The Incidence of Social Security Taxes in Economies with Partial Compliance: Evidence from the SS Reform in Mexico

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Abstract

Looking at improvements in social security benefits in Mexico, this paper evaluates what fraction of the new mandated benefits can be shifted to wages in economies where there is a large prevalence of non-compliance with the regulation. I depart form previous studies on the effects of labor regulations in economies where there is a large fraction of uncovered workers that use Differences-in-Differences methods comparing covered and uncovered workers. These methods require the composition of the control group to be constant when regulation changes. Evidence from Mexico challenges this assumption since labor reallocated towards the covered sector after social security benefits improved.

Instead of relying on the Difference-in-Difference estimator, I evaluate the regulation using a two-sector general equilibrium model with labor mobile between sectors. In this model, I explicitly derive the effects of labor reallocation on wages induced by changes in taxes and benefits. I extend Harberger's two-sector model to account for social security taxation and introduce social security benefits into it. I also extend his model by explicitly modeling worker's selection into the covered sector using

a Generalized Roy Model. The model shows the wage differential between the covered and the uncovered sectors depends on changes in the composition of workers across sectors, but also on the equilibrium effect caused by changes in relative supply. Under this scenario, incidence of the regulation cannot be calculated based solely on changes in the wage differential, even after controlling for selection.

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1 Introduction

This paper makes two contributions. First, it derives an analytical framework for understanding the effects of social security taxation on wages and employment when non-compliance is substantial[1]. Second, it uses a 1997 Social Security Reform in Mexico to compare estimates based on widely used Differences-in-Differences methods with estimates derived from an econometric general equilibrium model. This paper shows that Differences-in-Differences methods generate inaccurate estimates of the incidence of the regulation on wages. In Mexico, the substitution of the Pay-As-You-Go for Individual Retirement Accounts increased covered workers' benefits by 7 to 9 percent of their wage. Incremental benefits measured by Differences-in-Differences were only 2.4 percent, while estimates based on wage responses predicted by the model implied incremental benefits of 10 percent.

Many studies on the effects of labor regulations in economies where there is a large fraction of uncovered workers use Differences-in-Differences methods; the common identifying assumption is that uncovered workers are an ideal control group[2]. This identification strategy requires that the reform does not change the composition of the control group. Intuitively, this is a strong assumption since changes in regulations will induce labor reallocation across sectors. First, gains from reforms vary across demographic and skill groups. Second, social security taxes

[1] In Mexico 37% of private sector employees work at a firm that does not comply with the regulation. Non-compliance with social security coverage is substantial in many Latin American countries.

[2] See Kugler (1999), Mondino and Montoya (2001). See Gruber (1997) and Kugler and Kugler (2001), although they do not use uncovered workers as a control they ignore composition and equilibrium effects on wages paid by

distort labor costs in the covered sector relative to the uncovered sector. When a reform contaminates the control group, Differences-in-Differences fail to control for compositional bias and general equilibrium effects. I find evidence for Mexico that justifies these concerns.

Two years after the legislation the social security system was improved in Mexico, labor reallocated towards the covered sector. Coverage increased among those demographic groups that benefited from the new retirement system. In fact, there is no change in the share of labor employed in the uncovered sector among workers who will retire under the old regime (Figures 1 and 2). The fraction of workers employed by for non-complying firms decreased from 41.5 percent just before the new law was announced to 34.12 in the third quarter of 1999 (Figure 3). Further, reallocation effects were stronger in sectors typically covered by social security (Figure 4).

Instead of relying on the Difference-in-Difference estimator with its weak empirical formulation, I evaluate the regulation using a two-sector general equilibrium with labor mobile between sectors. In this model I explicitly derive the effects of labor reallocation on wages induced by changes in taxes and benefits. I extend Harberger's two-sector model to account for social security taxation and introduce social security benefits into it. In the model, covered employees receive the benefits of the programs financed with this tax and therefore, complying firms can pay lower wages in exchange for social security benefits. I also extend his model by explicitly considering how workers select into the covered sector.

I derive labor supply under two scenarios: a) workers are homogenous in tastes and skills and b) workers are heterogeneous in their benefits from coverage and productivity differentials. When workers are homogenous labor supply between the covered and uncovered sector is completely elastic and wage differential between sectors equals differences in benefits. In this scenario, the model resembles Harberger's original model. However, the homogeneity

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complying firms.

assumption requires that there are comparable jobs in each sector for every worker in the economy or else that complying and non-complying firms are randomly allocated across sectors. Because the cost of avoiding regulatory agencies varies among economic sectors, in equilibrium there are economic sectors that are typically covered by social security as well as economic sectors without coverage[3]. As a result, a worker's productivity in the covered sector may not be equal to his productivity in the uncovered sector. When workers are heterogeneous in skills they select into the covered sector based on their preferences for coverage, but also based on their comparative advantage.

The implications of the model are two. First, if the complying and the non-complying sectors have different technologies, then social security taxes distort the comparative advantage of workers across sectors. In this case, social security taxes force workers to move from the sector where they are more productive to a sector where they are less productive. Second, the equilibrium wage differential between the covered and the uncovered sectors depends on the distribution of workers across sectors and therefore, tax incidence cannot be calculated based solely on changes in the wage differential, even after controlling for selection.

An additional advantage of using the model to derive the effects of social security taxation on wages is that I can separate wage effects of reducing social security taxes from the effects of tying workers benefits to their contributions. Previous studies based on wage differentials between the covered and uncovered sector[4] do not answer the key empirical question that the analysis of the incidence of social security taxation requires: What fraction of the cost of social security can the firm shift to workers in form of lower wages? Inability to answer this questions arises from the fact that most social security reforms combine changes in benefits with tax reductions, thus shifting both labor demand and supply. Besides the limitations of ignoring

[3] Coverage in large manufacturing firms is about 85% while coverage in non-tradable sectors is about 28%.

[4] Mondino and Montoya (2000), Cox-Edwards (2000)

equilibrium effects of labor reallocation, Differences-in-Differences methods cannot isolate the effects that changes in benefits had on equilibrium wages from changes in the tax rate.

The paper is organized as follows. Section 2 describes the main features of the new Social Security legislation implemented in July 1997. Section 3 presents the general equilibrium model and derives determinants of the shifting of taxes and benefits to wages. Section 4 presents estimates on the valuation of new benefits based on Difference-in-Difference estimators methods. Section 5 describes the empirical methods used to estimate the econometric general equilibrium model and compare these results with difference-in-difference estimators. Section 6 concludes the paper and suggests directions for future research.

2 Social Security Reform in Mexico

The Reform in 1997 substituted the Pay-As-You-Go retirement system for a system based on Individual Retirement Accounts. Contributions to the Individual Retirement Accounts increased from 2% to 13.5%. The reform has distinctive cohort effects, workers older than 50 are more likely to retire under the old regime rules and therefore, have no direct benefits from the privatization of the retirement pension[5].

Evidence from the Social Security reform in Mexico challenges empirical methods that require a constant control group, since labor reallocates across sectors depending on benefits. First, coverage increased more among those demographic groups that benefited the most from the new retirement system. In fact, there is no change in the share of labor employed in the non-complying sector among workers who will retire under the old regime. Second, the share of labor

[5] See Appendix A for a detailed description of the elements of the reforms as well as the comparison of benefits in the old regime and new regime for different skills and demographic groups.

employed in the non-complying sector decreased across all economic sectors. Third, reallocation effects were stronger in sector typically covered by social security.

The reform clearly affects young and old workers differently. Older workers, more than 50, are more likely to retire under the old regime rules and therefore receive no direct benefits from the privatization of the retirement pension. However, older workers could claim Pay-As-You-Go benefits only if they were registered before the new legislation was implemented in July 1997. Figure 1 shows older workers moved away from the uncovered sector to the covered sector to be entitled to Pay-As-You-Go benefits. In addition, reallocation towards the covered sector did not increase further after the law was implemented. The later is consistent with the fact that old worker had no further gains from switching sectors after July 1997. Figure 2 shows young workers reallocated towards the covered sector after the new law was implemented in July 1997.

Coverage increased when benefits improved, figure 3 shows the fraction of workers employed by for non-complying firms decreased from 41.5 percent just before the new law was announced to 34.12 in the third quarter of 1999.

Evidence from the reform in Mexico shows that changes in the regulation do not affect all economic sectors equally. Intuitively, in economies with large prevalence of non-compliance, changes in the regulation will be stronger to complying firms or firms that are at the margin of compliance. Figure 4 shows reallocation effects were stronger in economic sectors typically covered by social security. Differences in reallocation in the manufacturing sector, a sector with traditionally high compliance rates and in the service sector, a sector with low coverage, are not small.

The covered sector is primarily composed of large firms while the uncovered sector is composed mainly of firms with 16 or fewer workers. In this sense, regulation increases the relative cost of labor to large firms. As the Social Security reform reduces the relative cost of labor in the complying sector, we expect employment to move away from small firms toward large firms. Figure 5 and Figure 6 show that this is the case; after 1997, the distribution of

employment across firm sizes moved away small firms towards larger firms after being constant from 1993 to 1997.

3 Model

I extend Harberger's two-sector general equilibrium model to account for social security taxation and introduce social security benefits into it. In the model, covered employees receive benefits from the programs financed with this tax and therefore, complying firms can pay lower wages in exchange for social security benefits. I also extend his model by explicitly considering how workers select into the covered sector. I derive labor supply under two scenarios: a) workers are homogenous in tastes and skills and b) workers differ in their benefits from coverage and productivity in the two sectors.

The analysis of the two-sector model shows that the Social Security tax is an implicit tax to firms that have higher cost of avoiding the regulation, and therefore it is an implicit tax to goods produced by economic sectors providing social security. I find that even if wages adjust completely between the complying and the non-complying sector for differences in benefits, social security taxes distort the comparative advantage between sectors when the firms with high cost of avoiding the regulation differ in their production technology to the rest of the economy and benefits are not equal to contributions. Also, I find that reducing social security taxes is not equivalent to tying benefits to contributions.

The model has the following empirical implication, widely used Differences-in-Differences methods fail to control for compositional bias and general equilibrium effects. For example, an increase in benefits in the covered sector reallocates labor supply from the covered sector to the uncovered sector, increasing the equilibrium wage in the uncovered sector and decreasing wages in the covered sector.

3.1 Homogeneous Agents

The economy is divided in two sectors Sector 1 is the taxed sector and Sector 0 is the untaxed (non-complying sector). X_1, and X_o are respectively the output produced in the taxed sector and the untaxed sectors.

Assuming constant returns to scale, 3.1 and 3.2 represent the cost functions in each sector:

$$C^1(r, w, X_1) = c^1(r, w_1(1+t))X_1 \quad 3.1$$

$$C^0(r, w, X_0) = c^0(r, w_0)X_0 \quad 3.2$$

Competition forces prices equal to marginal cost

$$p_1 = c^1(r, w_1(1+t)) \quad 3.3$$

$$p_0 = c^0(r, w_0) \quad 3.4$$

Demand for goods produced in each sector are given by:

$$X_1 = X_1(p_1, p_0, w_1(1+t)L_1 + w_0L_0 + rK) \quad 3.5$$

$$X_0 = X_0(p_1, p_0, w_1(1+t)L_1 + w_0L_0 + rK) \quad 3.6$$

The factors demands are:

$$L_1^d = c_2^1(r, w_1(1+t))X_1 \quad 3.7$$

$$L_0^d = c_2^0(r, w_0))X_0 \quad 3.8$$

$$K_1^d = c_1^1(r, w_1(1+t))X_1 \quad 3.9$$

$$K_0^d = c_1^0(r, w_0))X_0 \quad 3.10$$

Where:

p_j is the price of the good produced in sector *j*

t is the tax paid by the firm

r is the rental price of capital

w is the wage rate

L_j is the labor employed in sector *j*

K_j is the capital employed in sector *j*

c_i^j Corresponds to the derivative of the *i* argument of the unitary cost function in sector *j*.

The total tax rate is divided in two parts, so that the tax paid by the firm is given by:

$$t = t_1 + t_2$$

t_1 is the portion of the payroll tax that is allocated to programs whose benefits are perceived as public. t_2 corresponds to the portion of the Social Security tax that goes into the individual retirement accounts. The partition is irrelevant for the firm, however, only t_2 determines the relative labor supply between the covered and the uncovered sector.

Each agent supplies a single unit of labor to the sector that gives them the highest benefits. Wages adjust in each sector so that no one is better off switching sectors. Assuming that there are no switching costs we have that:

$$w_1 + b(t_2) = w_o$$

Where $b(t_2)$ represents the monetary equivalent of the benefits received in the covered sector. $b(t_2)$ is a function of the tax paid by the firm since the revenues are used to finance programs favoring workers employed in the covered sector.

Let a be the ratio of benefits to contributions. Then, $b(t_2)=w_1 a t_2$,.

The solution of the model gives the following relationship[6]:

$$\frac{d(w_1/r)}{w_1/r} = \frac{-\lambda\sigma_m\theta_{l1}dt - \sigma_1(\theta_{l1}k_1 + \theta_{k1}l_1)dt + \lambda\sigma_m\theta_{l0}adt_2 - \sigma_0(\theta_{l0}k_0 + \theta_{k0}l_0)adt_2}{\lambda\sigma_m(\theta_{l1} - \theta_{l0}) + \sigma_1(\theta_{l1}k_1 + \theta_{k1}l_1) + \sigma_0(\theta_{l0}k_0 + \theta_{k0}l_0)} \qquad 3.11$$

Where

θ_{ij} is the factor i share on sector j

σ_j is the elasticity of substitution between capital and labor in sector j.

$$\lambda \equiv \left(\frac{L_1}{L} - \frac{K_1}{K}\right)$$

The relative price of production factors paid by complying firms, w_1/r, increases with the Social Security tax. As a result, employment will reallocate to the uncovered sector.

If $a=1$ and $dt=dt_2$, that is workers who are covered value their benefits at their exact cost, then dt_2=- dt_2. Wages paid by complying firms will decrease by the same proportion as the tax. In this case, complying and non-complying firms face equal labor costs. If $a=1$, the relative price of factors $w_1(1+t)/r$ does not depend on the tax levied, nor does the relative price of the goods produced in each sector depend on the tax. Under this model diverting taxes to Individual

[6] Appendix B derives the solution of the model and compares results with Hargerber's original model.

Retirement Accounts should decrease wages by the same amount and there will not be any reallocation of workers towards sectors,, employment shares in the covered and the uncovered sector should remain constant.

Equation 3.11 shows that it is possible that the relative price of labor rise in response to a reduction in the tax rate, even if wages in the complying sector do not adjust to benefits (i.e. *a=0*). Note that when *a=0,* complying firms absorb all the cost of the regulation.

The previous analysis shows that even if workers are homogenous, the relationship dw_1/dt does not provide any evidence on what fraction of the cost is shifted to wages. In order to estimate this fraction we need to evaluate the response of the relative price of labor to capital to a change in taxes.

The homogeneity assumption implies that labor supply is completely elastic between sectors and therefore, complying firms are not able to shift pure taxes to wages. If workers are homogenous then the wage differential between the covered and uncovered sector does not depend on the tax levied to firms. The homogenous model implies that when benefits improve, wages in the covered sector to fall by the same proportion and employment shares remain constant

The homogeneity assumption requires that there are comparable jobs in each sector for every worker in the economy or else that complying and non-complying firms are randomly allocated across sectors. Because the cost of avoiding regulatory agencies varies among economic sectors, in equilibrium there are economic sectors that are typically covered by social security as well as economic sectors without coverage[7]. As a result, a worker's productivity in the covered sector may not be equal to his productivity in the uncovered sector. In the next section I extend the previous model to derive the implications when the covered and uncovered

[7] Coverage in large manufacturing firms is about 85% while coverage in non-tradable sectors is about 28%.

sector demand different types of skills and workers select into the taxed sector based on preference for coverage but also based on their comparative advantage.

3.2 Heterogeneous Workers

Each agent is endowed with a pair of sector specific efficiency units of labor q_{1i} and q_{0i}. That is, an agent i supplies q_{1i} efficiency units of labor if he works in the compliance sector or q_{0i} efficiency units of labor if he works in the non-compliance sector. It is assumed that the distribution of sector specific efficiency units is given.

The agent with endowment (q_{0i}, q_{1i}) selects into the sector that yields him the higher benefits, but he can only work at one sector at a time. Benefits in sector 1 include, in addition to earnings, benefits covered by social security. An agent with endowment (q_{0i}, q_{1i}) will work in the covered sector if benefits in Sector 1 are higher than benefits in Sector 0. Let π_j be the price of sector specific efficiency units in sector *j*, an agent will supply labor in the covered sector if:

$$\pi_1 q_{i1}(1 + at_2) \geq \pi_0 q_{i0}$$

Number of workers employed at each sector is given by:

$$N_1 = \int_{-\infty}^{\infty} \int_{-\infty}^{\frac{\pi_1 q_1 (1+at_2)}{\pi_0}} Nf(q_0, q_1) dq_0 dq_1$$

$$N_0 = \int_{-\infty}^{\infty} \int_{\frac{\pi_1 q_1 (1+at_2)}{\pi_0}}^{\infty} Nf(q_0, q_1) dq_0 dq_1$$

Where:

$f(q_1, q_0)$ is the joint density of sector specific skills and,

N is number of agents in the economy.

Labor supply measured in efficiency units in each sector is given by:

$$L_1 = \int_{-\infty}^{\infty} \int_{-\infty}^{\frac{\pi_1 q_1 (1+at_2)}{\pi_0}} N q_1 f(q_0, q_1) dq_0 dq_1 \qquad 3.12$$

$$L_0 = \int_{-\infty}^{\infty} \int_{\frac{\pi_1 q_1 (1+at_2)}{\pi_0}}^{\infty} N q_0 f(q_0, q_1) dq_0 dq_1 \qquad 3.13$$

Equation 3.14 and 3.15 represent the differentials of the labor supply evaluated at $t_2=0$:

$$dL_1 = \left(\hat{\pi}_1 + a dt_2 - \hat{\pi}_0 \right) \left(\frac{\pi_1}{\pi_0} \right) N \int_{-\infty}^{\infty} {q_1}^2 f(A, q_1) dq_1 \qquad 3.14$$

$$dL_0 = -\left(\hat{\pi}_1 + a dt_2 - \hat{\pi}_0 \right) \left(\frac{\pi_1}{\pi_0} \right) N \int_{-\infty}^{\infty} q_1 q_0 f(A, q_1) dq_1 \qquad 3.15$$

Where

$$A = \frac{\pi_1 q_1 (1 + at_2)}{\pi_0}$$

Note that $f(A, q_1)N$ is the number of workers with specific capital q_1 that are indifferent between sectors because total benefits are equal in both sectors. Labor supply is not completely elastic because workers that have a significant comparative advantage in one sector will not

respond to small changes in the relative price of sector specific skills. Labor supply elasticity is higher the larger is the correlation between sector specific skills.

To understand the direction of the compositional bias note that labor market equilibrium is achieved when no one is better off switching sectors. Equilibrium is reached when the rate at which efficiency units in Sector 1 are converted to efficiency units in Sector 0 equals the relative price π_1/π_0. Identity holds for marginal workers. Benefits from switching to Individual Retirement Accounts are proportional to $q_{I,}$ the new retirement system will attract workers employed in the uncovered sector that have the highest ratios of q_{i1}/q_{i0} among uncovered workers, but lower ratio of q_{i1}/q_{i0} among covered workers. Therefore, the difference in average efficiency units is reduced.

Note that it is not longer true that $dL_1 = -dL_0$ as it is the case when workers are homogenous in skills. Equation 3.18 shows that the rate at with labor in Sector 1 transforms into labor in Sector 0 is equal to the conversion rate for individuals who are at the margin.

$$\frac{dL_0}{dL_1} = -\frac{\int_{-\infty}^{\infty} q_1 q_0 f(A, q_1) dq_1}{\int_{-\infty}^{\infty} q_1^2 f(A, q_1) dq_1} * \frac{P(q_0 \le A)}{P(q_0 \le A)} \equiv \beta(\pi_1, \pi_0) \qquad 3.16$$

It will be useful to define the labor supply elasticity between the covered and the uncovered sector:

$$\ln\left(L_1 / L_0\right) = \gamma \ln\left(\pi_1/\pi_0\right) \qquad 3.17$$

According to Equations 3.16 and 3.18, the labor supply elasticity is given by:

$$\gamma(\pi_1,\pi_0)=\left(\pi_1/\pi_0\right)\int_{-\infty}^{\infty}\left(q_1^2/Eq_1+q_1q_0/Eq_0\right)f(A,q_1)$$

Let π_j be the price for sector specific skill in sector *j* and r be the user cost of capital.

Assuming constant returns to scale in L_j and K_j, 3.12 and 3.13 represent the cost functions in each sector:

$$C^1(r,\pi_1,X_1)=c^1(r,\pi_1(1+t))X_1 \qquad 3.18$$

$$C(r,\pi_0,X_1)=c^1(r,\pi_0)X_0 \qquad 3.19$$

The solution of the model gives the following relationships[8]:

$$d\ln\pi_1/\pi_0=\frac{1}{D}\left[-\eta_1+(k_1-g(\pi))(\eta_1-\eta_0)\right]dt-\left[\lambda\gamma(\eta_1-\eta_0)-\gamma\right]adt_2 \qquad 3.20$$

Where

$\eta_j=-\sigma_j(1-\theta_{lj})-(\varepsilon_{ij}-\varepsilon_{kk})\theta_{lj}$ is the labor elasticity in sector j

$D=\eta_1-(k_1-g(\pi)-\lambda\gamma(\pi))(\eta_1-\eta_0)-\gamma(\pi)$

Efficiency losses arise when taxes distorts the effective comparative advantage between sectors, forcing workers to move from the sector where they are more productive to a sector

[8]Appendix B derives the solution of the model and compares results with Hargerber's original model.

where they are less productive. If there are not changes in t_1 or taxes used to finance public goods, we can decompose the Equation 3.20 in two terms:

$$d\ln \pi_1 \big/ \pi_0 = (1-a)\frac{-\eta_1 + (k_1 - g(\pi))(\eta_1 - \eta_0)}{\eta_1 - (k_1 - g(\pi) - \lambda\gamma(\pi))(\eta_1 - \eta_0) - \gamma(\pi)} dt_2 - a dt_2 \qquad 3.21$$

The second term in equation 3.21 corresponds to pass trough of benefits on wages. If there were no equilibrium effects, then wages in the covered sector will decrease by the same proportion to new benefits.

The first term corresponds to the incidence of the fraction of the tax that is not related to benefits. In other words, it corresponds to the incidence of pure taxes. The degree of shifting increases with demand elasticity in the covered sector and decreases with demand elasticity in the uncovered sector and supply elasticity.

4 Evidence from Differences-in-Differences Methods

Gruber (1994) uses the Differences-in-Differences-in-Differences (DDD) estimator to determine the fraction of the cost of benefits that it shifted to wages. He compares wage differentials between control and treatment groups between experimental states where the provision was mandated and states where it was not. To follow Gruber's (1994) approach, I would have to compare the wage differential between the covered and uncovered sectors for young workers to the wage differential for old workers. Differences in taxes will affect the wage differential between the covered and uncovered workers, but new benefits will affect only the wage differential among young workers. To calculate the fraction of benefits that is shifted to

wages, I compare the DDD estimator with firm's mandated contributions to the Individual Retirement Accounts.

The DDD requires several conditions to identify the effect of improved benefits on wages. First, aggregate shocks have common effects on both sectors. Second, we are able to control for changes in the composition of workers across sectors by conditioning earnings to variables we observe. Third, labor supply to the covered sector has no positive slope, so changes in relative prices measure exactly the shift of the due to change in benefits. In other words, labor supply between sectors is completely elastic.

4.1 Data

The empirical evidence is based on data from the ENEU (Encuesta Nacional de Empleo Urbano). The ENEU is a quarterly household survey that covers the largest urban areas in Mexico. This survey covers approximately 61 percent of urban population and 92 percent of the cities with populations greater than 100,000. The sample includes non-agricultural private sector employees from 16 to 65 years old, who worked more than 30 hours during the week previous to the interview. The sample size is approximately 60,000 individuals for each quarter from 1994 to 1999[9].

4.2 Comparison Groups

4.2.1 Covered and Uncovered Sectors

The most extensive definition of the non-complying or uncovered sector includes all employees that have a job without labor protection and the self-employed. Approximately 50 percent of the Mexican labor force falls into to this category. The incidence of non-compliance is still high

[9] The survey starts in 1987, but I restricted the sample to the years 1994-1999 since the question about contractual form is added until the fourth quarter of 1999. In addition, occupations and economic sectors are coded differently

even if the self-employed are excluded from the sample. About 37 percent of full time private sector workers belong to this more narrow definition of the non-complying sector.

I restrict the sample to private sector employees[10], and then I divide the sample according to the degree of protection received from the firms they work. The highest form of compliance constitutes jobs that provide both social security and severance payment coverage (SS+SP). This group includes workers covered by social security that either have a permanent contract or do not have a written contract[11]. The second group constitutes employees who have social security coverage but are hired under a temporary contract so that the severance payment regulation does not apply to them (SS). The last group, which I define as the "uncovered sector'' is comprised of employees who do have neither social security nor severance payment protection.

Table 1 shows the sample averages according to the group they belong. Workers in the covered and uncovered sector are comparable in sex, age and experience, but workers in the covered sector have on average more years of schooling.

The most significant difference between workers in the complying and non-complying sector is the distribution of workers across firm sizes. About 83% of workers in the uncovered sector work in a firm that has fewer than 16 employees, compared to only 22% of the workers in

[10] I excluded self-employed from the sample for several reasons. First, individuals become self employed to avoid other regulations as well. Maloney (1998) shows that micro-enterprises avoid federal and state treasury regulation[10] in addition to labor regulation. Second, earnings can only be computed with large measurement error. The survey reports the total income, which includes in addition to earnings, the return for capital investment and may include earnings of the unpaid labor of relatives.

[11] Individuals without a written contract are included in this group because the Conciliation Board assumes the existence of a permanent contract whenever there is no written contract, as long as the employee can prove that an employment relationship exists. Once a firm registers a worker in the social security administration, it gives the employee the necessary documents to demand all benefits of a permanent contract at the Conciliation Board. Therefore, an effective way to avoid severance regulations is to offer a temporary contract rather than not offering a written contract.

the covered sector work in a firm of with fewer than 16 employees. One explanation is that firms deciding not to comply must restrict their size in order to avoid detection by the regulatory agencies. The evidence suggests that firms that comply are not randomly distributed across sectors raising the possibility of productivity differential in both sectors.

Most of workers employed in the covered sector have severance payment benefits in addition to Social Security benefits. Workers with Social Security benefits but without severance payment benefits constitute an ideal control group to analyze the effect of the reform. However, Social Security and severance payment benefits are bundled[12], and therefore only a small fraction of workers in the covered sector have a temporary labor contract. In addition, it is difficult to distinguish whether a worker with a temporary contract is on a trial period or if he agreed not to have severance payment coverage[13]. Restricting the control group to temporary workers will implicitly restrict the control group to workers with low tenure. I included all workers employed in the covered sector in the control group to avoid comparison among groups of workers with systematic differences in tenure levels. Table 1 shows workers in the covered sector with severance payment and workers without severance payment coverage have similar skill and demographic characteristics. Furthermore, they have similar occupational structure and skill distribution.

Workers employed in the covered are not less likely to have outside coverage than workers employed in the uncovered sector. The variable outside coverage is a dummy equal to one if the individual lives in a household where there is somebody else that is covered by a health plan and he is eligible to receive medical treatment from this plan[14].

[12] Once a firm registers a worker in the Social Security Administration, it is difficult not to comply with the severance payment regulation as well.

[13] Trial period contracts are prohibited but extensively used by complying firms.

[14] The criteria for coverage within the household include public sector workers. Public sector workers receive similar medical benefits than Social Security and are also extended to the immediate family of the worker.

Differences in education are more evident when we compare the distribution of years of schooling. The fraction of workers in the uncovered sector with 6 or fewer years of education is almost twice the fraction than in the SS+SP sector. Only 8 percent of the uncovered sector workers have more than 12 years of education compared to 20 percent of SS+SP workers. The fact that the complying sector is more skill intensive does not preclude us to compare wages unless workers sort according to skill. Table 2 shows the distribution according to skill and age groups. Workers with higher schooling attainment are more likely to work in the covered sector. However, schooling does not determine which sector a worker is going to be employed. More than one third of workers with fewer than 6 years of schooling are employed in the covered sector. At the same time, more than one third of workers with college education are employed in the uncovered sector.

The evidence shows that Social Security regulation does not impact all economic sectors equally, but there is an important variation on the non-compliance incidence across economic sectors. Table 3 shows coverage by economic sector. The sample includes only male workers with 7 to 9 years of education in order to control for differences in the composition of workers across economic sectors. The incidence of non-compliance is twice as high in the service sector than in the manufacturing sector, this is related to the fact that the scope of economies of scale is higher manufacturing sector.

The incidence of non-compliance is particularly high in sectors with seasonal demand fluctuations such as hotels, restaurants and construction. Surprisingly, the share of temporary workers in the sector composed of hotels and restaurants is lower than the average. A possible explanation could be that the two different forms of non-compliance, Social Security and SP, complement each other. For example, it is easier to avoid the SP regulation if workers are not

registered in the Social Security, and at the same time is easier to avoid the Social Security tax if the employees are replaced constantly.

To conclude, workers in the covered sector are comparable to workers in the uncovered sector but firms are not. Firms in the covered sector are skill intensive, are larger and are more likely to be producing goods in the manufacturing sector than in the service sector. The decision to choose a job with benefits is linked to the decision on which economic sector to be employed.

4.2.2 Treatment Group and Control Groups

The 1997 Social Security reform increased the contributions to the individual retirement accounts and reduced the tax rate used to finance public programs. The effect of this tax reform on wages is ambiguous. On one hand, a lower Social Security tax will increase wages if labor supply is not perfectly elastic. But on the other hand, a Social Security job becomes more attractive and thus the labor supply in the covered sector should increase and drive wages paid by complying firms down. However we can separate these effects by comparing wage responses of demographic groups who were affected differently by the reform. The reform has distinctive cohort effects. Workers older than 50 are more likely to retire under the old regime rules and therefore, have no direct benefits from the privatization of the retirement pension. For this group of workers, the Reform in 1997 implied a reduction in the Social Security tax with no change in the benefits.

4.3 Differences-in-Differences Estimator

I divided the sample between old and young workers to evaluate the impact of the change of the regulation on each demographic group. I test for structural change in the wage differential between the taxed and the untaxed sectors trend.

Since benefits from the substitution of the Pay-As-You-Go to the Individual Retirement Accounts increases with schooling, I evaluate the impact of the reform at three different skill levels: 1) workers with less than 9 years of schooling, 2) workers that have between 9 and 12 years of schooling, and 3) workers that have more than 12 years of schooling.

The regression includes skill specific explanatory variables, regional and industry dummies to isolate changes in the differential produced by changes in the composition of workers and firms across sectors, t. The regression also includes skill-time interaction variables to isolate changes in the differential produced by variations in the skill premium.

The differential could be driven by the fact that wages old and young workers have a distinctive response to local demand shocks. To control for deviations in the young-old differential caused by short-term fluctuations in the labor market I included employment growth rates by region.

Equation 4.3 shows the regression equation. I estimate the following regression for young and old workers separately. To control for counterfactual trends in the wage differential, we identify the impact of the wage differential by changes in the trend of the relative wage that at the time of the reform.

$$Wij = \sum_n (\beta_{n0} s_{in} + \beta_{n1} s_{in} \exp_i + \beta_{ns2} s_{in} \exp_i^2 + \beta_{s3} s_{in} * time_i) + \sum_m \gamma_i i_{im} + \sum_n \alpha_i z_{in} + \lambda' X_i + \sum_n (\beta_{n4} s_{in} d_i + \beta_{n5} s_{in} d_i * time_i + \beta_{n6} s_{in} d_i * after_i * (time_i - T)) \quad 4.3$$

Where:

Wij is the log hourly wage of individual *i* in sector j .

s_{in} $n=1,2,3$ is a dummy variable equal to 1 if individual *i* belongs to skill level *n.*

d_i=1 is the individual works at the taxed sector.

exp_i is potential labor market experience (age-schooling years-6).

i_{im} $m = 1.....11$ is a dummy variable equal to 1 if individual *i* works in industry *m*

z_{ip} $p = 1.....5$ is a dummy variable equal to 1 if individual *i* lives in region *p*.

$after_i$ is a dummy equal to one if the wage is observed after June 1997.

X_i is a set of variables that control for regional-time demand shocks.

T is equal to the number of quarterly observations before the new legislation was implemented in July 1997.

The effect of the reform on the wage differential is given by the coefficients β_{16}, β_{26} and β_{36}. These coefficients measure time trend change on the wage differential for periods after the reform.

Table 4 shows the OLS estimates of β_{s6} to test if the trend of the taxed-untaxed sector differential changed upon the reform. Estimates are shown for different demographic and skill groups. The sample is divided between "young" workers, those who will retire under the new regime, and "old" workers, those who will retire under the old regimen.

The *t* statistics are consistent with a change in the trend of the taxed-untaxed wage differential in the sample of young workers in all specifications, while it is consistent with no change in the old workers' taxed-untaxed sector wage differential.

The estimates on the first column correspond to the specification that includes a single time trend for all skill groups. A different time trend for each skill is specified in the second column. The third column includes employment growth in the region to control for distinctive cohort response to local demand shocks.

I constructed the DDD estimator by subtracting $\hat{\beta}_{s6\,young} - \hat{\beta}_{s6\,old}$. Table 5 compares the DDD estimator with incremental benefits form substituting Pay-As-You-Go for Individual

Retirement Accounts. The DDD estimator shows wages for those who benefited from the reform fell by only 2.4 percent, which corresponds to 29 percent of incremental benefits.

5 Econometric General Equilibrium Model

5.1 Prices of sector specific skills

The amount of efficiency units of individual *i* in sector *j* is determined by observed individual characteristics *Xi* and a sector specific random component *Uij*. Assuming that the function that maps skills into sector specific efficiency units is log linear in X_i and U_{ij}, Equation 6.1 represents workers *i* potential supply of efficiency units to sector *j* .

$$\ln q_{ij} = \beta_j X_i + U_{ij} \qquad 5.1$$

Equation 6.2 represents earnings in sector *j* at time *t*.

$$\begin{aligned} W_{ij_t} &= \pi_{jt} q_{ij} \\ \ln W_{ijt} &= \ln \pi_{jt} + \ln q_{ij} \end{aligned} \qquad 5.2$$

Where

π_{jt} is the equilibrium price of efficiency units of labor in sector *j*

The log wage of individual *i* on sector *j* at time *t* is given by:

$$\ln W_{ijt} = \ln \pi_{jt} + \beta_j X_i + u_{ij} \qquad 5.3$$

In addition to earnings, workers employed in covered sector receive mandated social security benefits. Valuation of benefits varies across individuals according to function $a(Zi)$.

Where:

$Z_i=[R,X]$ is a vector of observed random variables

R is a vector of observed random variables that determines participation in the Social Security sector, but does not determine earnings. R includes compliance rate in the city where individuals lives, family size and years upon retirement.

An agent with endowment (q_{0i}, q_{1i}) will work in the covered sector if:

$$\pi_1 q_{i1}(1 + a(z)t_2) \geq \pi_0 q_0$$

Define

$$D_i^* = \ln q_{i1} - \ln q_{i0} + \ln \pi_{1t} + \ln(1 + a(z)t_2) - \ln \pi_{0t} \qquad 5.4$$

Where:

U_d is a random component on the preference for coverage.

Note that D^* can be decomposed into two components:

$$D_i^* = G(Z_i) - U_{id} \qquad 5.5$$

Where:

$$U_{id} = U_{i0} - U_{i1}$$

$$D_i = 1 \quad \text{if} \quad D_i^* > 0 \qquad 5.6$$

Assume that:

(i) U_1, U_0 are unobserved random variables with mean zero.

(ii) U_1, U_0 are independent of (R, X)

(iii) $G(Z)$ is a non-degenerate random variable conditional on X

A useful transformation proposed by Heckman and Vytlacil (1999) is to assume that $U_d \sim Unif[0,1]$, there is no loss of generality if F_{Ud} is strictly monotonic. In this case $G(z)=Pr[D=1|Z=z]$, since $Pr[D=1|Z=z]=F_{Ud}(G(Z))$. Given this transformation, Equation 6.7 represents the conditional expectations of U_0 and U_1[15] :

$$\begin{aligned} E[U_1 \mid P(Z), X, D=1] &= E[U_1 \mid U_d < P(Z)] \\ E[U_0 \mid P(Z), X, D=1] &= E[U_0 \mid U_d < P(Z)] \\ E[U_1 \mid P(Z), X, D=0] &= E[U_1 \mid U_d \geq P(Z)] \\ E[U_0 \mid P(Z), X, D=0] &= E[U_0 \mid U_d \geq P(Z)] \end{aligned} \qquad 5.7$$

Earnings in Sector j are composed by the sum of two functions: a known linear function of individual characteristics X_i, and by an unknown function of $P(Z_i)$.

$$\begin{aligned} E(W_{1t} \mid X, P(Z), D=1) &= X_{it}'\beta_1 + K_{11t}(P(Z)) \\ E(W_{0t} \mid X, P(Z), D=0) &= X_{it}'\beta_0 + K_{00t}(P(Z)) \end{aligned} \qquad 5.8$$

Where:

K_{ijt} is the conditional expectation of Ui given that a worker belongs to sector j.

$$K_{ijt} \equiv E(U_i \mid Z, D=j) = K_{ijt}(P(Z))$$

[15] See Heckman and Robb (1986) for derivation of this representation, also Heckman, Ichimura and Todd (1998).

I follow Heckman,. Ichimura and Todd (1998) to estimate the partial linear regression model in Equation 6.8[16]. The estimation has two stages. In the first stage $\ln W_{iit}$ and each element of X_{it} are regressed against the estimated probability $\hat{P}(Z_i)$. $P(Z_i)$ is estimated by logit regression. The variables used in the logit regression are skill and skill specific time trends, experience and its square, city and industry dummies. It also includes years upon retirement, a dummy for married, the rate of regional employment growth and the city compliance rate[17].

I estimate by local linear regression $E(W_1 \mid P(Z), D=1)$ and $E(X \mid P(Z), D=1)$ using the sample of workers employed in the covered sector[18]. In the same way, I estimate $E(W_1 \mid P(Z), D=0)$ and $E(X \mid P(Z), D=0)$ using the sample of workers employed in the uncovered sector.

On the second stage, I use the residuals $\ln W_{ijt} - E[\ln W_{ij} \mid P(Z_{it}), D=j]$ and $X_{it} - E[X_{it} \mid P(Z_{it}), D=j]$ to construct the OLS model represented in Equation 6.9 to obtain unbiased estimates of β_j.

$$W_{ijt} - E(W_{tjt} \mid P_i, D_i) = [X_{ti} - E[X_{it} \mid P_{it}, D_{it}]'\beta_j + \upsilon_{it} \qquad 5.9$$

Where:

$$E(\upsilon_{i\,t} \mid P_{it}, D_{ti}) = 0$$

[16] See Robinson (1988) for a detailed description of the partially linear model as well as the asymptotic properties of the estimators.

[17] See Appendix C for details on the estimation of P(Z).

[18] See Heckman, Ichimura and Todd (1998) for details and Fan(1993) for the distribution theory of the local linear regression estimator.

Residuals from the second stage form a function of the constant term and the conditional expectation of the error term U_j. The later is a function of *P(Z)*.

$$W_{ijt} - X_{it}\hat{\beta}_j = \ln \pi_{jt} + \beta_{oj} + K_{jj}(P(Z_{it})) \qquad 5.10$$

To identify $\ln \pi_{jt} + \beta_{0j}$ from $K_{jjt}(P(Z_{it}))$, we need to evaluate the function $\beta_{0j} + K_{jj}(P(Z_{it}))$ at values of $P(Z_{it})$ where $K_{jjt}(P(Z_{it}))$ =0. Note that:

$$E(U_1 \mid X, P(Z) = 1, D = 1) = E(U_1 \mid U_d < 1) = E(U_1) = 0$$

Alternatively,

$$E(U_0 \mid X, P(Z) = 0, D = 0) = E(U_1 \mid U_d > 0) = E(U_1) = 0$$

The estimates of $\beta_{oj} + \ln \pi_{jt}$ correspond to the value of $E[\ln W_{ijt} - X_{it}\hat{\beta}_j \mid P(Z), D = 1]$. To identify $\beta_{o0} + \ln \pi_{0t}$, I evaluated the estimated function $\hat{K}_{oo}(P(Z_{it}))$ at $P(Z_{it})$=0.05. Ideally, I would like to evaluate the conditional expectation at $P(Z_{it})$=0, but there are few observations of workers in the non-complying sector where *P(Z)*<0.025[19]. To identify $\beta_{o1} + \ln \pi_{1t}$, I evaluated the estimated function $\hat{K}_{11t}(P(Z_{it}))$ at $P(Z_{it})$=0.975.

Table 6 replicates the calculations shown in Table 5 using prices of specific labor units instead of observed wages. I compared changes in the trend of the wage differential between the covered and uncovered sectors for young workers with changes in the trend in the wage

[19]Although there is enough observations in the cells were P(Z) approaches to one, there is few observations in the intervals where P(Z) approaches to zero even for the sample that includes only workers at the non-complying sector.

differential for old workers. The estimates of the shifting are higher once we control for changes in the composition of workers within each sector.

The Differences-in-Differences estimator is:

$$\pi_{1t} - \pi_{ot} + E(U_{1t} \mid d_{it} = 1) - E(U_{0t} \mid d_{it} = 0)$$

The change in the wage differential after the reform is

$$d_{t+1} - d_t = (\pi_{1t+1} - \pi_{ot+1}) - (\pi_{1t} - \pi_{ot}) +$$
$$\left[E(U_{1t+1} \mid d_{it+1} = 1) - E(U_{0t+1} \mid d_{it+1} = 0) - E(U_{1t} \mid d_{it} = 1) - E(U_{0t} \mid d_{it} = 0)\right]$$

6.6

The first two components of equation 6.6 correspond to the change in the equilibrium wage differential. The terms inside the brackets is the change in the observed wage differential caused by a change in the composition of workers across sectors.

Table 6 confirms the predicted direction of the bias, the Difference-in-Difference corrected for selection implies that wages for young workers decreased by 6 percent, an estimate that is closer to the reduction of the net tax rated produced by the substitution to Individual Retirement Accounts. However, the estimates not provide definite estimates of the shifting of taxes and benefits on wages. Estimates shown in Table 6 do not take into account the general equilibrium effects on the relative prices of labor when the rate at which labor supply shifts from one sector to another is not equal to minus one.

5.2 Labor Supply Elasticity

Because regulation is not neutral across economic sectors, employment opportunities in the uncovered sector vary according workers' skills. The individual selection model shows that an increase in the relative wage in the covered sector will attract first workers that are indifferent

between sectors at the previous equilibrium prices. A feature of selection models is that labor shifting between sectors depends on the response of marginal workers to changes in skill prices. Therefore, labor supply elasticity from Sector 0 to Sector 1 is determined by the distribution parameters corresponding to marginal workers

According to the individual selection model, the labor supply elasticity is given by:

$$\gamma(\pi_1,\pi_0)=\left(\pi_1 \big/ \pi_0\right)\int_{-\infty}^{\infty}\left(q_1^2 \big/ Eq_1+q_1q_0 \big/ Eq_0\right)f(A,q_1)$$

To estimate $\gamma(\pi)$ we only need to recover the joint distribution of q_{0i} and q_{1i} at the points where $q_0=\pi q_1(1+at_2)$, or $\pi_0 q_0=\pi_1 q_1(1+at_2)$. Following Heckman and Honore (1990) identification theorem when panel data on aggregate earnings is available and the distribution of skills does not change with time[20], I estimated the joint distribution of q_{0i} and q_{1i} at this point. Note that if $\pi(1+at_2)q_{1i}\le q_{0i}\le \pi'(1+at_2)q_{1i}$ then:

$$F(q_1,q_0)=\Pr(q_{i1}<q_1,q_{i2}<q_2)=$$

$$\Pr\left(q_{i1}<q_1,q_{i0}\left(\frac{1}{\pi'(1+at_2}\right)<q_1,q_{io}<q_0,\pi(1+at_2)q_{1i}<q_0\right)$$

$$F(q_1,q_0)=\Pr\left(\max\left\{q_{1i},q_{0i} \big/ \pi'(1+at_2)\right\}\le q_1,\max\left\{q_{1i},q_{0i} \big/ \pi(1+at_2)\right\}\le \frac{q_0}{\pi}\right)$$

The density $\hat{f}\left(\pi q_1,q_1\right)$ can be approximated by $\hat{F}(\pi' q_1,q_1)-\hat{F}(\pi q_1,q_1)$ when π is close to π'.

[20] Heckman and Honore (1990) *Theorem 11*

Using estimates of $\ln \hat{\pi}_{jt}$, I computed $\ln q_{i1}$ by subtracting $\ln \hat{\pi}_{1t}$ to $\ln W_{i1t}$ to workers employed in the covered sector. I estimated $\ln q_{i0}$ by subtracting $\ln \hat{\pi}_{1t}$ to $\ln W_{i1t}$ to workers employed in the covered sector.

The reference period used is 1997:1 and 1997:2 to obtain the elasticity corresponding to the date at which the reform took place. In the reference period $d\pi/\pi$ =0.04 and t_2 is equal to zero. The distribution of $Z = \max\{q_{1i}, q_{0i}/\pi\}$ and $Z' = \max\{q_{1i}, q_{0i}/\pi'\}$[21] is estimated using the Epanechnikov kernel. The bandwidth was chosen following Silverman (1986) optimal bandwidth rule[22].

Estimates of the functions $\gamma(\pi)$ using $\hat{f}(\pi q_1, q_1)$ are. When the equilibrium price ratio is greater than 1, higher benefits in the covered sector increase the fraction of workers at the margin, and therefore, supply is more elastic.

5.3 Labor Demand Elasticities

Assuming labor demand for sector specific efficiency units is log linear in real prices, Equation 6.11 represents the demand of sector specific efficiency units in Sector j:

$$\ln L_{jt} = \eta_0^j + \eta_{ll}^j \ln\left(\frac{\pi_{jt}}{P_{jt}}\right) + \sum_k \eta_k^j \ln\left(\frac{P_{kt}}{P_{jt}}\right) \qquad 5.11$$

[21] Where Z=q1 if the individual selects into the covered sector and $Z = q_0/\pi$ if the individual works in the uncovered sector.

[22] . $h=A(K)n^{-1/6}$. Where A(K)=2.40 for a multivariate Epanechnikov kernel of dimension 2.

Where:

P_{kt} is the price for intermediate input k. Includes index price for energy, intermediate inputs in the sector, user cost of capital.

To estimate Equation 5.11 I follow Heckman and Sedlacek (1985). They estimate demand functions for unmeasured tasks that are sector specific using sectoral wage bills in the manufacturing and services sectors. They observe that total wages paid in each Sector *j* are equal L_{jt} times $\ln\Pi_{jt}$. . Substituting total waged paid in equation 6.11 gives:

$$\ln(\text{Wages Paid in Sector } j) = \eta_o^j - \beta_{oj}(\eta_{ll}^j + 1) + (\eta_{ll}^j + 1)\left(\frac{\ln \hat{\pi}_j}{\ln P_{jt}}\right) + \sum_k \eta_k^j \left(\frac{\ln P_{kt}}{\ln P_{jt}}\right) \qquad 5.12$$

Table 7 shows the estimates of demand elasticities. Wage bills and prices are not aggregated in covered and uncovered sectors, instead these variables are aggregated by industries. I selected industries that are representative of the covered and uncovered sectors respectively to estimate. For example, data for the covered sector comes from the Encuesta Industrial Mensual. The Encuesta Industrial Mensual is a firm based survey that covers the largest firms in the manufacturing sector, where compliance is the highest. Data on wages paid in the uncovered sector comes from INEGI calculations based on the Encuesta Comercial Mensual. The Encuesta Comercial Mensual is an establishment-based survey that covers small retailers and restaurants. These industries have high non-compliance incidence. Prices of other factors include: energy price index, investment index, intermediate good price index and the net rate of return of commercial bonds at 28 days[23].

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[23] Data on prices and interest rates comes from Cuadernos de Informacion Economica, Banco de Mexico, various issues.

5.4 What Fraction of the Tax is Shifted to Wages?

The degree of shifting depend on the following parameters: the relative demand elasticities between covered and uncovered sector, as well the joint distribution of . q_{0i} and q_{1i} corresponding to marginal workers, the correlation of benefits to taxes.

Equation 3.20 separates the effect the regulation reform into two components: changes in the cost of providing Social Security and changes in the benefits received by workers employed in the covered sector. The first term is the shifting of the cost of providing Social Security (*dt*) on wages.. The second term determines how this differential is affected by changes in benefits.

Table 8 shows the estimates of Equation 3.20 substituting the estimates previously defined for the whole sample and for males between 20 and 40 years old. The estimates show that increasing the tax to finance Social Security programs wile leaving benefits unchanged will reduce wages in the covered sector by 43% of the tax increase. If the tax is not changed but benefits are tied to contributions at a one to one relationship, wages paid in the covered sector will decrease by 57% of the value of benefits.

Full shifting of the cost cannot be achieved unless labor supply is inelastic. The higher the elasticity of supply into the covered sector the lower is the shifting of the tax in form of lower wages. On the contrary, higher elasticity of supply results in larger shifting of benefits to wages.

The model was specified to evaluate the effect of diverting part of the tax to Individual Retirement Accounts. I defined benefits to be proportional to q_1 to resemble deposits on the Individual Retirement Accounts. An increase in the fraction of the wage that firms deposit into the Individual Retirement Accounts will attract workers employed in the covered sector with higher q_1/q_o ratios. This will create an excess of supply in Sector 1 relative to Sector 0, driving the wage differential down.

Table 6 compares Differences-in-Differences estimators with estimates presented in Table 7. Differences-in-Differences estimators bias downward the value of shifting. Based on the estimates obtained in the Differences-in-Differences estimator and the assumptions that support these methods, homogenous workers, benefits can only be transferred to wages in 29 percent.

The Differences-in-Differences estimator is consistent only if workers are homogenous in skills and tastes and therefore labor supply is completely elastic. In this case, according to the homogenous agents model there must be full shifting of benefits to wages but no shifting of pure labor taxes. The difference between predicted and observed shifting is driven by differences in benefits of Investment Retirement Accounts compared to Pay-As-You-Go benefits.

Differences-in-Differences estimators provide an inaccurate measure of the incidence of the regulation on wages. To illustrate this point, I computed the incremental benefits from switching from Pay-As-You-Go to Individual Retirement Accounts for the average worker and compared this figure with the estimates implied by Differences-in-Differences and the estimates based on the parameters predicted by the model. While switching from Pay-As-You-Go to Individual Retirement Accounts implies a reduction in the average net tax rate of 7 to 9 pp, Differences-in-Differences estimates imply a reduction of only 2.4 pp while the model implies a reduction of 10 pp (See Table 9).

6 Conclusions

Two contributions are presented in this paper. First, it derives the framework for understanding Social Security taxation when there is a sector that does not comply with the regulation and workers self-select into the covered sector. Second, it uses evidence on a Social Security reform in Mexico to compare Differences-in-Differences methods with estimates from the econometric general equilibrium model.

There are two important lessons derived from the analysis. First, Social Security regulation distorts the optimal allocation of labor and capital between production sectors. Second, evidence from the Social Security reform in Mexico raises serious concerns in Differences-in-Differences methods.

Differences-in-Differences methods require that the reform does not change the composition of the control group. Intuitively, this is a strong assumption since changes in regulations will induce labor reallocation across sectors. First, gains from reforms vary across demographic and skill groups. Second, social security taxes distort labor costs in the covered sector relative to the uncovered sector. When a reform contaminates the control group, Differences-in-Differences fail to control for compositional bias and general equilibrium effects.

A general equilibrium analysis is required to identify the effect of any labor regulation when there is a sector that does not comply because regulation is not neutral across economic sectors and because the composition of the treatment group depends on how benefits are specified. .

The model shows that efficiency losses arise because factors are misallocated between sectors. In the case of labor, there is a misallocation when regulation affects the effective comparative advantage among sectors. In order to reduce this distortion is it required that benefits in the covered sectors to be proportional to earnings potentials.

The analysis presented in this paper assumes a given distribution of firms across sectors, future work will benefit from explicitly deriving firms' decisions to comply. Findings presented in this paper will hold if the new composition of firms across sectors did not switch workers' comparative advantage between covered and uncovered sectors.

7 References

Atkinson Anthony B., Stiglitz Joseph E. (1986), *Lectures in Public Finance*. Published by McGraw-Hill Book Company, New York, New York.

Cunningham Wendy, Maloney William (1998),"Heterogeneity among Mexico's Micro-Enterprises. An Application of Factor and Cluster Analysis. *Policy Research Working Paper 1998*. World Bank Latin American and Caribbean Region Poverty Reduction and Economic Management Unit, Washington, DC 1998.

Fan, J (1993), "Local Linear Regression Smoothers and their Minimax Efficiencies", The Annals of Statistics, 21,196-216

Gruber, J (1994), "The Incidence of Mandated Maternity Benefits", American Economic Review, Volume 84, Issue 3 (June 1994), 622-641.

Gruber, J.(1997) "The Incidence of Payroll Taxation: Evidence from Chile". Journal of Labor Economics; 15(3),72-101.

Hammermesh,D. (1996), *Labor Demand,* Princeton:Princeton, NJ.

Heckman, J. and H. Ichimura, J. Smith and P.Todd (1998), "Characterizing the Selection Bias Using Experimental Data." Econometrica, 66(5), 1017-1098.

Heckman, J. and C. Pages, "The Cost of Regulation: Evidence from Latin American Labor Markets", Economia I.

Heckman J. and G. Sedlacek (1985), "Heterogeneity, Aggregation and Market Wage Functions: An Empirical Model of Self-Selection in the Labor Market", *Journal of Political Economy,* Vol. 93, No.6, pp. 1077-1125.

Heckman J. and E. Vytlacil (1999), "Local Instrumental Variables and Latent Variable Models for Identifying Treatment Effects", *Proceedings of the National Academy of Sciences,* Vol96, No. 8, p.p.4730-4734.

Kugler, A (1999), *The Incidence of Job Security Regulations on Labor Market Flexibility and Compliance in Colombia.* (mimeo) Universitat Pompeu Fabra, Barcelona Spain.

Lazear, E. (1999), "Job Security Provisions and Employment." Quarterly Journal of Economics, 105(3), 699-676

Maloney William (1998). "Are Labor Markets in Developing Countries Dualistic?". *Policy Research Working Paper 1998.*

Robinson, C., (1999), "The Joint Determination of Union Status and Union Wage Effects: Some Test of Alternative Models" *Journal of Political Economy,* June 1989,97, pp.639-667.

Silverman B.W. (1996), Density Estimation for Statistics and Data Analysis, Chapman& Hall/CRc, Washington, D.C.

Summers (1989), "Some economics about mandated benefits", American Economic Review vol. 79 No.3, May 1999, pp174-183.

Figure 1
Percentage of Private Sector Workers
Without Social Security Coverage

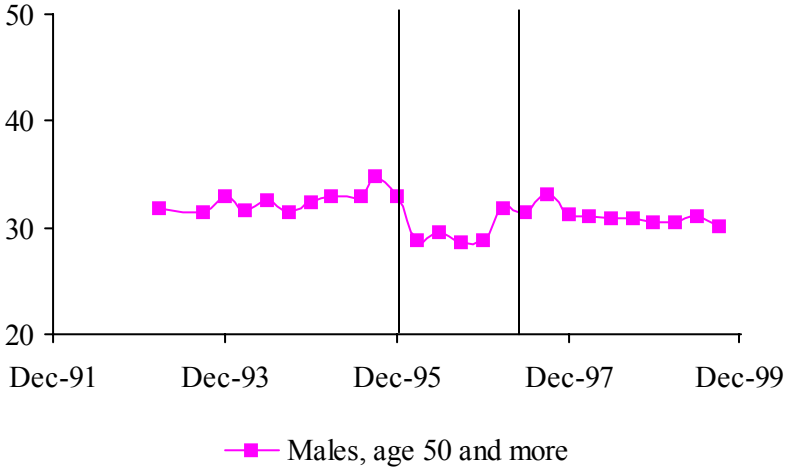


Figure 2
Percentage of Private Sector Workers
Without Social Security Coverage

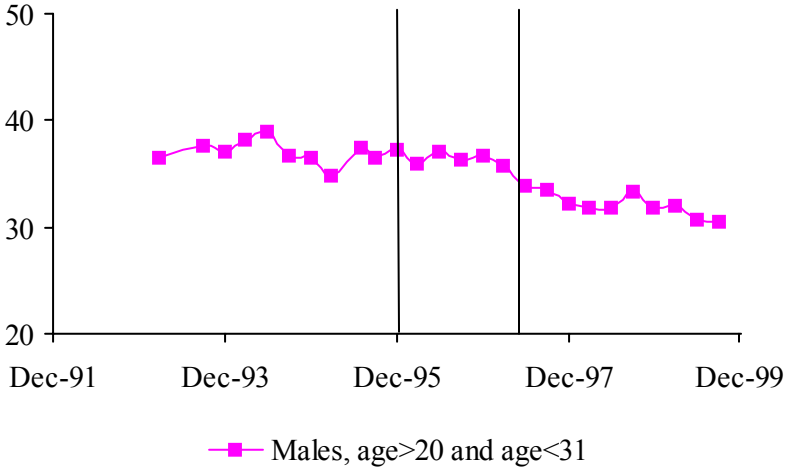


Figure 3
Percentage of Private Sector Workers
Without Social Security Coverage

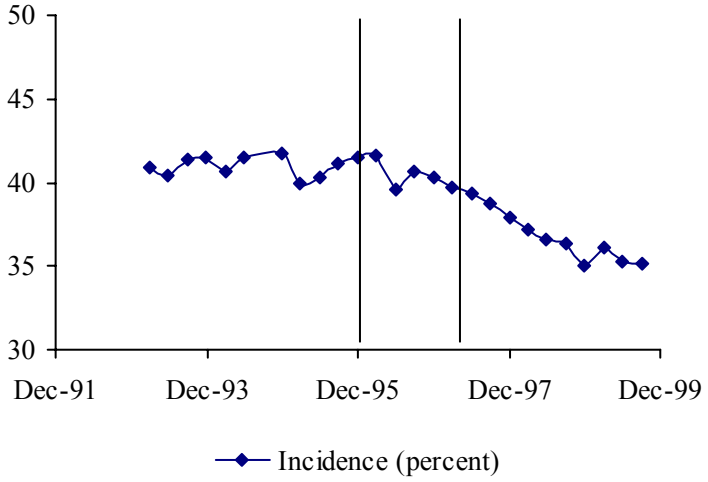


Figure 4
Percentage of Private Sector Workers
Without Social Security Coverage
By Economic Sector

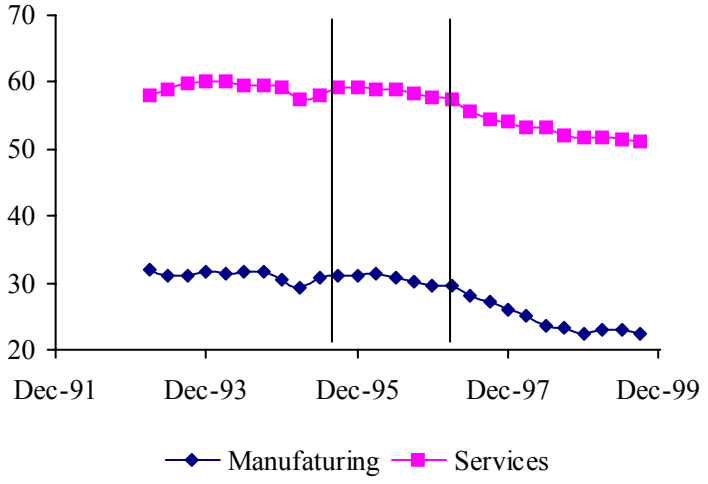


Figure 5
Employment Share working at a firm size below 16

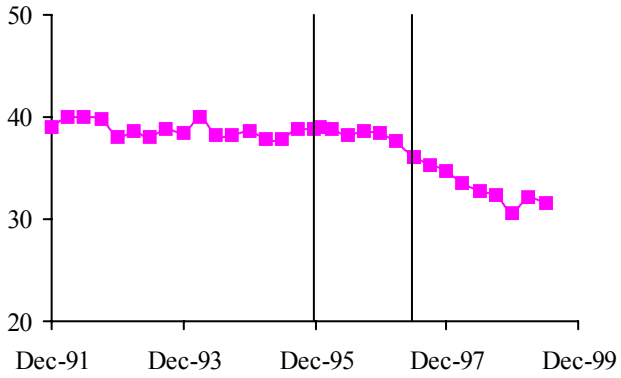


Figure 6
Employment Share working at a firm size above 100

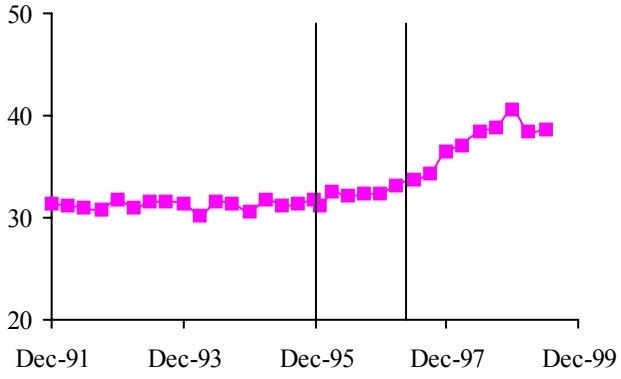


Table 1
Summary Statistics by Coverage Group

	Benefits		
	Social Security and Severance Payment	Social Security only	Uncovered
Years of Schooling			
Fewer or equal than 6	0.28	0.27	0.46
Fewer or than 9	0.57	0.61	0.76
Fewer or equal than 12	0.80	0.84	0.91
Experience			
Fewer or equal than 5	0.14	0.22	0.19
Fewer or equal than 10	0.35	0.42	0.40
Fewer or equal than 15	0.53	0.65	0.54
Male	0.66	0.66	0.65
	(0.47)	(0.47)	(0.47)
Age	31.85	28.47	30.11
	(10.50)	(9.56)	(11.68)
Professional	0.03	0.02	0.01
	(0.18)	(0.15)	(0.10)
Technician	0.04	0.03	0.02
	(0.21)	(0.10)	(0.14)
Manager	0.04	0.01	0.00
	(0.20)	(0.10)	(0.07)
Production Worker	0.17	0.18	0.19
	(0.39)	(0.38)	(0.40)
Clerk	0.18	0.15	0.06
	(0.33)	(0.35)	(0.24)
Crafts	0.13	0.11	0.16
	(0.32)	(0.31)	(0.36)
Sales	0.12	0.17	0.26
	(0.32)	(0.38)	(0.43)
Services	0.26	0.31	0.28
	(0.43)	(0.46)	(0.45)
Married	0.63	0.52	0.50
	(0.48)	(0.49)	(0.50)
Share Working on a	0.22	0.12	0.83
Firm size <20	(0.41)	(0.34)	(0.37)
Share with Social Security Coverage	0.33	0.32	0.26
from other household member	(0.47)	(0.46)	(0.43)
Number of Observations	29782	4451	22401

Notes:
Standard Errors in Parenthesis.

The variable outside coverage is a dummy equal to one if the individual lives in a household where there is somebody else that is covered by a health plan and he is eligible to receive medical treatment from this plan. The criteria for coverage within the household include public sector workers. Public sector workers receive similar medical benefits than SS and are also extended to the immediate family of the worker. To determine eligibility I followed the criteria of the legislation. Only immediate family member are eligible and descendants aged 21 or less if they are studying or 16 or less if they are not.

Table 2
Distribution of Workers by Coverage Group

	Social Security and Severance Payment	Social Security only	Uncovered
Schooling years<6	36.69	5.59	57.62
6<= schooling years<9	46.79	6.87	46.34
9<= schooling years<12	55.82	9.13	35.05
Schooling years =12	59.73	8.82	31.46
Schooling years >12, technical	74.09	8.29	17.63
Schooling years>12, College	56.71	9.04	34.26
Age <20	33.06	8.56	59.38
Age 20-30	53.75	9.8	36.44
Age 30-40	58.98	7.11	33.91
Age 40-50	57.21	5.05	37.74
Age >50	53.29	4.61	42.1
Average	54.65	7.77	37.5

Source: ENEU, 1996. Non-agricultural private sector employees that work at least 30 hours a week.

Table 3
Coverage by Economic Sector
Males, 7 to 9 years of Schooling

Industry	Benefits		
	Social Security and Severance Payment	Social Security only	Uncovered
Textile, except apparel	0.82	0.08	0.10
Apparel	0.65	0.10	0.25
Leather and footwear	0.73	0.16	0.10
Wood and Paper	0.68	0.11	0.21
Chemicals	0.53	0.08	0.39
Plastics and Glass	0.67	0.14	0.18
Basic Metals	0.84	0.14	0.02
Machinery and Equipment	0.82	0.09	0.08
Construction	0.27	0.12	0.61
Retailing	0.54	0.07	0.39
Retailing (Bulk)	0.49	0.11	0.40
Hotels and Restaurants	0.41	0.05	0.54
Transportation	0.78	0.07	0.15
Communication	0.63	0.08	0.29
Real state and financial services	0.61	0.13	0.26
Professional services	0.58	0.09	0.34
Repairing services	0.27	0.06	0.67
Other Services	0.47	0.10	0.43
Std. Deviation	0.16	0.03	0.18

Source: ENEU96 non-agricultural, private sector employees that work at least 30 hours a week. The sample is restricted to males with 9 years of schooling.

Table 4
Change in the Log Wage Differential
Between the Taxed and the Untaxed Sector
Male Workers

	(1)	(2)	(3)
Schooling Years below 9			
Age 20-40	-0.0092*	-0.0076*	-0.0443*
	(0.0028)	(0.0024)	(0.0039)
Age 50 and more	0.0051	0.0052	-0.0045
	(0.0049)	(0.0049)	(0.0051)
Schooling Years between 9 and 12			
Age 20-40	0.0136*	0.0132*	-0.0085
	(0.0024)	(0.0034)	(0.0057)
Age 50 and more	0.0028	0.0210	-0.0008
	(0.0039)	(0.0039)	(0.0106)
Schooling Years >12			
Age 20-40	0.0022	0.0122	-0.0160*
	(0.0039)*	(0.0139)*	(0.0072)
Age 50 and more	0.0368	0.0419	0.0241*
	(0.0133)	(0.0133)	(0.0191)
Covariates	Yes	Yes	Yes
Skill*time interaction	No	Yes	Yes
Region*time fix effects			
Region Employment Growth Rates	No	No	0.0732*
			(0.0174)

Notes:
Standard errors in parenthesis.

Covariates include skill specific experience profiles, industry, and city fix effects.

The estimates correspond to the change in the slope of the wage differential between the taxed and the untaxed sector with respect to time after the second trimester of 1997.

* Significant at 5%

Table 5
Differences-in-Differences-in-Differences

Years of Schooling	DDD	Incremental Benefits for Young Workers relative to Old Workers*	DDD/Additional Benefits
Fewer than 9	-0.0398	0.08	-0.495
	(0.0064)		
Between 9 and 12	-0.0077	0.10	-0.07
	(0.1062)		
More than 12	-0.0321	0.10	-0.32
	(0.0204)		
All Workers	-0.0241	0.086	-0.29
	(0.0154)		

Notes:
Sample includes full-time males employees working on the private sector.
*Assuming Individual Accounts yield a return of 4 percent and the minimum wage depreciates at 2 percent each year.
**Required Savings for the average worker
Standard errors in parenthesis.

DDD is equal to $\hat{\beta}_{s6young} - \hat{\beta}_{s6old}$. Where $\hat{\beta}_{s6j}$ is the estimated change in log wage differential between covered and uncovered sectors for skill group *s* and demographic group *j*. Estimates of $\hat{\beta}_{s6j}$ are presented in Table 4.

Government Transfers are transfers from general revenues to Individual Retirement Accounts. Legislation mandates transfers equal to 2 percent of the median wage. In this table, transfers are measured as percentage of the average earnings of the corresponding schooling group.

Table 6
Differences-in-Differences-in-Differences
Selection Corrected Price Differentials

Years o Schooling	Difference-in-Differences	Incremental Benefits	DD/Additional Benefits
Fewer than 9	-0.0785	0.080	-0.97
	(0.0329)		
Between 9 and 12	-0.0308	0.100	-0.38
	(0.0350)		
More than 12	-0.0877	0.105	-0.87
	(0.0567)		
All Workers	-0.0632	0.086	-0.73
	(0.0411)		

Notes:
Sample includes full-time males employees working on the private sector.
*Assuming Individual Accounts yield a return of 4 percent and the minimum wage depreciates at 2 percent each year.
**Required Savings for the average worker

Difference-in-Differences is equal to $\hat{d\pi}_{syoung} - \hat{d\pi}_{6old}$. Where $\hat{d\pi}_{sj}$ is the estimated change in log labor price differential between covered and uncovered sectors for skill group *s* and demographic group *j*

Table 7
Labor Demand for Sector Specific Skills

Sector	OLS		Instrumental Variables	
	Coefficient	Standard Error	Coefficient	Standard Error
Covered Sector				
Ln π_1	-1.3636	0.3339	-1.5464	0.4507
Ln Energy Price Index	0.4790	1.0882	0.6013	1.0349
Ln Investment Deflator	2.8275	1.7807	3.1528	1.7144
Ln Intermediate Inputs Price Index	-0.5146	0.3983	-0.3923	0.3970
Ln Commercial Bond Interest Rate	0.0080	0.0060	0.0086	0.0057
Constant	8.3780	2.4885	7.3308	2.5849
R square	0.71		0.68	
Uncovered Sector				
Ln π_0	-0.8575	0.3462	-0.7018	0.5355
Ln Energy Price Index	4.3923	0.9347	4.4444	0.9361
Ln Investment Deflator	-3.6437	1.6105	-3.9338	1.7679
Ln Intermediate Inputs Price Index	-0.8559	0.2764	-0.8874	0.2863
Ln Commercial Bond Interest Rate	0.0244	0.0070	0.0234	0.0074
Constant	9.5099	2.2641	10.5183	3.4821
R square	0.85		0.89	

Notes:
All prices are divided by the producer's price index of the corresponding sector.

Covered sector's labor demand is estimated using data from largest firm in the manufacturing sector.

Uncovered sector's labor demand is estimated using data from small establishments in retail and restaurants.

Instruments are: index price for energy, investment and intermediate inputs, 28 days commercial bond interest rate, unemployment rate and mandated minimum wage.

Table 8
Estimates of the Shifting of Taxes to Wages

	Male Workers 40 years or younger
$\frac{d \ln\left(\pi_1 / \pi_0\right)}{dt_1}$	-0.43
$\left.\frac{d \ln\left(\pi_1 / \pi_0\right)}{dt_2}\right\|_{t=t_1+t_2, a=1}$	-0.57

Estimates are computed according to Equation 4.17'.

$$\hat{\pi}_1 - \hat{\pi}_0 = \frac{1}{D}\left[-\eta_1 + (k_1 + g(\pi)(\eta_1 - \eta_0)\right]dt - \left[(\lambda\gamma(\eta_1 - \eta_0) - \gamma\right]adt_2$$

Where

$\eta_j = -\sigma_j(1-\theta_{lj}) - (\varepsilon_{lj} - \varepsilon_{kk})\theta_{lj}$ is the labor elasticity in sector j

$D = \eta_1 - (k_1 - g(\pi) - \lambda\gamma(\pi))(\eta_1 - \eta_0) - \gamma(\pi)$

Demand elasticties correspond to the OLS estimates presented in Table 12.

$k_1 = K_1 / K = 0.85$ Is the share of capital in the covered sector (Banco de México)

$\gamma = 3.2$

$g = 2.32$

Table 9
Individual Retirement Accounts
Incremental Benefits Measured as % of Wage

Method	Incremental Benefits	Value
IRA-PAYG	$t_2 - \delta_{ij}$ [1,2]	[0.073-0.091]
Differences-in-Differences	Change in Log Wage Differential	0.024
Based on the Predicted Shifting	Change in Log Wage Differential[3] / Predicted Shifting	0.105

Notes:

[1]. δ_{ij} is the percentage of wages that saved into an Individual Retirement Account yields the same benefits granted by the Pay-As-You-Go system. This percentage depends on the interest rated paid by Individual Retirements Accounts, as well as the rate at which the minimum wage depreciates. The interval presented in this table assumes an interest rate equal to 4 percent and that the minimum wage depreciates from 0 percent to 6 percent year.

[2].Average rate among workers between 20 and 40 years old.

[3].The predicted change in the Log Wage Differential for young males 40 years or younger is $-0.57dt_2$.

Appendix A

Social Security Reform in Mexico

A.1 1997 Social Security Law

The Mexican Social Security System provides three main benefits: a retirement pension, life and disability insurance, and medical insurance. The new legislation introduced in July 1997 reduced the payroll tax for the median worker by 6 percent while simultaneously substituting the Pay-As-You-Go system for a retirement plan based on Individual Retirement Accounts.

Workers registered in the Social Security sector before 1997 are allowed to choose when they retire the program that yields higher replacement rates. Regardless of what would be their choice, all workers stopped paying the Social Security retirement tax in July 1997. Instead, firms deposit a fraction of their employee earnings in their Individual Retirement Accounts. If at the retirement date, a worker decides to be paid according to the Pay-As-You-Go rules, he has to forfeit his balance on the Individual Retirement Accounts and gives them to the government. Therefore, the fiscal cost of the reform is determined by the difference between the worker's savings and the net present value of the retirement benefits according to the old regime.

The new pension system is however not entirely private. First, there is a minimum pension that the government guarantees regardless of the amount of savings the worker has in his individual account[1]. Second, the government contributes a fixed amount to the Individual Retirement Accounts every time the firm pays the Social Security tax. Third, according to the regulation, at least 65 percent of the funds must be invested on government debt instruments during the first 10 years.

[1] Workers have to pay Social Security taxes for at leas 25 years of their working life.

Table A.1 shows the payroll tax for each of the different insurance program[2]. In the case of the firm, since participation to all programs is mandatory, the relevant tax is just the sum of the individual taxes. The last two rows of Table A.1 show how the total tax rate for the median worker[3] breaks into these two categories. In the case of the worker, the division of Social Security contribution between individual accounts and the rest of the programs is relevant.

The Reform in 1997 reduced the total average tax rate from 26.9% to 20.33%. In addition, about half of this contribution is now allocated to the Individual Retirement Accounts. Therefore, the Social Security tax for that is not directly linked to contributions decreased from 26.9% to 9.33%.

For the median worker, the total contribution to the Individual Retirement Accounts increased from 2% to 13.5%. The firm contributes 11.5% and the government a fixed amount equivalent to 5.75% of the minimum wage.

Figure A.1 and Figure A.2 show the firm contributions to Social Security and to the individual accounts respectively.

Benefits and eligibility rules for the medical insurance did not change after 1997. Although the medical benefits from participating in the formal sector are considerable[4], there are several features that make this system more similar to a public good than to an amenity the individual has to buy through a Social Security sector job. First, eligibility requirements are not strictly followed. Second, since the medical benefits are extended to all immediate family

[2] There are additional taxes used to fund day care centers for working mothers and to cover the expenses derived from on the job accidents. The specific amount of the tax depends on the accident incidence of the firm.
[3] The median worker earns three times the minimum wage.
[4] Medical benefits include up to two years of unlimited medical treatment for each illness. Medical treatment is provided and managed by the Institute of Social Security. If an illness prevents the worker from going to work, the Social Security pays cash transfer equivalent to up to 60 percent of his current wage for a maximum period of one and a half years. These benefits are offered during the working life and continue after retirement. The medical benefits extend to the worker's spouse and children under age 16. If children are attending to school at age 16, their benefits are extended until they reach 21. It is also possible to extend the benefits to a worker's parents if their parents live in the same household.

members of the insured worker, the marginal gain of insuring an additional member in the family is zero.

A.2 Comparison of PAYG and IRA Benefits

In order to compare benefits between regimes we need to know what fraction of the current wage does a worker has to save in order to meet benefits granted by the old regime. In Equation A.1 the net present value of PAYG benefits are equalized to savings in a regime where a worker saves a fixed percent (δ), of his wage into an Individual Retirement Account[5].

$$\frac{NPV(PAYG_i)}{(1+d)^{65-j}} = \sum_{t=0}^{65-j} \delta_{ij} W_{ij} (1+r)^{65-j-t} \Pr[I_{ij} \text{ works at the taxed sector at age } j+t]$$

Where:

W_{ij} is the wage of a worker with skill *i* and age *j*.

$PAYG_i$ is the value of the retirement pension of a worker with skill i.

r is the return rate on the Individual Retirement Accounts

d is the discount factor, equals r plus the annual rate of depreciation of the PAYG pension. The PAYG pension depreciates at the same rate of the minimum wage.

$\Pr[I_{ij} \text{ works at the taxed sector at age } j+t]$ Is the probability that a worker with skill level *i* will be working at the taxed sector at age *j*.

[5] See Appendix C for detailed explanation on how I computed delta.

If $\delta_{i\varphi}$ exceeds the IRA tax then a worker with skill i and age j will not be able to save enough to buy an annuity equal to the retirement pension granted by the old regime. In this case, a worker with skill i and age j will choose to retire under the PAYG rules[6] while giving up his retirement account savings. On the contrary, if $\delta_{i\varphi}$ is lower than the tax, then this worker will gain from switching to the IRA regimen. Gains, measured as a percentage of wages, equals the difference between the tax invested in the Individual Retirement Account and $\delta_{i\varphi}$.

Figure A.3 and Figure A.4 show the estimates of δ for various skill levels and the discount factor. The discount factor is equal to the real interest rate plus the annual rate of depreciation of the PAYG retirement pension.

Figure A.3 shows that old young workers will retire using their balance on their retirement accounts whenever the rate of depreciation is higher than 1 percent when the real return is equal to 4 percent[7]. This scenario is not difficult to fulfill given that the retirement pensions are indexed to the minimum wage and the average rate of depreciation of the minimum wage over the last 10 years was 4.5 percent. In addition, the rate of return on Individual Retirement Accounts over the past three has been about 7 percent. A more conservative scenario used in various studies about the Social Security Reform in Mexico (Sales, et al. 1999) uses interest rates on the range of 3 to 5 percent.

To interpret gains from the new system assume that the PAYG retirement pension depreciates at 4 percent annually. Before the reform, every time a worker with more than 12 years of schooling paid Social Security Taxes was as if his firm deposited 4 percent of his wage into a retirement account; with the reform he instead gets 14% into his account. For this

[6] Provided he paid taxes before 1997.
[7] The rate of return on Individual Retirement Accounts has been about 7 percent. A more conservative scenario used in various studies about the Social Security Reform in Mexico (Sales, et al. 1999) uses interest rates on the range of 3 to 5 percent.

particular worker, change in the legislation implied additional benefits equal to 10 percent of his wage. Gains are higher the higher is the returns on assets.

According to Figure A.4, old workers will retire under the old regime regardless of their skill level if the rate of depreciation of the minimum wage is lower than 5 percent. At the scenario described earlier, workers with fewer than 9 years of schooling would have to save 60 percent of their wages in order to save enough to buy an annuity equals to the PAYG pension. Even though replacement rates are particularly low for skilled workers, workers older than 50 will still be better off if retired under the old regime.

These graphics do not show an important improvement in the retirement benefits that the reform created. Specifically, under the old regime the retirement pension was indexed to the minimum wage while now is indexed to the inflation rate. Because the minimum wage decreased by 45 percent during the last decade, the retirement pension lost a significant share of its value in real terms. An easy way to default social security liabilities was to create inflation. In the Individual Retirement Account's system, the value of the retirement pension does not depend on the rate of inflation, as the rate of return in the retirement fund must be at least two percent in real terms. However, workers now have to contribute at least 25 years in order to be eligible for the minimum pension compared to only 10 years under the previous regime. Therefore, only young workers gain from the substitution of the Pay-As-You-Go system to individual retirement accounts.

Table A.1
Average Social Security Tax Rates for the Median Worker[1/]

	Before 1997		After 1997	
Program	Employer	Employee	Employer	Employee
Medical Insurance	8.75	3.125	5.38	0.25
Disability, Death and Retirement Insurance	5.95	2.125		
Disability and Death Insurance			1.75	0.625
Health Plan for Retired Workers	0.00	0.00	1.05	0.375
Individual Retirement Accounts	2		6.5	
INFONAVIT[2/]	5		5	
Total Tax Rate	14.7	5.25	8.18	1.25
Total Tax deposited on the IRA	2		11.5[3/]	

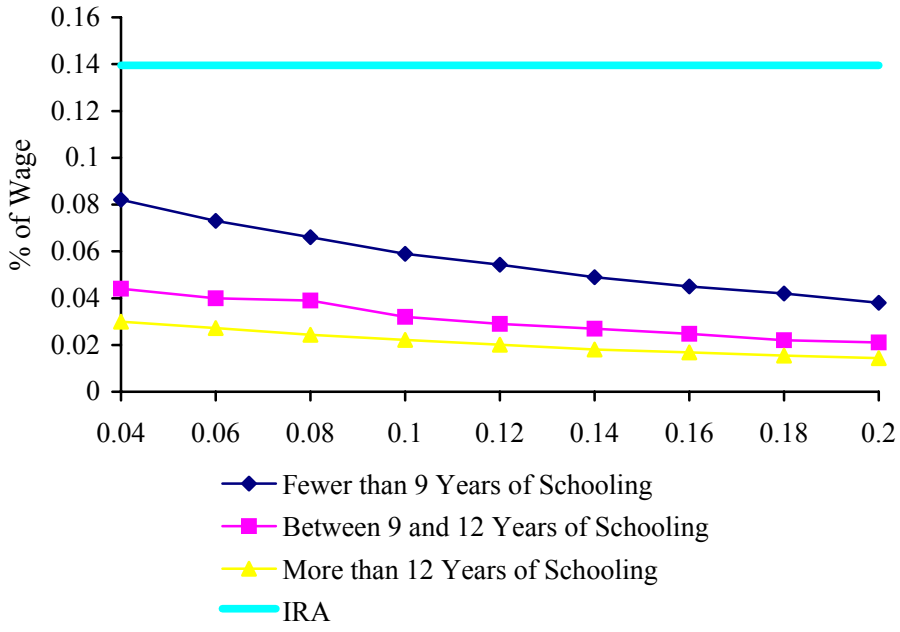
Notes:

1/The median worker earns three times the minimum wage.

2/ INFONAVIT is a government institution that provides low cost financing for housing. Before the reform, INFONAVIT's funding was limited and restricted to those workers that purchase a house built by the Institute. Because the loan was tied to the property, INFONAVIT rationed credit by building a limited number of houses. The new legislation, substituted INFONAVIT tax for a an individual INFONAVIT account, and funding is not longer tied to the property. The legislation states that the balances in the INFONAVIT account will be transfer to the IRA at the retirement date.

3/ This is the payroll contribution to the IRA. In addition, the government deposits about 6% of monthly earnings of the minimum wage worker to each worker registered in the SS.

Figure A1
Required Savings to Meet PAYG Benefits
Male Workers, 40 Years or Younger



Notes:

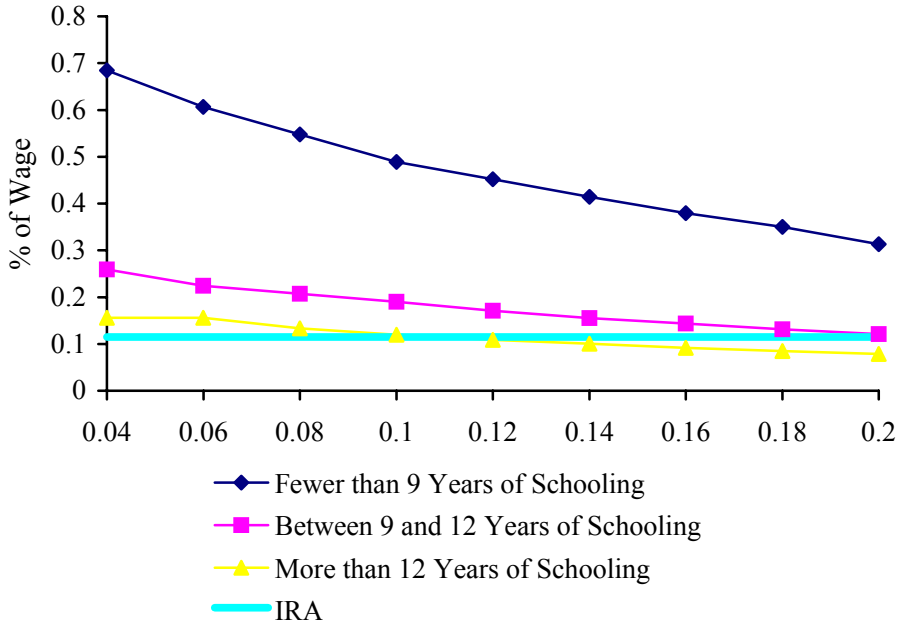
Savings are defined as a percentage of the wage.

d is the discount factor, equals return rate on the Individual Retirement Accounts plus the annual rate of depreciation of the PAYG pension.

IRA is the percentage that the new legislation mandates to be deposited into Individual Retirement Accounts.

PAYG benefits were computed following the legislation and average replacement rates.

Figure 5
Required Savings to Meet PAYG Benefits
Male Workers, 50 Years or Older



Notes:

Savings are defined as a percentage of the wage.

d is the discount factor, equals return rate on the Individual Retirement Accounts plus the annual rate of depreciation of the PAYG pension.

IRA is the percentage that the new legislation mandates to be deposited into Individual Retirement Accounts.

PAYG benefits were computed following the legislation and average replacement rates.

Appendix B:

Two Sector Tax Model

The economy is divided in two sectors Sector 1 is the taxed sector and Sector 0 is the untaxed (non-complying sector). X_1, and X_o are respectively the output produced in the taxed sector and the untaxed sectors.

Assuming constant returns to scale, A.1 and A.2 represent the cost functions in each sector:

$$C^1(r, w, X_1) = c^1(r, w_1(1+t))X_1 \qquad \text{b.1}$$

$$C^0(r, w, X_0) = c^0(r, w_0)X_0 \qquad \text{b.2}$$

Competition forces prices equal to marginal cost

$$p_1 = c^1(r, w_1(1+t)) \qquad \text{b.3}$$

$$p_0 = c^0(r, w_0) \qquad \text{b.4}$$

The demand for the goods produced in each sector are given by:

$$X_1 = X_1(p_1, p_0, w_1(1+t)L_l + w_0 L_0 + rK) \qquad \text{b.5}$$

$$X_0 = X_0(p_1, p_0, w_1(1+t)L_l + w_0 L_0 + rK) \qquad \text{b.6}$$

The factors demands are:

$$L_1^d = c_2^1(r, w_1(1+t))X_1 \qquad \text{b.7}$$

$$L_0^d = c_2^0(r, w_0))X_0 \qquad \text{b.8}$$

$$K_1^d = c_1^1(r, w_1(1+t))X_1 \qquad \text{b.9}$$

$$K_0^d = c_1^0(r, w_0))X_0 \qquad \text{b.10}$$

Where:

p_j is the price of the good produced in sector *j*

t is the tax paid by the firm

r is the rental price of capital

w_j is the wage rate in sector *j*

L_j is the labor employed in sector *j*

K_j is the capital employed in sector *j*

c_i^j Corresponds to the derivative of the *i* argument of the unitary cost function in sector *j*.

Wages adjust in each sector so that no one is better off switching sectors. Assuming that there are no switching costs and that wages can adjust, we have the following:

$$w_1 + b(t_2) = w_o$$

where $b(t)$ represents the monetary equivalent of the benefits received in the covered sector.

The total tax rate is divided in two parts, so that the tax paid by the firm is given by:

$$t = t_1 + t_2$$

t_1 is the portion of the payroll tax that is allocated to programs whose benefits are perceived as public. t_2 corresponds to the portion of the SS tax that goes into the individual retirement accounts.

The conditions for full employment conditions in the factor markets are:

$$c_2^1(r, w_1(1+t))X_1 + c_2^0(r, w_0)X_0 = L \qquad \text{b.12}$$

$$c_1^1(r, w_1(1+t))X_1 + c_1^0(r, w_0)X_0 = K \qquad \text{b.13}$$

Differentiate the demand functions to get

$$\hat{X}_1 = \hat{x} = \varepsilon_{11} p_1 + \varepsilon_{12} p_2 + \eta_1 \frac{dU}{dM} e_u \qquad \text{b.14}$$

$$\hat{X}_0 = \hat{x}_0 = \varepsilon_{21} p_1 + \varepsilon_{22} p_2 + \eta_0 \frac{dU}{dM} e_u \qquad \text{b.15}$$

Where

$$\hat{x} \equiv \frac{dx}{x}$$

$$M = w_1(1+t)L_1 + w_0 L_0 + rK$$

Assuming that preferences are homothetic $(\eta_1 = \eta_0 = 1)$ we have that:

$$\hat{x}_1 - \hat{x}_0 = -(\varepsilon_{11} - \varepsilon_{00})(p_1 - p_0) \qquad \text{b.16}$$

Differentiation of the price equations yields:

$$dp_1 = c_w^1 dw_1(1+t) + c_r^1 dr + c_w^1 w_1 dt$$
$$dp_0 = c_w^0 dw_0 + c_r^0 dr$$

Which simplifies to:

$$\hat{p}_1 - \hat{p}_0 = \theta_{l1}(\hat{w}_1(1+t) - \hat{r}) - \theta_{ly}(\hat{w}_0 - \hat{r}) + \theta_{l1} dt \qquad \text{b.17}$$

Where

θ_{ij} is the factor *i* share on sector *j*

From the factor demand functions we have that:

$$\hat{L}_1 - \hat{L}_0 = \hat{c}_w^1 + \hat{X}_1 - (\hat{c}_w^0 + \hat{X}_0) \qquad \text{b.18}$$

Differentiating the factor demand equations we have that:

$$dc_w^1 = c_{ww}^1 dw_1(1+t) + c_{ww}^1 w_1 dt + c_{wr}^1 dr$$

$$\frac{dc_w^1}{c_w^1} = \frac{c_{ww}^1 w_1(1+t)}{c_w^1}\frac{dw_1}{w_1} + \frac{c_{ww}^1 w_1}{c_w^1}\frac{dt}{} + \frac{c_{wr}^1 r}{c_w^1}\frac{dr}{r}$$

$$\hat{c}_w^1 = -\frac{c^1 c_{wr}^1 w_1}{c_w^1 c_r^1 r}\left(\frac{r c_r^1}{c^1}\right)\left(\hat{w}_1(1+t) + dt - \hat{r}\right)$$

$$= \sigma_x \theta_{k1}\left(\hat{w}_1(1+t) + dt - \hat{r}\right)$$

where σ_j is the elasticity of substitution between capital and labor in sector j.

By analogy we derived the following identities:

$$\hat{c}_w^0 = \sigma_0 \theta_{k0}(\hat{w}_0 - \hat{r})$$
$$\hat{c}_r^1 = \sigma_1 \theta_{l1}(\hat{w}_1(1+t) - \hat{r})$$
$$\hat{c}_r^0 = \sigma_0 \theta_{l0}(\hat{w}_0 - \hat{r})$$

$$dK_1 - dK_0 = \frac{K_1}{K}\hat{x}_1 - \frac{K_0}{K}\hat{x}_0 - \sigma_1\left(\frac{K_1}{K}\theta_{l1}\right)\left(\hat{w}_1(1+t) + dt - \hat{r}\right) + \sigma_0\left(\frac{K_0}{K}\theta_{l0}\right)\left(\hat{w}_0 - \hat{r}\right) \qquad \text{b.19}$$

$$dL_1 - dL_0 = \frac{L_1}{L}\hat{x}_1 - \frac{L_0}{L}\hat{x}_0 - \sigma_1\left(\frac{L_1}{L}\theta_{k1}\right)\left(\hat{w}_1(1+t) + dt - \hat{r}\right) + \sigma_0\left(\frac{L_0}{L}\theta_{k0}\right)\left(\hat{w}_0 - \hat{r}\right) \quad \text{b.20}$$

Full Employment conditions in factor market forces b.19 and b.20 to be equal to zero.

Subtracting equation b.20 from equation b.19 gives

$$\left(\frac{L_1}{L} - \frac{K_1}{K}\right)\hat{x}_1 - \left(\frac{L_0}{L} - \frac{K_0}{K}\right)\hat{x}_0 = \sigma_1\left(\frac{L_1}{L}\theta_{k1} - \frac{K_1}{K}\theta_{l1}\right)\left(\hat{w}_1(1+t) + dt - \hat{r}\right) + \sigma_0\left(\frac{L_0}{L}\theta_{k0} - \frac{K_{10}}{K}\theta_{l0}\right)\left(\hat{w}_0 - \hat{r}\right) \quad \text{b.21}$$

Define $\lambda \equiv \left(\frac{L_1}{L} - \frac{K_1}{K}\right) = -\left(\frac{L_0}{L} - \frac{K_0}{K}\right)$

$$A_j \equiv \frac{L_j}{L}\theta_{kj} - \frac{K_1}{K}\theta_{lj}$$

Equation b.21 is simplified to:

$$\lambda(\hat{x}_1 - \hat{x}_0) = \sigma_1 A_1(\hat{w}_1(1+t) + dt - \hat{r}) + \sigma_0 A_0(\hat{w}_0 - \hat{r}) \quad \text{b.22}$$

We have the following system of equations

$$
\begin{aligned}
(\hat{x}_1 - \hat{x}_0) &= -(\varepsilon_{11} - \varepsilon_{00})(\hat{p}_1 - \hat{p}_{10}) \\
(\hat{p}_1 - \hat{p}_{10}) &= \theta_{l1}(\hat{w}_1(1+t) - \hat{r}) - \theta_{l0}(\hat{w}_0 - \hat{r}) + \theta_{l1}dt \\
\lambda(\hat{x}_1 - \hat{x}_0) &= \sigma_1 A_1(w_1(\hat{1}+t) + dt - \hat{r}) + \sigma_0 A_0(\hat{w}_0 - \hat{r})
\end{aligned}
\qquad \text{b.23}
$$

Substitute $\hat{x}_1 - \hat{x}_0$ and evaluate at t=0, we derived a system of two equations with two unknowns:

$$
\begin{aligned}
&(\hat{p}_1 - \hat{p}_{10}) - \theta_{l1}(\hat{w}_1 - \hat{r}) + \theta_{l0}(\hat{w}_0 - \hat{r}) = \theta_{l1}dt \\
&\lambda(\varepsilon_{11} - \varepsilon_{00})(\hat{p}_1 - \hat{p}_{10}) - \sigma_1 A_1(\hat{w}_1 - \hat{r}) + \sigma_0 A_0(\hat{w}_0 - \hat{r}) = \sigma_1 A_1 dt
\end{aligned}
\qquad \text{b.24}
$$

If workers are heterogeneous in skills, then the condition $dL_1 - dL_0 = 0$ no longer holds. Instead we have the following identities:

$$dL_1 - dL_0 = (\hat{\pi}_1 - \hat{\pi} + adt_2)_0 \, g(\pi_1, \pi_0)$$

where

$$g(\pi_1, \pi_0) = \left(\pi_1 \big/ \pi_0\right) \int_{-\infty}^{\infty} q_1 (q_{i1} - q_{i0}) f(A, q_1) dq_1$$

Also,

$$\hat{L}_1 - \hat{L}_0 = (\hat{\pi}_1 - \hat{\pi} + dat_2)_0 \gamma(\pi_1, \pi_0) = (\hat{x}_1 - \hat{x}_0) - \sigma_1 \theta_{k1}(\hat{\pi}_1 + dt - \hat{r}) + \sigma_0 \theta_{k1}(\hat{\pi}_0 - \hat{r}) \qquad \text{b.25}$$

where

$$\gamma(\pi_1, \pi_0) = \frac{\int_{-\infty}^{\infty} q_{i1}^2 f(A, q_1) dq_1 \; (1 + \beta(\pi_1, \pi_0)}{E(q_1)E(q_0)} \left(\pi_1 \Big/ \pi_0 \right)$$

Substituting $dL_1 - dL_0$ in b.20 gives:

$$\lambda(\varepsilon_{11} - \varepsilon_{00})(\hat{p}_1 - \hat{p}_{10}) - (\sigma_1 A_1 - g(\pi))(\hat{\pi}_1 - \hat{r}) + (\sigma_0 A_0 + g(\pi))(\hat{\pi}_0 - \hat{r}) = (\sigma_1 A_1 + g(\pi))dt + g(\pi)dat_2 \qquad \text{b.26}$$

Equation b.17 evaluated at Π_1 and Π_0, Equation b.25 and Equation b.26 generates the following system:

$$\begin{aligned}
&(\hat{p}_1 - \hat{p}_{10}) - \theta_{l1}(\hat{\pi}_1 - \hat{r}) + \theta_{l0}(\hat{\pi}_0 - \hat{r}) = \theta_{l1} dt \\
&\lambda(\varepsilon_{11} - \varepsilon_{00})(\hat{p}_1 - \hat{p}_{10}) - (\sigma_1 A_1 - g(\pi))(\hat{\pi}_1 - \hat{r}) + (\sigma_0 A_0 + g(\pi))(\hat{\pi}_0 - \hat{r}) = (\sigma_1 A_1 + g(\pi))dt) \\
&(\varepsilon_{11} - \varepsilon_{00})(\hat{p}_1 - \hat{p}_{10}) - (\gamma(\pi) + \sigma_1 \theta_{k1}(\hat{\pi}_1 - \hat{r})) + (\gamma(\pi) + \sigma_0 \theta_{1k0}(\hat{\pi}_0 - \hat{r})) = \sigma_1 \theta_{k1} dt + dat_2 \gamma(\pi)
\end{aligned} \qquad \text{b.27}$$

Appendix C:

Estimates of the Probability of Participation

C.1. Logit Estimates

I constructed the variable *d=1* if a worker is employed in the covered sector and *d=0* if he is employed in the uncovered sector, therefore the estimates corresponds to the probability of working in the covered sector conditional on being a private sector employee. Table C1 shows the estimates of the probability *d=1* using a logit model.

The variables used in the logit regression include skill and skill specific time trends, experience and its square, city and industry dummies. It also includes years until retirement, a dummy for married, rate of regional manufacturing employment growth in the covered sector and the city compliance rate.

The estimates show that variables that have a positive impact on earnings have also a positive effect on the probability of being employed in the covered sector. Industries and cities with higher earnings (positive dummy coefficients in the earnings equations) have at the same time higher rates of compliance. Experience increases the probability of employment in the complying sector among low skill workers but does not have a significant effect on the probability of participation for higher skill workers. Married workers and workers who are closer to retirement have higher probability of being employed in the covered sectors, both factors are positively related with the benefits of participation.

City rate of compliance and regional employment growth in the complying sector increase the probability of participation. The exclusion restriction is that the city rate of compliance enters the sector-choice equations but does not directly in the wage equations. Cross city variation in compliance rates identify exogenous shift in labor demand by complying firms as long as variation in coverage incidence is caused by other actors besides labor force demographic characteristics or skill distribution of the labor force in the city. The evidence suggests that this is the case, the coefficient on city incidence is robust to other specifications that exclude skill variables or experience. Further, city compliance is the highest in cities where state owned enterprise are located (mainly oil) and border cities where the industry is dominated by firms participating in the outsourcing program. Since only complying firms can participate in these programs, industries in the covered sector tend to cluster around these cities.

Table C.1

Logit Estimates

Variable	Coefficient	Standard Error
Skill 2	0.1890	0.0545
Skill 3	0.0513	0.0805
Skill1*experience	-0.0132	0.0048
Skill2*experience	0.0029	0.0053
Skill3*experience	-0.0031	0.0076
Skill1*experience^2	-0.0009	0.0000
Skill2*experience^2	-0.0017	0.0001
Skill3*experience^2	-0.0022	0.0002
Skill1*time	0.0122	0.0023
Skill2*time	0.0059	0.0027
Skill3*time	0.0026	0.0050
Technician	0.4384	0.0257
Married	0.5934	0.0160
City compliance rate	4.3714	0.1985
Years until retirement	-0.0804	0.0042
Employment growth	0.3883	0.2232
Constant	-0.0400	0.2612
Industry dummies	yes	
Region dummies	yes	