSS system, see Levy (2008).

those who are not (i.e., informal workers). Employers account for 4.8% of total employment, while own-account (26.3%), informal salaried (39.5%), and formal salaried (29.4%) workers make up the remaining 95.2%. Formal salaried workers receive an average salary of $7,447 pesos per month, and informal salaried workers receive an average salary of $4,344 pesos per month. Though not required for the calibration process, the average earnings of entrepreneurs and own-account workers are also reported.

3.2 Functional forms

The model requires specifying the functional forms for the distribution of skills, the weight of formal workers in the production function, and the probability of detection by the authorities. For the first case, labor ability e is described in terms of a truncated log-normal distribution with mean μ_E, variance σ_E^2 and support $[\underline{e}, \overline{e}]$. Entrepreneurial ability z is defined by a truncated log-normal distribution with support $[\underline{z}, \overline{z}]$, mean μ_Z and variance σ_Z^2.

For the function $q(z)$ included in expression (2), the following specification is adopted:

$$q(z) = 1 - \exp\left[-\left(\frac{z-\underline{z}}{\lambda}\right)^{\zeta}\right]. \tag{19}$$

where $\lambda > 0$ is a "scale" parameter, while $\zeta > 0$ is a "shape" parameter. This expression is a variant of Weibull's cumulative distribution function and is sufficiently flexible depending on the values of λ and ζ. Assuming that firm size is proportional to z, the probability of detection $V(m)$ may be expressed as $V(m(z))$. For simplicity, the function $V(m(z))$ is set to depend linearly on $q(z)$.

3.3 Parameter values

The model uses three groups of parameters. The first group reflects the current structure of the PIT, SUFE, and CSS schemes, which are defined by 110 parameters set according to their 2018 values. The second group includes 12 parameters related to technology, preferences, transfers, and the distribution of

labor ability. Several parameters within this group are selected to determine the earnings profile of own-account, informal salaried, and formal salaried workers. Others are fixed according to the available data or values used in the literature. Without further evidence from either the data or the literature, the remaining parameters are set *a priori* and are subjected to a sensitivity analysis in section 5.

For technology parameters belonging to the second group, returns to scale in the production function of the entrepreneur, γ, are fixed at 0.76 following Leal (2014). For simplicity, parameter γ_O is also fixed at 0.76. The technology level of the own-account, A_0, is set at 5,574, which yields reasonable monthly earnings estimate for this occupation type.[10] A value of 0.86 is assigned to parameter α, which measures returns to scale for the skill levels of informal salaried workers. Fixing the values for these three technology parameters helps determine the earnings profile of the own-account and informal salaried workers not related to lump-sum transfers (see equations 10 and 11). The parameter linked to the elasticity of substitution between formal and informal effective labor (ψ) is set at 0.9, which implies a relatively high value for the elasticity of substitution. In the absence of further evidence on α and ψ, alternative values are considered in the sensitivity analysis. When the authorities discover that a firm has evaded SSCs, it is assumed that the firm must cover the evaded amount plus a fine equivalent to 50% of that amount.[11] Therefore, we set $\sigma = 1.5$.

Some preference parameters reflect workers' valuation of social security and fringe benefits. For formal employees, it is assumed that $\beta_F = 0.30$, meaning that workers value only 30% of the benefits associated with mandatory SSCs. Similarly,

[10] In the data, the average earnings of own-account workers are slightly higher than those of informal wage earners (see Table 5). Both revenues are difficult to replicate in the model simultaneously, as those with the lowest labor skills in the model (and thus with the lowest average earnings) are own-account workers while those with moderate labor skills are informal salaried workers (see Figure 1). In view of this, the calibration is done such that the average income of informal wage earners in the model replicates the data (see Table 3). In contrast, the value of parameter A_0 yields an average income of $2,766 pesos per month for own-account workers, which is a reasonable amount, though it falls significantly below the observed figure given in the data (see Table 5).

[11] Mexico's social security law establishes fines of between 40 and 100 percent of the amount evaded, based on the severity of the offense. Firms must also cover the evaded amount plus the foregone interest. See Levy (2008) for a discussion.

the valuation of fringe benefits, β_S, is fixed at 0.90. The valuation of lump-sum transfers to informal workers, β_I, is set at 0.85. As the values for these parameters may be controversial, the sensitivity analysis uses alternative specifications.

The value of government transfers to informal workers, T_{NC}, is estimated at \$948 pesos per month based on Antón and Hernández (2017) and adjusted for inflation using 2018 prices. Compensation for labor ability is defined by $\underline{e} = 0.14$ and $\overline{e} = 12$. These values allow for labor incomes ranging from just over \$850 to \$73,500 pesos per month. Parameter values of the second group are reported in Table 2.[12]

Table 2. Values of parameters of the second group

Parameter	Value	Parameter	Value
γ	0.76	β_F	0.3
γ_O	0.76	β_S	0.9
A_0	5,574	β_I	0.85
α	0.857	T_{NC}	948
ψ	0.9	$\underline{e}$	0.14
σ	1.5	$\overline{e}$	12

The third group includes the remaining ten parameters, which are simultaneously calibrated and for which there are no direct references in the literature. These parameters are related to technology (A, λ and ζ), fiscal policy (τ_Y), and the distribution of abilities (μ_E, σ_E^2, μ_Z, σ_Z^2, $\underline{z}$ and $\overline{z}$). Since we have ten unknowns, we set ten relevant moments from the theoretical model to match the data. Moments used for the calibration exercise are reported in Table 3. The moments chosen are associated with the relative shares of occupation types, the average income of salaried workers, the earnings distribution, and the tax revenue generated by CIT. Given that the earnings profiles of own-account and salaried workers are previously determined, parameters within this group can be calibrated to match the share of

[12] The model is also calibrated to replicate the ratio of fringe benefits over production reflected in the data. In addition, payroll taxes at the state level are set to 2% of the wage rate (cfr. Antón et al., 2012). Recall that these two elements form part of formal non-wage costs $\tau(e)$ of a firm. Finally, the model estimates are adjusted to replicate fiscal accounts of the government as a share of GDP and the employers' average earnings under the benchmark scenario.

each occupation type, the average income of salaried workers and the earnings distribution.

The calibration is performed simultaneously because a change in the value of a given parameter affects two or more moments in the model. Nevertheless, some parameters are more useful than others to match specific moments in the data. For example, the distribution parameters μ_E and μ_Z are particularly useful for matching the average income of formal and informal salaried workers. Similarly, parameters , σ_E^2 and σ_Z^2 are useful for replicating the shares of own-account and formal salaried workers. Boundary parameters $\underline{z}$ and $\overline{z}$ are appropriate for matching the share of workers earning up to 1 MW and more than 10 times the MW, respectively.[13] On the other hand, the share of workers earning 1-2 and 5-10 times the MW and the share of formal workers earning up to 1 MW are matched with the "scale" and "shape" parameters λ and ζ and the technology parameter A. Finally, the tax parameter τ_Y is calibrated to replicate CIT revenue as a share of GDP.

Once all parameter values are set, equilibrium wages w_F^* and w_I^* solve for equilibrium conditions (17) and (18). Table 3 illustrates how well the model replicates the data.[14] Parameter values obtained under the benchmark calibration are as follows: $A = 27{,}448, \lambda = 7.14, \zeta = 0.15, \tau_Y = 0.08, \mu_E = -0.34, \sigma_E^2 = 0.25, \mu_Z = -1.12, \sigma_Z^2 = 0.26, \underline{z} = 0.21$ and $\overline{z} = 11.17$.

4. Reform Simulations

Having calibrated the model to replicate key aspects of the Mexican economy, this section analyzes how changes to the SUFE and PIT schemes would affect labor

[13] The difficulties of the log-normal distribution for replicating both the upper and lower tails of actual income distributions are well known (Dagum, 1977). Numerical simulations show that increasing the number of parameters in a generalized version of the log-normal distribution improves the fitness to the data (McDonald and Ransom, 2008). In our case, the truncation of the log-normal distribution allows for a better calibration of the model to the data in both tails.

[14] From a technical view, the numerical solution to the nonlinear system above is generally non-unique. For this reason, we tried alternative initial parameter values to find the best fit to the data. On the other hand, the calibration of the income distribution is far from perfect. In particular, the fraction of workers earning between 2 and 3 MW is underestimated by two percentage points, implying that the earnings distribution between 3 and 5 MW is overestimated by the same amount.

informality and the fiscal accounts.[15] This section presents a series of comparative-statics exercises designed to elucidate the relevant policies. It is especially critical to understand that the SUFE and PIT are not equivalent. As explained in Appendix A, the SUFE is a transfer to low-income formal workers based on their gross income. The SUFE does not affect the tax base for each worker's PIT, and the worker can credit the SUFE against her tax liability. Consequently, the SUFE and PIT may have quantitatively different effects on workers' occupational decisions.

Table 3. Moments reflected in the data and model

Moment	Data	Model
Share of own-account employment	0.263	0.263
Fraction of formal salaried employment	0.294	0.294
Average income of formal salaried workers (pesos per month)	7,447	7,469
Average income of informal salaried workers (pesos per month)	4,344	4,419
Fraction of workers earning up to 1 MW	0.124	0.124
Fraction of workers earning 1 to 2 times the MW	0.385	0.385
Fraction of workers earning 5 to 10 times the MW	0.048	0.048
Fraction of workers earning more than 10 times the MW	0.012	0.012
Fraction of formal workers earning up to 1 MW	0.004	0.004
Corporate income tax collection (% of GDP)	3.10	3.11

4.1 Simulations of an alternative SUFE policy

The SUFE in Mexico is granted as a function of gross income to reduce PIT payments of low-income workers. The scheme is progressive because the subsidy increases as the worker's income decreases. For illustrative purposes, Table 4 presents the SUFE scheme in place in 2018, where lower and upper bounds of gross

[15] The simulation exercises generate a change in the government's budget balance in all cases. To generate a policy that is balance-neutral, the government could implement lump-sum transfers (taxes) to all workers in the event of an increase (decrease) in the budget balance. Under such a policy, the set of occupational choice allocations described by equations (12)-(15) would not change because all workers receive the same lump-sum transfer (alternatively, pay the same lump-sum tax). Of course, such a policy would change both workers' earnings and utilities.

monthly income are defined by law. For example, if a worker earns $6,500 pesos per month, the SUFE granted amounts to $253.54 because her income falls in the interval between $6,224.68 and $7,113.90. If a worker earns more than $7,382.33 pesos per month, she has no right to the SUFE. Further explanation of this scheme can be found in Appendix A.

Table 4. 2018 SUFE Scheme (monthly income in pesos)

Lower bound	Upper bound	Subsidy
0.01	1,768.96	407.02
1,768.97	2,653.38	406.83
2,653.39	3,472.84	406.62
3,472.85	3,537.87	392.77
3,537.88	4,446.15	382.46
4,446.16	4,717.18	354.23
4,717.19	5,335.42	324.87
5,335.43	6,224.67	294.63
6,224.68	7,113.90	253.54
7,113.91	7,382.33	217.61
7,382.34	Onwards	0

Source: Ministry of Finance.

This section analyzes three potential changes to the SUFE: (i) eliminating the policy; (ii) switching to a uniform transfer of $400 pesos per month to all formal salaried workers regardless of income level; and (iii) altering the benefit amount and the eligibility threshold. As shown below in detail, our findings suggest that eliminating the SUFE would reduce the formality rate by 6 percentage points, with an adverse overall impact on the fiscal accounts due to rising informality. By contrast, switching to a uniform $400 transfer to all formal workers would increase the formality rate by nearly 3 percentage points, but this improvement would come at a significant fiscal cost. Finally, altering the benefit amount and the eligibility threshold would increase the formality rate by 2.4 percentage points while yielding a modest improvement in the fiscal accounts.

Table 5 illustrates the effects of changes to the SUFE scheme on labor-market outcomes, net incomes, the fiscal accounts, and the burden of PIT and SSCs. The column entitled "Model (baseline)" presents the different variables of interest under

Table 5. Subsidy for formal employment (SUFE) reform simulations

	Data	Model (baseline)	Model (elimination of subsidy to formal workers)	Model (uniform subsidy of $400 to formal workers)	Model (limited subsidy to formal workers)
OCCUPATION (AS A SHARE OF EMPLOYMENT)					
Total informal	0.658	0.658	0.720	0.630	0.634
Own-account	0.263	0.263	0.312	0.236	0.267
Informal salaried	0.395	0.395	0.408	0.394	0.367
Formal salaried	0.294	0.294	0.232	0.322	0.318
Employers	0.048	0.048	0.048	0.048	0.048
AVERAGE NET INCOME (PESOS PER MONTH)					
Total salaried	5,668	5,720	5,892	5,720	5,737
Formal	7,447	7,469	8,049	7,494	6,918
Informal	4,344	4,419	4,664	4,268	4,715
Own-account	4,762	2,766	2,887	2,695	2,778
Employers	12,817	12,817	12,407	12,995	12,805
FISCAL ACCOUNTS (AS % OF GDP)					
Salaried workers					
(A) Income tax	3.10	3.10	3.07	2.11	3.49
(B) SSC	n.a.	0.29	0.24	0.31	0.32
Employers					
(C) Income tax	3.10	3.10	3.33	3.00	3.11
(D) SSC	n.a.	2.81	2.34	3.01	3.04
Government - Contributory SS					
(E) SS revenue (B+D)	3.10	3.10	2.59	3.32	3.36
(F) SS expenditures	0.53	0.53	0.44	0.57	0.57
(G) Extra operating expenditures	N/A	N/A	-0.11	0.08	0.07
(H) Balance (E-F-G)	2.57	2.57	2.26	2.67	2.71
Government - Other					
(I) Income tax revenues (A+C)	6.20	6.20	6.40	5.10	6.60
(J) Subsidy to formal employment	0.20	0.20	0.00	0.59	0.19
(K) Non-contributory SS	1.70	1.70	1.92	1.61	1.64
(L) Balance (I-J-K)	4.30	4.30	4.48	2.91	4.78
Government - Total					
(M) Revenue (E+I)	9.30	9.30	8.99	8.42	9.96
(N) Expenditures (F+G+J+K)	2.43	2.43	2.25	2.85	2.47
(O) Budget balance (M-N)	6.87	6.87	6.74	5.58	7.49
TAX BURDEN (%)					
Income tax					
Salaried workers	50.0	50.0	48.0	41.2	52.8
Employers	50.0	50.0	52.0	58.8	47.2
SSC					
Salaried workers	n.a.	9.4	9.5	9.4	9.4
Employers	n.a.	90.6	90.5	90.6	90.6

Source: own.

N/A: not applicable.

n.a.: not available.

the baseline calibration, which can be compared to the values presented in the "data" column. The definition of the budget balance used in the section on fiscal accounts corresponds to the public revenues and expenditures included in the model, not to the government's actual fiscal balance, which encompasses all public revenues and expenditures. The section on the tax burden reports on how PIT and SSC revenues are distributed between salaried workers and employers.

In the third column of Table 5, the SUFE is eliminated for all formal salaried workers, which causes the formality rate to drop from 29.4% to 23.2%, as some lower-income workers who currently benefit from the SUFE see their incentives shift in favor of informality. The exit of the lowest-skilled, lowest-paid workers from the formal sector increases the average wage for formal workers, w_F^*, to $8,049 pesos per month. Meanwhile, those previously formal workers become the most-skilled, highest-paid members of the informal workforce, which raises the average income of informal salaried and own-account workers. However, the average earnings of employers decrease as average wages rise, suggesting that they benefit indirectly from the SUFE.

The decline in formality boosts CIT revenue because wages paid to formal workers are tax-deductible for the employer, whereas the wages of informal workers are not.[16] Nevertheless, total fiscal revenue (row M) falls due to the drop in both PIT (row A) and worker/employer SSC (row E). Government spending decreases as the SUFE disappears (row J) and rising informality reduces contributory social security expenditures (row F), but the increase in informality also increases noncontributory social security expenditures (row K). In net terms, the budget balance deteriorates, falling from 6.87 to 6.74% of GDP. Overall, the elimination of the SUFE reduces the formality rate by 6 percentage points while marginally worsening the fiscal balance.

[16] The elimination of the SUFE entails two conflicting effects on the total cost of hiring formal workers. On the one hand, lower earnings for formal workers cause formal labor supply to fall and the equilibrium wage to increase. On the other hand, this causes the demand for formal work to decrease in equilibrium. In this specific case, the total cost decreases on average, which indicates that the fall in formal work is more significant than the wage increase.

The fourth column in Table 5 shows the effects of transforming the SUFE into a uniform transfer of $400 pesos per month to all formal workers. This change increases the formality rate by 2.8 percentage points to 32.2% of total employment. The uniform SUFE decreases the PIT liability of all formal workers, increasing their average net income while simultaneously reducing PIT revenue from 3.1 to 2.1% of GDP. As PIT revenue falls, the share of the CIT in total revenue rises from 50 to 58.8%, raising the tax burden on employers relative to workers. The increase in formalization has a positive fiscal impact, but the cost in foregone PIT revenue outweighs this effect. After the other fiscal implications have been accounted for, the budget balance deteriorates from 6.87 to 5.58% of GDP.

The last column in Table 5 simulates changes to the SUFE designed to enhance its positive impact on both the formality rate and the fiscal balance. Under these changes, a uniform employment subsidy of $400 pesos per month is provided to all formal salaried workers earning up to $4,910 pesos per month. The eligibility ceiling for the maximum subsidy corresponds to the current upper bound of the second income bracket of the PIT scheme (see Table 6).[17] Among formal salaried workers earning more than $4,910 pesos per month, the SUFE decreases linearly until it reaches zero for workers with incomes of $7,410 pesos per month.[18] Overall, these changes shift the distribution of SUFE benefits toward lower-income formal workers.

These changes increase the formality rate while improving the fiscal balances. The positive effect on formality is similar to that observed under the uniform SUFE transfer. However, the fiscal balance changes markedly. On one hand, higher levels of formality boost the collection of PIT and SSCs while leaving CIT revenues broadly unchanged. On the other hand, the fiscal cost of the SUFE declines relative to the baseline, as does spending on noncontributory social security programs; in contrast, higher levels of formality increase the government's SSC, leaving total expenditures

[17] This amount represents 1.8 times the MW for 2018. According to the ENOE, approximately 50% of Mexican employees in the private sector earn up to twice the MW.
[18] The gradual reduction of the SUFE is designed to ameliorate disincentives to formality generated with an abrupt elimination of the subsidy.

virtually unchanged. Overall, these changes to the SUFE would increase the fiscal balance from 6.87 to 7.49% of GDP while substantially raising the formality rate.

Table 6. PIT schemes
(monthly income in pesos)

A. 2018 PIT table

Lower bound	Upper bound	Fixed amount	Rate (%)
0.01	578.52	0.00	1.92
578.53	4,910.18	11.11	6.40
4,910.19	8,629.20	288.33	10.88
8,629.21	10,031.07	692.96	16.00
10,031.08	12,009.94	917.26	17.92
12,009.95	24,222.31	1,271.87	21.36
24,222.32	38,177.69	3,880.44	23.52
38,177.70	72,887.50	7,162.74	30.00
72,887.51	97,183.33	17,575.69	32.00
97,183.34	291,550.00	25,350.35	34.00
291,550.01	Onwards	91,435.02	35.00

B. PIT table under reforms

Lower bound	Upper bound	Fixed amount	Rate (%)
0.01	4,910.18	0.00	0.00
4,910.19	8,629.20	0.00	10.88
8,629.21	10,031.07	404.63	16.00
10,031.08	12,009.94	628.93	17.92
12,009.95	24,222.31	983.54	21.36
24,222.32	38,177.69	3,592.10	23.52
38,177.70	72,887.50	6,874.40	30.00
72,887.51	97,183.33	17,287.34	32.00
97,183.34	291,550.00	25,062.00	34.00
291,550.01	Onwards	91,146.67	35.00

Sources: 2018 PIT table: Ministry of Finance; PIT table under reforms: own.

4.2 Simulation of changes to the PIT scheme

Table 6 presents the impact of simulated changes to the PIT scheme. Panel A shows the baseline, which reflects the conditions that were in place in 2018. The first reform scenario grants a 100% tax exemption to formal workers in the first two income brackets. This exemption is applied by setting a 0% tax rate and a fixed payment amount of $0 for the first two brackets, while all other tax rates remain unchanged. To avoid creating a tax notch, the fixed amount for the third income

bracket would also be $0, and the fixed amounts for the remaining brackets would be adjusted according to the formula currently used by the Ministry of Finance. Panel B of Table 6 shows the PIT table for the proposed reform after combining the first two income brackets in panel A. As described next, eliminating PIT for workers in the lowest income brackets could significantly increase employment formality with almost no effect on the fiscal balance.

Table 7 shows the impact of these changes to the PIT scheme. Exempting incomes of up to $4,910 pesos per month from PIT liability increases the net incomes of low-wage formal workers, encouraging high-skilled informal workers to formalize. As a result, the formality rate increases by almost 10 percentage points. Formalization among high-skilled informal workers reduces the average net earnings of both formal and informal employees, as workers who were previously the highest-paid employees in the informal sector become the lowest-paid employees in the formal sector, while the inflow of low-ability workers into the formal sector further reduces its equilibrium wage rate. Although the outflow of labor from the informal sector raises its equilibrium wage rate, this effect is more than offset by the exit of highly paid workers from the informal sector, combined with an influx of formerly own-account workers seeking higher incomes as informal salaried employees.

These changes to the PIT entail multiple countervailing effects of the fiscal accounts. Eliminating the tax liability of low-income workers causes PIT revenue to fall to 2.67% of GDP, while the rising formalization rate allows firms to increase their tax deductions, causing a slight drop in CIT revenue. Since the former effect is greater than the latter, the relative income-tax burden on firms rises from 50 to 51.2%. While income-tax revenue declines, formalization increases SSCs, leaving fiscal revenue largely unchanged. Meanwhile, total expenditures increase from 2.43 to 2.56% of GDP because of higher spending on SSC, the SUFE and extra operating expenditures on health care. Consequently, the budget balance deteriorates slightly relative to the baseline.

Table 7. Personal income tax (PIT) reform simulations

	Data	Model (baseline)	Model (income tax exemption up to $4,910)
OCCUPATION (AS A SHARE OF EMPLOYMENT)			
Total informal	0.658	0.658	0.559
Own-account	0.263	0.263	0.183
Informal salaried	0.395	0.395	0.376
Formal salaried	0.294	0.294	0.393
Employers	0.048	0.048	0.048
AVERAGE NET INCOME (PESOS PER MONTH)			
Total salaried	5,668	5,720	5,549
Formal	7,447	7,469	6,978
Informal	4,344	4,419	4,054
Own-account	4,762	2,766	2,547
Employers	12,817	12,817	13,376
FISCAL ACCOUNTS (AS % OF GDP)			
Salaried workers			
(A) Income tax	3.10	3.10	2.67
(B) SSC	n.a.	0.29	0.36
Employers			
(C) Income tax	3.10	3.10	2.80
(D) SSC	n.a.	2.81	3.51
Government - Contributory SS			
(E) SS revenue (B+D)	3.10	3.10	3.87
(F) SS expenditures	0.53	0.53	0.67
(G) Extra operating expenditures	N/A	N/A	0.24
(H) Balance (E-F-G)	2.57	2.57	2.96
Government - Other			
(I) Income tax revenues (A+C)	6.20	6.20	5.47
(J) Subsidy to formal employment	0.20	0.20	0.27
(K) Non-contributory SS	1.70	1.70	1.38
(L) Balance (I-J-K)	4.30	4.30	3.82
Government - Total			
(M) Revenue (E+I)	9.30	9.30	9.34
(N) Expenditures (F+G+J+K)	2.43	2.43	2.56
(O) Budget balance (M-N)	6.87	6.87	6.78
TAX BURDEN (%)			
Income tax			
Salaried workers	50.0	50.0	48.8
Employers	50.0	50.0	51.2
SSC			
Salaried workers	n.a.	9.4	9.3
Employers	n.a.	90.6	90.7

Source: own.

N/A: not applicable.

n.a.: not available.

4.3 Simulation of simultaneous changes to the PIT and SUFE

This section simulates the effects of modifying both the PIT and SUFE schemes, a scenario described in the tables as the “full reform.” The change to the PIT is the same as that described in the above section, while the change to the SUFE is the same as the final scenario presented in section 4.1, in which a unform transfer of $400 pesos per month is granted to all workers with incomes of up to $4,910 pesos per month, with transfer amounts being progressively reduced above that level and ultimately eliminated for earnings of $7,410 pesos per month or more. As the changes to the PIT and SUFE both incentivize formalization individually, their combined effect is especially large. Under the “full reform” scenario, the formality rate rises by nearly 12 percentage points. Meanwhile, the positive fiscal impact of the change in the SUFE outweighs the negative impact of the PIT change, resulting in a modest net improvement in the government’s budget balance.

Table 8 presents the model’s results in terms of employment, average earnings, and the average utility of disposable income. The combination of the PIT exemption for the first two income brackets and the redesign of the SUFE increases the share of formal salaried employees from 29.4 to 41.3% of total employment. As discussed above, these measures strongly incentivize labor formalization mainly at the expense of own-account workers. They also decrease average net earnings for both formal and informal employment as own-account and informal salaried workers with the highest skills enter informal salaried and formal salaried occupations, respectively.

Table 8 also shows the average utility of disposable income for workers in both scenarios, monetized in pesos per month. In our model, workers’ utility is equivalent to their earnings, given by equations (9) - (11). Therefore, the difference between the average utility of disposable income and net income for both own-account workers and informal salaried employees is explained by their valuation of lump-sum transfers. For formal employees, the difference reflects the valuation of their social security benefits plus the fringe benefits conferred by formal employment, and thus

the utility and net income of these workers move in the same direction. For entrepreneurs, utility is assumed to be identical to net benefits.

Table 8. Effects of the combined PIT and SUFE reforms on occupational choice, net income, and average utility of disposable income

	Data	Model (baseline)	Model (full reform)
OCCUPATION (AS A SHARE OF EMPLOYMENT)			
Total informal	0.658	0.658	0.539
Own-account	0.263	0.263	0.179
Informal salaried	0.395	0.395	0.360
Formal salaried	0.294	0.294	0.413
Employers	0.048	0.048	0.048
AVERAGE NET INCOME (PESOS PER MONTH)			
Total salaried	5,668	5,720	5,545
Formal	7,447	7,469	6,700
Informal	4,344	4,419	4,223
Own-account	4,762	2,766	2,536
Employers	12,817	12,817	13,331
AVERAGE UTILITY OF DISPOSABLE INCOME (PESOS PER MONTH)			
Formal salaried	N/A	8,441	7,556
Informal salaried	N/A	5,225	5,029
Own-account	N/A	3,572	3,342
Employers	N/A	12,817	13,331

Source: own.

N/A: not applicable.

Table 9 shows how the combined changes to the PIT and SUFE affect the fiscal accounts. Under this scenario, PIT revenue increases slightly relative to the scenario in which the PIT is reformed while the SUFE is left unchanged (see Table 7). This effect occurs for two reasons. First, because the modified SUFE is less favorable for wage earners with incomes greater than $5,600 pesos per month, the SUFE reform increases the amount of PIT collected from workers with incomes between $5,600 and $7,400 pesos per month. Second, higher formalization expands the PIT tax base. This increase in formalization also raises revenue from SSC. Overall, the changes implemented under the “full reform” scenario increase total government revenue by 0.34% of GDP relative to the baseline.

Table 9. Effects of the combined PIT and SUFE reforms on the fiscal accounts

	Data	Model (baseline)	Model (full reform)
FISCAL ACCOUNTS (AS % OF GDP)			
Salaried workers			
(A) Income tax	3.10	3.10	2.90
(B) SSC	n.a.	0.29	0.38
Employers			
(C) Income tax	3.10	3.10	2.81
(D) SSC	n.a.	2.81	3.70
Government - Contributory SS			
(E) SS revenue (B+D)	3.10	3.10	4.08
(F) SS expenditures	0.53	0.53	0.71
(G) Extra operating expenditures	N/A	N/A	0.27
(H) Balance (E-F-G)	2.57	2.57	3.09
Government - Other			
(I) Income tax revenues (A+C)	6.20	6.20	5.71
(J) Subsidy to formal employment	0.20	0.20	0.25
(K) Non-contributory SS	1.70	1.70	1.34
(L) Balance (I-J-K)	4.30	4.30	4.12
Government - Total			
(M) Revenue (E+I)	9.30	9.30	9.78
(N) Expenditures (F+G+J+K)	2.43	2.43	2.57
(O) Budget balance (M-N)	6.87	6.87	7.21
TAX BURDEN (%)			
Income tax			
Salaried workers	50.0	50.0	50.9
Employers	50.0	50.0	49.2
SSC			
Salaried workers	n.a.	9.4	9.3
Employers	n.a.	90.6	90.7

Source: own.

N/A: not applicable.

n.a.: not available.

Table 9 also shows the effects of the combined PIT and SUFE reforms on public spending. Higher formality rates increase expenditures on contributory social security to 0.71% of GDP while boosting extra operating expenses in healthcare by 0.27% of GDP. However, formalization also decreases spending on non-contributory SS transfers to informal workers, and total government spending increases by just

0.14% of GDP. Because the increase in revenues exceeds the increase in expenditures, the budget balance improves relative to the baseline. The combined reforms successfully encourage labor formalization while also strengthening the fiscal accounts, yielding clear benefits in two major economic policy areas while incurring no evident cost.

Finally, Table 9 reports how the burden of income taxes and SSC is distributed between workers and employers. It may be observed that the reform slightly increases the income-tax burden borne by workers from 50.0 to 50.9%, but the burden of SSC remains broadly unchanged.

5. Sensitivity analysis

The results presented above are based on specific parameter values. However, as discussed in section 3, some values are determined *a priori*, as no comparable evidence is presented in the literature. To test the robustness of the results, we conduct a sensitivity analysis of the "full reform" scenario. The analysis shows that the combined PIT and SUFE reforms generate a significant increase in employment formality along with a modest improvement in the fiscal accounts under a range of alternative parameter values.

The following parameters are considered for this analysis: the parameter related to the elasticity of substitution between formal and informal salaried labor (ψ); returns to scale for the production function of the entrepreneur (γ); the valuation of social security benefits (β_F) and noncontributory transfers (β_I); returns to scale for the skill levels of informal salaried workers (α); and the lower and upper bounds for labor ability ($\underline{e}$ and $\overline{e}$). The first two parameters are directly related to the labor demand of entrepreneurs, while the next three are labor-supply parameters affecting the occupational choices of workers, and the last two relate to the distribution of labor ability. In each of the following exercises, a single parameter is changed and the ten parameters under the third group are re-estimated to match the moments of Table 3. We also present an exercise in which three parameters are simultaneously changed.

For ψ, we consider the alternative values of $\psi = 0$ and $\psi = -9$, which imply elasticities of substitution between formal and informal labor of 1 and 0.1, respectively, instead of the elasticity value of 10 used in the baseline scenario. Lower values for ψ reflect a diminished willingness among employers to substitute formal for informal labor, which attenuates the impact of the reforms on formalization. For parameter γ, alternative values of 0.67 and 0.82 are adopted instead of the original value of 0.76. A lower value for γ implies a decrease in the marginal product of labor, which discourages the hiring of salaried workers, while a higher value implies the opposite. Decreasing the value of parameter β_F from 0.30 to 0.05 means that workers value their social security benefits 83% less than in the baseline scenario, while increasing the value of β_F from 0.30 to 0.60 means that they will value those benefits twice as highly as in the baseline. Raising the value for β_I from 0.85 to 1 increases the valuation of lump-sum transfers, encouraging informal employment at the expense of formal employment, while reducing the value for β_I to 0.35 has the opposite effect. For α, we use an alternate value of 0.9, which is slightly above the benchmark value of 0.857. For labor ability, we raise the lower bound of e while lowering its upper bound, narrowing the domain of its distribution, which has unpredictable implications for the impact of the reforms on the formalization rate.

Tables 10A and 10B present the results of the sensitivity analysis, as well as the simulation conducted under the baseline scenario. We begin by analyzing changes in a single parameter. For occupational choices, the strong effect on formality previously reported is robust to alternative parameter values. Even in the least-favorable scenario ($\psi = 0$), the formality rate increases to 37%. Changes in average net income relative to the baseline are registered across all occupation types, but these changes are modest. Changes to the fiscal accounts are also relatively small but uniformly positive: in the least-favorable scenario, the budget balance rises from 6.87% of GDP to 7.05%.

Table 10A. Sensitivity analysis of the combined PIT and SUFE reforms

	Benchmark model (baseline)	Benchmark model (full reform)	Sensitivity analysis							
			$\psi = 0$	$\psi = -9$	$\gamma = 0.67$	$\gamma = 0.82$	$\beta_F = 0.05$	$\beta_F = 0.60$	β_I =0.35	$\beta_I = 1$
OCCUPATION (AS A SHARE OF EMPLOYMENT)										
Total informal	0.658	0.539	0.582	0.581	0.558	0.529	0.543	0.549	0.510	0.548
Own-account	0.263	0.179	0.179	0.171	0.195	0.162	0.185	0.189	0.194	0.173
Informal salaried	0.395	0.360	0.403	0.410	0.362	0.367	0.357	0.360	0.316	0.375
Formal salaried	0.294	0.413	0.370	0.371	0.394	0.423	0.409	0.403	0.442	0.404
Employers	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048	0.048
AVERAGE NET INCOME (PESOS PER MONTH)										
Total salaried	5,720	5,545	5,539	5,521	5,579	5,509	5,515	5,486	5,304	5,481
Formal	7,469	6,700	6,742	6,748	6,707	6,702	6,743	6,568	5,995	6,790
Informal	4,419	4,223	4,433	4,411	4,351	4,136	4,108	4,276	4,338	4,070
Own-account	2,766	2,536	2,536	2,510	2,583	2,482	2,640	2,249	1,876	2,547
Employers	12,817	13,331	13,374	13,383	13,214	13,377	13,293	13,320	13,289	13,315
FISCAL ACCOUNTS (AS % OF GDP)										
Salaried workers										
(A) Income tax	3.10	2.90	2.82	2.83	2.79	3.03	2.93	2.72	3.16	2.87
(B) SSC	0.29	0.38	0.35	0.35	0.37	0.39	0.38	0.37	0.41	0.37
Employers										
(C) Income tax	3.10	2.81	3.07	3.07	2.93	2.73	2.80	2.87	2.86	2.81
(D) SSC	2.81	3.70	3.26	3.27	3.55	3.79	3.65	3.66	4.00	3.61
Government - Contributory SS										
(E) SS revenue (B+D)	3.10	4.08	3.61	3.62	3.92	4.18	4.02	4.03	4.42	3.99
(F) SS expenditures	0.53	0.71	0.61	0.61	0.68	0.72	0.70	0.71	0.77	0.69
(G) Extra operating expenditures	N/A	0.27	0.21	0.21	0.23	0.30	0.27	0.24	0.33	0.26
(H) Balance (E-F-G)	2.57	3.09	2.79	2.80	3.00	3.16	3.05	3.08	3.32	3.04
Government - Other										
(I) Income tax revenues (A+C)	6.20	5.71	5.89	5.89	5.72	5.76	5.72	5.59	6.01	5.68
(J) Subsidy to formal employment	0.20	0.25	0.19	0.20	0.24	0.25	0.25	0.25	0.26	0.24
(K) Non-contributory SS	1.70	1.34	1.44	1.44	1.40	1.31	1.35	1.37	1.27	1.36
(L) Balance (I-J-K)	4.30	4.12	4.26	4.25	4.08	4.20	4.13	3.97	4.48	4.08
Government - Total										
(M) Revenue (E+I)	9.30	9.78	9.50	9.51	9.64	9.93	9.74	9.61	10.43	9.67
(N) Expenditures (F+G+J+K)	2.43	2.57	2.45	2.46	2.55	2.58	2.56	2.57	2.63	2.55
(O) Budget balance (M-N)	6.87	7.21	7.05	7.05	7.08	7.35	7.18	7.05	7.80	7.11
TAX BURDEN (%)										
Income tax										
Salaried workers	50.0	50.9	47.9	48.0	48.8	52.6	51.2	48.6	52.5	50.5
Employers	50.0	49.2	52.1	52.0	51.2	47.4	48.8	51.4	47.5	49.5
SSC										
Salaried workers	9.4	9.3	9.6	9.7	9.3	9.3	9.3	9.3	9.3	9.3
Employers	90.6	90.7	90.4	90.3	90.7	90.7	90.7	90.7	90.7	90.7

Source: own.
n.a.: not available.

The last column of Table 10B shows the results of a simulation in which three parameters are simultaneously changed to make formalization more difficult. The elasticity of substitution between formal and informal salaried workers is set to 1 ($\psi = 0$), while β_F and β_I are set at 0.05 and 1, respectively. Even in this scenario, the formality rate rises by 7 percentage points over the baseline, from 29.4 to 36.4%, while the fiscal balance remains broadly unchanged.

Table 10B. Sensitivity analysis of the combined PIT and SUFE reforms

	Benchmark model (baseline)	Benchmark model (full reform)	Sensitivity analysis		
			$\alpha = 0.9$	$\underline{e} = 0.3, \overline{e} = 10$	$\psi = 0, \beta_F = 0.01, \beta_I = 1$
OCCUPATION (AS A SHARE OF EMPLOYMENT)					
Total informal	0.658	0.539	0.529	0.531	0.588
Own-account	0.263	0.179	0.205	0.182	0.171
Informal salaried	0.395	0.360	0.323	0.349	0.417
Formal salaried	0.294	0.413	0.423	0.421	0.364
Employers	0.048	0.048	0.048	0.048	0.048
AVERAGE NET INCOME (PESOS PER MONTH)					
Total salaried	5,720	5,545	5,705	5,537	5,454
Formal	7,469	6,700	6,446	6,560	6,948
Informal	4,419	4,223	4,735	4,301	4,151
Own-account	2,766	2,536	2,414	2,722	2,618
Employers	12,817	13,331	13,184	13,336	13,482
FISCAL ACCOUNTS (AS % OF GDP)					
Salaried workers					
(A) Income tax	3.10	2.90	3.02	2.76	2.74
(B) SSC	0.29	0.38	0.40	0.38	0.34
Employers					
(C) Income tax	3.10	2.81	2.84	2.80	3.05
(D) SSC	2.81	3.70	3.85	3.79	3.19
Government - Contributory SS					
(E) SS revenue (B+D)	3.10	4.08	4.25	4.17	3.53
(F) SS expenditures	0.53	0.71	0.74	0.74	0.60
(G) Extra operating expenditures	N/A	0.27	0.29	0.28	0.19
(H) Balance (E-F-G)	2.57	3.09	3.22	3.15	2.74
Government - Other					
(I) Income tax revenues (A+C)	6.20	5.71	5.86	5.56	5.79
(J) Subsidy to formal employment	0.20	0.25	0.26	0.27	0.20
(K) Non-contributory SS	1.70	1.34	1.33	1.32	1.45
(L) Balance (I-J-K)	4.30	4.12	4.27	3.97	4.15
Government - Total					
(M) Revenue (E+I)	9.30	9.78	10.11	9.72	9.33
(N) Expenditures (F+G+J+K)	2.43	2.57	2.61	2.60	2.44
(O) Budget balance (M-N)	6.87	7.21	7.50	7.12	6.88
TAX BURDEN (%)					
Income tax					
Salaried workers	50.0	50.9	51.6	49.6	47.4
Employers	50.0	49.2	48.4	50.4	52.6
SSC					
Salaried workers	9.4	9.3	9.3	9.2	9.7
Employers	90.6	90.7	90.7	90.8	90.3

Source: own.

n.a.: not available.

The sensitivity analysis indicates that the results obtained are robust to a range of alternative parameter values. Even under the least-favorable scenario, the combined reforms would have a highly positive impact on formalization while incurring no significant fiscal cost.

6. Conclusions

This paper has presented a static general equilibrium model of occupational choice with heterogeneous labor and entrepreneurial skills to evaluate how changes in the labor-income tax scheme affect employment informality and the fiscal accounts. Heterogeneity in labor skills is important because it generates an income distribution and a corresponding income-based tax and subsidy structure, capturing an important characteristic of tax schemes observed in countries around the world. Heterogeneity in entrepreneurial skills is also relevant because it allows larger firms to hire more formal workers than smaller firms, reflecting another important feature of the data. The model has been calibrated for Mexico, which is characterized by a high rate of labor informality. Various reforms to the current SUFE and PIT schemes have been considered, both separately and together, and their impacts on labor formality and the fiscal accounts have been estimated.

The exercises indicate that minor modifications to the current labor-tax and subsidy scheme could have large, positive effects on labor formality with no adverse impact on the fiscal balances. Modifying the SUFE schedule while eliminating the PIT liability of the lowest-income formal workers strongly incentivizes formalization, and our simulations suggest that these measures could increase the formality rate by between 7.0 and 11.9 percentage points. Importantly, these changes to tax and subsidy policies would entail no net cost to the government: the fiscal balance would either remain constant or modestly improve. Meanwhile, the distribution of the income tax-burden between workers and employers would shift only slightly relative to the baseline scenario.

The simulation exercises presented above underscore how general equilibrium models can yield important insights into prospective changes to income-tax and

subsidy policies in contexts of high labor informality. For example, in the scenario where the SUFE is eliminated, the government balance does not improve due to the decrease in subsidy spending, but instead deteriorates because of a sharp increase in informality. Similarly, reducing PIT liability for low-income workers can improve the fiscal balances by increasing the formality rate, which more than compensates for the loss of direct tax revenue. These counterintuitive results are better understood once the endogenous links between informality and the tax base have been considered.

Despite the important results obtained by the simulations, the model could be elaborated further to address some of its limitations. For example, due to its static nature the model is unable to produce a transitional path to a new equilibrium after the introduction of fiscal changes. During the transitional period, such changes may be substantially different from those observed under the new equilibrium. Another extension relates to the inclusion of informal firms that hire salaried workers, which could enable the model to explicitly evaluate the effect of changes in the labor-income tax scheme on those firms.

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Appendix A. A brief explanation of the PIT, SUFE and CSS schemes in Mexico

In Mexico, all people must pay taxes on their income. In this regard, five different regimes of personal income taxes are classified according to the taxpayer's income source (wages, professional services, real estate, and small and large businesses). The amount of tax that must be paid under each regime is determined from the information included in a single reference table, which guarantees that the amount due is based on the taxpayer's income and not on the regime to which she belongs.

The determination of income tax due is based on five variables: the taxpayer's income; the lower and upper bound defining the tax bracket to which the taxpayer belongs; a fixed-amount component of the tax due (the "fixed fee"); and the tax rate. The last two variables are defined as a function of the tax bracket. Under this scheme, the tax due has a fixed and variable component.

By way of illustration, panel A of Table 6 presents the PIT on monthly income in place in 2018. As can be observed, the PIT scheme is progressive. It should be noted that the scheme is composed of 43 parameters belonging to the model described in section 2.

To show how income tax is determined, assume that a worker earns a gross income of $6,500 pesos per month. Taking the lower and upper bounds of panel A in Table 6 as a reference, this income belongs to the third income bracket, implying that the fixed component of the tax due is valued at $288.33. To determine the variable portion of the tax, the excess amount of income over the lower bound is taxed at 10.88%, resulting in a variable tax of ($6,500 - $4,910.19) x 0.1088 = $172.97. Finally, this amount is added to the fixed component to determine the total amount of tax due, which in this case is equivalent to $288.33 + $172.97 = $461.30.

To decrease the PIT for low-income workers, the Mexican government has been implementing the SUFE scheme for several years. Under this scheme, formal salaried workers are entitled to a subsidy to reduce their income tax burden, which

is granted based on their gross income. For 2018, the SUFE was determined according to information shown in Table 4. As mentioned earlier, this scheme is designed to be progressive. As can be observed in Table 4, the SUFE scheme is determined by 32 parameters considered in the model.

The worker can credit the SUFE against the amount of tax due. Returning to the example of the worker with a monthly gross income of $6,500 pesos, the information provided in Table 4 indicates that the corresponding amount of SUFE is $253.54. This implies that the net amount of income tax due is calculated as $461.30 - $253.54 = $207.76. With the SUFE, the net income tax for workers who earn up to $5,245 per month (equivalent to 1.95 times the MW) is negative. That is, these workers receive some extra income each month because of the SUFE.

The employer is responsible for the retention of the PIT for her workers and for calculating the corresponding SUFE. When the net tax is negative, the employer must pay that amount to the worker directly. This amount may, in turn, be credited by the employer against her income tax due.

The CSS scheme provides health, disability and work-risk insurance, and finance housing, daycare, and retirement pensions for workers. Contributions are covered by employees, employers, and the government. The scheme is defined by 27 parameters, including the lump-sum subsidy to finance the pension of low and middle-income workers currently in place (for details, see Antón and Hernández, 2017). In the model, there are 8 additional parameters defining payroll taxes at the state level, a series of tax deductions allowed by the law, and the amount of taxable and non-taxable fringe benefits for workers (as a proportion of the wage). Overall, the PIT, SUFE and CSS schemes are defined by 110 parameters.

Appendix B. Data sources

All information used to calibrate the model is mainly taken from Mexico's National Statistics Institute (INEGI) and Ministry of Finance (SHCP). Data on CIT and PIT revenues are obtained from the Ministry of Finance (2017c). To ensure consistency with the model, a distinction is made between tax revenues from wages

and salaries and those generated from firms and individuals running their own businesses or delivering professional services. Revenues from worker-employer contributions to social security originate from the INEGI (2017). This information is available on an annual basis for 2003-2016. For this period, these revenues represent 3.1% of GDP on average. Unfortunately, the INEGI does not distinguish between payments made by workers and those made by employers.

Information on the SUFE granted by the government for 2017 is obtained from the Ministry of Finance (2017b). The amount spent by the government under the CSS scheme originates from the Ministry of Finance (2017a). The average annual cost of providing health services to a formal worker is set at $13,503 pesos. This information is estimated with data from IMSS (2018). GDP figures are obtained from the INEGI's System of National Accounts.

Data on the labor market are taken from INEGI's National Occupation and Employment Survey (2013). Employers as a share of employment in the private sector are estimated at 4.8% whereas the share of own-account workers is 26.3%. The rest are formal (29.4%) and informal (39.5%) salaried workers. These values are reported in Table 5. Regarding earnings, the survey provides information to estimate the average income for each occupation. When adjusting these data for inflation to the year 2018, average salaries of $7,447 and $4,344 pesos per month for formal and informal salaried workers, respectively, are estimated. Average earnings of employers and own-account workers are also reported even though they are not required for the calibration process. Information taken from the wage distribution reported in Table 3 is also obtained from this source, and it is adjusted for inflation to the year 2018. The MW is set at its 2018 level.