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The Impact of Firing Costs on Turnover and Unemployment: Evidence from the Colombian Labour Market Reform

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Abstract

Reductions in firing costs are often advocated as a way of increasing the dynamism of labour markets in both developed and less developed countries. Evidence from Europe and the U.S. on the impact of firing costs has, however, been mixed. Moreover, legislative changes both in Europe and the U.S. have been limited. This paper, instead, examines the impact of the Colombian Labour Market Reform of 1990, which substantially reduced dismissal costs. I estimate the incidence of a reduction in firing costs on worker turnover by exploiting the temporal change in the Colombian labour legislation as well as the variability in coverage between formal and informal sector workers. Using a grouping estimator to control for common aggregate shocks and selection, I find that the exit hazard rates into and out of unemployment increased after the reform by over 1% for formal workers (covered by the legislation) relative to informal workers (uncovered). The increase of the hazards implies a net decrease in unemployment of a third of a percentage point, which accounts for about one quarter of the fall in unemployment during the period of study.

Keywords: firing costs, worker turnover, exit hazard rates, grouping estimators, selection biases, labour market reform.

JEL Code: J41, J42, J63, J64, J65

I. Introduction

Job security regulations are often considered to impose substantial rigidities on the ability of firms to adjust their employment levels over the business cycle. These regulations are equivalent to taxes on job destruction that reduce firms' incentives not only to dismiss but also to hire new workers. Thus, job security provisions reduce both dismissals and hirings and, hence, the exit rates into and out of unemployment. Due to the effect on hirings, it is often argued that the strict job security requirements in Europe are in part to blame for the high unemployment rates in this continent. However, a priori, job security provisions could either decrease or increase unemployment, depending on whether the regulations have a greater effect on the exit hazard rates into or out of unemployment.[1]

Moreover, since the effects of firing costs on employment and unemployment are difficult to estimate, the net impact of job security provisions has not been determined empirically either. In fact, the empirical evidence on the net effects of firing costs is ambiguous. Using cross-sections, Grubb and Wells (1993) find that stricter provisions are negatively correlated with employment, while Bertola (1990) finds no relation between the strictness of job security provisions and medium and long run employment. These mixed results

are not surprising, given that cross-section studies are subject to omitted variables biases, simultaneity problems, and possible endogeneity of the regulations.

To overcome some of these problems, a number of studies have instead relied on pooled time-series and cross-section data and panel data. Nonetheless, the results from these studies are also mixed. Lazear (1990) uses pooled time-series and cross section data for 22 OECD countries over 29 years and finds that severance payments and advance notice requirements reduced employment. Dertouzos and Karoly (1993) use pooled time-series and cross-section data from the U.S. and find a reduction in employment in those states in the U.S. that introduced exceptions to the employment-at-will doctrine. In contrast, using a panel of 8,000 retail firms in the U.S., Anderson (1993) finds higher employment levels in firms subject to higher adjustment costs, due to the experience-rating feature of the U.S. unemployment insurance system. While these studies are not subject to some of the problems present in cross-section studies, they are subject to selection biases. For example, these estimates would be biased due to selection if high-turnover firms choose to locate in states where job-security provisions are less strict, or if high-turnover firms already located in states with high firing costs simply choose to exit the market.

In this paper, I develop a simple model of labour demand to illustrate how job-security provisions and changes in these provisions may induce self-selection. The model highlights the selection biases that may be present in the above estimates of the net impact of firing costs. Moreover, the model also shows how compositional changes may bias standard grouping estimators downwards. Consequently, below I discuss the necessary identifying assumptions for grouping estimators to be consistent in the presence of a time-variant composition.

Contrary to the above studies, which examine the effects of firing costs in Europe and the U.S., this paper exploits a large policy change in Latin America. I explore the impact of the Colombian Labour Market Reform of 1990, which substantially reduced firing costs, on worker turnover (exit rates into and out of unemployment). The identification strategy consists of exploiting the temporal change in the labour market legislation together with the variability in coverage across groups. Thus, the strategy relies on comparing the exit rates of groups of workers affected differently by the labour market reform, but subject to the same non-treatment shocks. However, as suggested above, the reform may induce reallocation across groups thus biasing grouping estimators. To obtain consistent grouping estimators an additional "reform" is required. The additional identifying assumption needed is that selection into groups be affected by some exogenous factor unrelated to those factors causing self-selection.[2]

The empirical analysis uses repeated cross-sections from the Colombian National Household Survey (NHS). The NHS data provides information on tenure, last unemployment spell, demographic characteristics, industry, city, and indicators of whether the employee is covered by labour market legislation. The empirical analysis shows that after controlling for composition changes, the reduction in firing costs increased the hazard rate out of employment of covered workers by up to 1.06% and the hazard rate out of unemployment of covered workers by up to 1.7% relative to uncovered workers.

The rest of the paper proceeds as follows. In Section II, I describe the legislative changes introduced by the Colombian labour market reform of 1990. In Section III, I present a simple

model that explains the compositional changes induced by a reduction in firing costs. In Section IV, I describe the conditions required on grouping estimators for the identification and estimation of firing cost effects. In Section V, I describe the data and present estimates of the incidence of firing costs on the exit rates into and out of unemployment. In Section VI, I conclude by explaining the implied net effect of the reform on unemployment.

II. The Colombian Labour Market Reform

The view that job security regulations hamper the flexibility of labour markets has driven a number of European countries to introduce labour market reforms, in the hope of reducing unemployment. However, most efforts in this direction have been limited to the introduction of temporary contracts. In contrast, in the United States, legislative changes have moved towards stricter regulations, but have been limited to the introduction of exceptions to the employment-at-will doctrine.

More recently, a number of Latin American countries have introduced large changes in their labour legislation towards greater flexibilization. These large policy changes in Latin America, thus, provide substantial temporal variation to study the effects of firing costs. In particular, this paper considers the Colombian Labour Market Reform of 1990.

In 1990, Colombia introduced a labour market reform that substantially reduced the cost of dismissing workers. The one major policy change introduced by the reform was a uniform reduction in severance payments.[3] The reduction in severance payments lowered the costs of hiring and firing workers hired after 1990 and covered by the legislation. Thus, the reform should not have affected the self-employed, family workers, and domestic workers, all of whom are exempted from severance payments. In addition, workers hired in the underground or informal sector are not protected by labour legislation and, thus, should not have been affected by the labour market reform. During the period of study 51.3% of all workers were employed in the informal sector and were thus not covered by job security provisions.

Prior to the reform, employers were mandated to pay severance of one month per year worked based on the salary at the time of separation (9.3% of the salary at the time of separation). From this amount, any *nominal* withdrawals made by the worker from his severance pay were subtracted,[4] but the employer paid for those withdrawals in *real terms*. These legislated firing costs introduced a corridor of inaction over which firms would prefer not to hire nor to fire, thus, reducing employment adjustments over the business cycle.[5] The reform, however, reduced these dismissal costs. After 1990, employers were, instead, required to make a monthly contribution of 9.3% of the present salary to a capitalised fund, which would be accessible to the worker in the event of separation. The change in the legislation reduced severance payments for three reasons. First, it eliminated the additional cost implied by the fact that, prior to the reform, the severance pay was based on the salary at the time of separation rather than on the current salary during each month. Second, the change in the legislation reduced severance payments by eliminating the possibility for employees to withdraw funds for investments in education and housing which would only be credited to the employer in *nominal* terms at the time of separation.[6] Finally, the replacement of severance payments at the time of firing for a monthly contribution turned

severance payments into a deferred compensation scheme and should had reduced the probability of inaction and increased turnover rates after 1990 for all workers covered by the legislation.[7]

Moreover, the reduction of severance payments and other firing costs decreased the propensity of firms to hire in the underground sector. Prior to the reform, 44.84% of all workers were employed in the formal sector while after the reform 51.05% of all workers were employed in the formal sector.[8] The reduction in firing costs should have increased expected formal profits, thus, inducing firms to hire formally rather than in the underground sector. Moreover, with heterogeneous firms, the reduction in firing costs must had been accompanied by a change in the composition of the two sectors, which is also likely to affect turnover in different sectors. The next section presents a model that shows how firing costs can affect self-selection of firms into the formal and informal sectors.

III. A Model of Selection into Formal and Informal Sector Activity

This section presents a model of formal and informal sector activity in which the size and composition of the formal and informal sectors are endogenously determined. In particular, the model shows how the size and composition of the two sectors are affected by changes in job security legislation.

The formal and informal sectors are distinguished by two characteristics. First, formal firms comply with labour market regulations (e.g., severance pay, indemnities for unjust dismissals), while informal firms do not comply with regulations. Consequently, formal firms have higher adjustment costs due to the legislated firing costs. Second, because formal firms are subject to unjust dismissal legislation, they must accumulate sufficient evidence before firing to avoid having to pay indemnities for 'unjust' dismissals. The presence of unjust dismissal legislation raises monitoring costs substantially for formal sector firms and they, thus, prefer paying efficiency wages rather than monitoring costs.[9] In contrast, informal firms can monitor cheaply and they pay reservation wages. Hence, the payment of efficiency wages introduces an additional source of adjustment costs. In particular, formal firms prefer not to adjust their employment because the expectation of being fired increases the efficiency wages that have to be paid to motivate workers.

A. Assumptions

Firms and workers are risk neutral, infinitely lived, and face a discount factor β.

Firms

(F1) The revenue of firm j is $R_{jt} = \theta_t f(e_t 1_{jt})$, where the price, θ_t, is an i.i.d. random variable drawn from a density $G(\theta)$, e_t are the efficiency units and 1_{jt} is employment at firm j at time t.

(F2) Formal firms pay legislated firing costs, C, while informal firms do not.

(F3) Firms can obtain a monitoring technology at a cost s that allows to perfectly monitor workers.[10] Without this technology firms can monitor imperfectly, as each firm j has a probability of catching a shirker q_j, where q_j is uniformly distributed between $\underline{q}$ and $\overline{q}$.

Workers

(W1) Workers can exert effort $e = 1$, or they can shirk, $e = 0$.

(W2) Workers employed in sector $s = F, I$ and firm j at time t face a separation rate x_{sjt}.

B. Solution of the Model

Firms determine the wage to be paid in each sector. Given these wages, firms then make hiring and firing decisions. Finally, given the wages and turnover patterns in each sector, each firm decides whether to produce in the formal or informal sector.[11]

Wage Determination

Since the cost of the monitoring technology is excessive for formal firms, these firms pay efficiency wages. That is, a firm j producing in the formal sector pays a wage to satisfy the no-shirking condition (NSC):

$$\begin{aligned} V_{Et}^{Fj} &= w_{Fjt} - 1 + \beta[(1 - x_{Fjt})E_t V_{Et+1}^{Fj} + x_{Fjt}E_t U_{t+1}] \\ &\geq V_{St}^{Fj} = w_{Fjt} + \beta[(1 - x_{Fjt})(1 - q_j)E_t V_{St+1}^{Fj} + ((1 - x_{Fjt})q_j + x_{Fjt})E_t U_{t+1}], \end{aligned}$$

where $(1 - x_{Fjt})(1 - q_j)$ is the probability that a worker does not get fired for shirking nor for exogenous reasons, and $(1 - x_{Fjt})q_j$ is the probability that a worker gets fired only for shirking. The wage that satisfies the NSC with equality is:

$$w_{Fjt} = a_{Fj} + b_{Fj}/(1 - x_{Fjt-1}),$$

where, $a_{Fj} = (E_{t-1}U_t - \beta E_{t-1}U_{t+1}) + (1 - 1/q_j)$ and $b_{Fj} = 1/\beta q_j$.

The informal sector can perfectly monitor workers, and hence, informal sector firms pay workers their opportunity cost:

$$w_I = a_I = (E_{t-1}U_t - \beta E_{t-1}U_{t+1}) + 1.$$

The probability of being fired by firm j in the formal sector, x_{Fjt}, is,

$$x_{Fjt} = \max\{(l_t^{Fj} - l_{t+1}^{Fj})/l_t^{Fj}, 0\},$$

and the probability of being fired in the informal sector, x_{It}, is,

$$x_{It} = \max\{(l_t^I - l_{t+1}^I)/l_t^I, 0\}.$$

Given the firing probabilities, the total cost of hiring formal workers is,

$$c(l_t^{Fj}, l_{t-1}^{Fj}) = w_{Fjt} l_t^{Fj} = a_{Fj} l_t^{Fj} + b_{Fj} \max\{l_{t-1}^{Fj}, l_t^{Fj}\},$$

and the total cost of hiring informal workers includes the cost of monitoring, s, and is,

$$c(l_t^I) = (w_I + s) l_t^I = (a_I + s) l_t^I.$$

Hiring and Firing Decisions

At the end of time t, formal firms choose their employment at time $t+1$ as to maximise their expected discounted profits:

$$V(l_t^{Fj}, \theta_{t+1}) = \max \theta_{t+1} f(e_t l_{t+1}^{Fj}) - c(l_{t+1}^{Fj}, l_t^{Fj}) + \beta E_t V(l_{t+1}^{Fj}, \theta_{t+2}).$$

where $e_t = 1$. Thus, hiring and firing decisions are determined as follows.

Case 1F. If $\theta_{t+1} f'(l_t^{Fj}) + \beta E_t \partial V(l_t^{Fj}, \theta_{t+2})/\partial l_t^{Fj} > a_{Fj} + b_{Fj} \Leftrightarrow l_{t+1}^{Fj} > l_t^{Fj}$, firm j hires new workers at time $t+1$. In particular the firm hires iff,

$$\theta_{t+1} > \overline{\theta}^{Fj} = \{a_{Fj} + b_{Fj} - \beta E_t \partial V(l_t^{Fj}, \theta_{t+2})/\partial l_t^{Fj}\}/f'(l_t^{Fj}).$$

Case 2F. If $\theta_{t+1} f'(l_t^{Fj}) + \beta E_t \partial V(l_t^{Fj}, \theta_{t+2})/\partial l_t^{Fj} + C < a_{Fj} \Leftrightarrow l_{t+1}^{Fj} < l_t^{Fj}$, firm j fires workers at time $t+1$. In particular, firm j fires iff,

$$\theta_{t+1} < \underline{\theta}^{Fj} = \{a_{Fj} - C - \beta E_t \partial V(l_t^{Fj}, \theta_{t+2})/\partial l_t^{Fj}\}/f'(l_t^{Fj}).$$

Case 3F. If $a_{Fj} + b_{Fj} > \theta_{t+1} f'(l_t^{Fj}) + \beta E_t \partial V(l_t^{Fj}, \theta_{t+2})/\partial l_t^{Fj} > a_{Fj} - C \Leftrightarrow l_{t+1}^{Fj} = l_t^{Fj}$, then at time $t+1$ firm j does not hire nor fire. In particular, firm j does not hire or fire iff:

$$\overline{\theta}^{Fj} > \theta_{t+1} > \underline{\theta}^{Fj},$$

and the probability that firm j remains inactive is $G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj})$.

Result 1. A reduction in firing costs decreases the probability of inaction of formal firms, $G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj})$.

Proof: All proofs are in Appendix A.

Informal firms' hiring and firing decisions can be determined similarly. The present discounted profits of informal firms are:

$$V(l_t^I, \theta_{t+1}) = \max \theta_{t+1} f(e_t l_{t+1}^I) - c(l_{t+1}^I, l_t^I) + \beta E_t V(l_{t+1}^I, \theta_{t+2}),$$

where $e_t = 1$. Hiring and firing is determined as before by the following cases.

Case 1I. If $\theta_{t+1} f'(l_t^I) + \beta E_t \partial V(l_t^I, \theta_{t+2})/\partial l_t^I > a_I + s \Leftrightarrow l_{t+1}^I > l_t^I$, informal firms hire new workers at time $t+1$. In particular, informal firms hire iff,

$$\theta_{t+1} > \overline{\theta}^I = \{a_I + s - \beta E_t \partial V(l_t^I, \theta_{t+2})/\partial l_t^I\}/f'(l_t^I).$$

Case 2I. If $\theta_{t+1} f'(l_t^I) + \beta E_t \partial V(l_t^I, \theta_{t+2})/\partial l_t^I < a_I + s \Leftrightarrow l_{t+1}^I < l_t^I$, informal firms lay off workers at time $t+1$. In particular, informal firms fire iff,

$$\theta_{t+1} < \underline{\theta}^I = \{a_I + s - \beta E_t \partial V(l_t^I, \theta_{t+2})/\partial l_t^I\}/f'(l_t^I).$$

Case 3I. If $a_I + s > \theta_{t+1} f'(l_t^I) + \beta E_t \partial V(l_t^I, \theta_{t+2})/\partial l_t^I > a_I + s \Leftrightarrow l_{t+1}^I = l_t^I$. However, since the LHS and the RHS of the inequality are the same, informal firms *always* adjust their employment in response to shocks.

Choice of Sector

Each firm j can choose whether to produce in the formal or informal sector. Firms producing in the formal sector pay firing costs and efficiency wages. Firms producing in the informal sector do not comply with labour legislation, but they pay a constant cost, s, to monitor workers. Since firms differ in terms of the increase in difficulty of firing shirkers if they switch from the informal to the formal sector, some firms find it more profitable to hire formally and others informally.

A firm j produces in the sector that maximises its present discounted profits. The present discounted profits of formal firms depend on whether they are hiring or firing,

$$\begin{aligned} V^e(l_t^{Fj}, \theta_{t+1}) &= \int_{\theta \in \theta(\text{hire})} V^{\text{hire}}(l_t^{Fj}, \theta_{t+1}) + \int_{\theta \in \theta(\text{inactive})} V^{\text{inactive}}(l_t^{Fj}, \theta_{t+1}) \\ &\quad + \int_{\theta \in \theta(\text{fire})} V^{\text{fire}}(l_t^{Fj}, \theta_{t+1}), \end{aligned}$$

where,

$$\begin{aligned} V^{\text{hire}}(l_t^{Fj}, \theta_{t+1}) &= V^{\text{inactive}}(l_t^{Fj}, \theta_{t+1}) \\ &= \max\{\theta_{t+1} f(l_{t+1}^{Fj}) - (a_{Fj} + b_{Fj}) l_{t+1}^{Fj} + \beta E_t V^e(l_{t+1}^{Fj}, \theta_{t+2})\}, \text{ and} \\ V^{\text{fire}}(l_t^{Fj}, \theta_{t+1}) &= \max\{\theta_{t+1} f(l_{t+1}^{Fj}) - a_{Fj} l_{t+1}^{Fj} + \beta E_t V^e(l_{t+1}^{Fj}, \theta_{t+2})\}. \end{aligned}$$

The probability of catching a shirker for the firm j that is just indifferent between producing in the formal or the informal sectors is, q^{crit}, and is determined by the following condition:

$$\begin{aligned} &\int_{\theta \in \theta(\text{hire})} V^{\text{hire}}(l_t^{Fj}, \theta_{t+1}) + \int_{\theta \in \theta(\text{inactive})} V^{\text{inactive}}(l_t^{Fj}, \theta_{t+1}) \\ &\quad + \int_{\theta \in \theta(\text{fire})} V^{\text{fire}}(l_t^{Fj}, \theta_{t+1}) = V^e(l_t^I, \theta_{t+1}) \end{aligned}$$

where,

$$V^e(l_t^I, \theta_{t+1}) = \int_{\theta \in \theta(\text{hire})} V^{\text{hire}}(l_t^{Fj}, \theta_{t+1}) + \int_{\theta \in \theta(\text{fire})} V^{\text{fire}}(l_t^{Fj}, \theta_{t+1}), \text{ and}$$

$$V^{\text{hire}}(l_t^{Fj}, \theta_{t+1}) = V^{\text{fire}}(l_t^{Fj}, \theta_{t+1})$$
$$= \max\{\theta_{t+1} f(e_t l_{t+1}^I) - (a_I + s) l_{t-1}^I + \beta E_t V(l_{t+1}^I, \theta_{t+2})\}.$$

Result 2. Firms with $q_j \in [q^{\text{crit}}, \overline{q}]$ produce formally, while firms with $q_j \in [\underline{q}, q^{\text{crit}}]$ produce informally.

Figure 1 in Appendix A shows the expected present discounted profits of formal and informal firms as a function of an inverse measure of the difficulty of firing shirkers. The figure shows the cut-off value that makes a firm j indifferent between producing formally and informally. Moreover, Result 3 shows how this cut-off value changes in response to changes in firing costs.

Result 3. A decrease in the firing costs, C, decreases the cut-off probability of catching a shirker, q^{crit}. As the cut-off probability decreases, the size of the formal sector increases and the average probability of inaction in the formal sector increases.

Result 3 is illustrated in Figure 2 in Appendix A. The reduction in firing costs shifts the expected profits of formal firms. This shift increases the number of firms producing in the formal sector and decreases the number of firms producing informally. Moreover, the shift generates a compositional change that decreases the average probabilities of firing and hiring. The net effect of this compositional change is to reduce the average probability of inaction of formal firms, without changing the response of informal firms to demand shocks.

The model shows that a reduction in firing costs increases firing and hiring and, thus, the exit rates into and out of unemployment. However, in the model a reduction in firing costs also induces sector reallocations that reduce turnover in the formal sector. Thus, this model suggests that the impact of firing costs on turnover is likely to be smaller when the reduction in firing costs also induces compositional changes. The next section discusses the identification of firing cost effects, using the Colombian Labour Market Reform, when there are compositional changes.

IV. Identification Strategy

A. A Grouping Estimator

According to the theory laid out above, the reduction in firing costs introduced by the Colombian labour market reform of 1990 should have affected firms' decisions to both fire and hire and, thus, the exit rates into and out of unemployment. To examine the effects of

the reform, an exponential hazard model is used to estimate exit rates out of employment and out of unemployment,

$$h(s_{it} \mid \mathbf{X}_{it}, \theta_{it}) = \exp\{\beta \mathbf{X}_{it} + \gamma \text{ reform}_{it} + \theta_{it}\},$$

where s_{it} is the employment or unemployment spell of person i in period t, $\mathbf{X}_{it}$ is a vector of observed characteristics of person i in period t and θ_{it} is a vector of unobservable factors affecting turnover behaviour of person i in period t. The unobservable factors may capture either common aggregate shocks or unobservable heterogeneity across groups of workers. Failing to account for both common shocks and unobservable heterogeneity would in general introduce biases. In order to control for the presence of aggregate shocks, I exploit the cross section variation between covered and uncovered workers. That is, the estimation relies on comparing otherwise similar groups of workers who were affected by the same aggregate shocks, but who were affected differently by the labour market reform.

The problems in estimating the effect of the reforms on turnover are the following. One must control for: (1) the presence of common aggregate shocks, (2) for the correlation between unobserved heterogeneity and firing costs, and (3) for selection into the covered and uncovered sectors.

Suppose workers can be categorised into two groups $g = \{F, I\}$ (i.e., formal and informal, or covered and uncovered), each sampled for at least two periods. The following identifying assumptions allow controlling for (1) and (2).

ASSUMPTION A.1.1 $\theta_{it} = \theta_g + \theta_t$.

ASSUMPTION A.2.1 $[\Delta h^{gt} \mid \theta_{it}]^2 \neq 0$,
where,

$$[\Delta h^{gt} \mid \theta_{it}] = h(s_{it} \mid \mathbf{X}_{it}, g_i \times t, g_i, t) - h(s_{it} \mid \mathbf{X}_{it}, g_i, t),$$

and $h(s_{it} \mid \mathbf{X}_{it}, g_i \times t, g_i, t) = h(s_{it} \mid \mathbf{X}_{it}, g_i \times t, g_i, t, \theta_{it})$ *and* $h(s_{it} \mid \mathbf{X}_{it}, g_i, t) = h(s_{it} \mid \mathbf{X}_{it}, g_i, t, \theta_{it})$.

Assumption A.1.1 states that a group component and an additive time component can capture the unobservable factors. This assumption, thus, says that, given the observables, the difference in the average turnover between the two groups remains unchanged over time. Consequently, this assumption does not require for the two groups to respond similarly to aggregate shocks, but rather for the response of the two groups to aggregate shocks to be similar over time. The second assumption states that after controlling for unobservables, turnover must change differentially over time across groups. A labour market reform between the two periods, which reduces firing costs and affects the two groups differently, would guarantee identification of the firing cost effect.

Considering the case with two groups and two-time period yields the following difference of differences estimator of the effect of firing costs on turnover:

$$\begin{aligned} \Delta h^{\text{formal} \times \text{post90}} \;=\; & h(s_{it} \mid \mathbf{X}_{it}, \text{formal}_i \times \text{post90}_t, \text{formal}_i, \text{post90}_t, \gamma_2 = \gamma_2^{\circ}) \\ & - h(s_{it} \mid \mathbf{X}_{it}, \text{formal}_i, \text{post90}_t, \gamma_2 = 0) \end{aligned}$$

$$= \exp\{\beta^{\circ}\mathbf{X}_{it} + \gamma_0^{\circ}\,\text{formal}_i + \gamma_1^{\circ}\,\text{post90}_t + \gamma_2^{\circ}\,\text{formal}_i \times \text{post90}_t\} - \exp\{\beta^{\circ}\mathbf{X}_{it} + \gamma_0^{\circ}\,\text{formal}_i + \gamma_1^{\circ}\,\text{post90}\},$$

where β° and γ° are the estimates of the parameters of the model. Because the exponential hazard is a non-linear model, the estimated coefficient γ_2° cannot be interpreted as a marginal effect. Instead, since the reform variable ($\text{formal}_i \times \text{post90}_t$) is discrete, the marginal effect of the reduction in firing costs is estimated by predicting two hazards, one with the interaction term set equal to one and the other with the interaction term set equal to zero. The firing cost effect on turnover is, then, estimated as the average difference in the two hazards, over the sample of post-1990 workers in the formal sector. Moreover, with exponential hazards the sample counterpart of the firing cost effect can be obtained using the inverse of the firing cost effect on employment and unemployment spells:

$$\Delta\overline{h}^{gt} = \Delta[\overline{h}^{\text{post90}} - \overline{h}^{\text{pre90}}]^{\text{formal}} - \Delta[\overline{h}^{\text{post90}} - \overline{h}^{\text{pre90}}]^{\text{informal}}$$

where, $\overline{h}^{gt} = 1/\overline{s}^{gt}$ and $\Delta\overline{s}^{gt} = \Delta[\overline{s}^{\text{post90}} - \overline{s}^{\text{pre90}}]^{\text{formal}} - \Delta[\overline{s}^{\text{post90}} - \overline{s}^{\text{pre90}}]^{\text{informal}}$.

B. Possible Selection Biases

A potential problem with the approach above is that it assumes that selection into the formal and informal sectors is constant over time and, thus, selection effects can be fully accounted for by the group effect. Nonetheless, as shown by the model in Section III, the changes in firing costs introduced by the reform are, in fact, likely to induce sector reallocations. In particular, sector reallocations are likely to cause firms with higher adjustment costs to self-select into the formal sector and thus to reduce average turnover in this sector. If this were the case, sector reallocations would introduce a downward bias in the firing cost effect and the grouping estimator considered above would, thus, provide a lower bound of the effects of firing costs on turnover.

The presence of selection effects that change over time would imply that unobservables are a more general function of time and group. To control for the possibility that unobservables may change over time across groups, the identifying assumptions above are modified as follows:

ASSUMPTION A.1.2 $\theta_{it} = \theta_g + \theta_t + \theta_{gt}$.

ASSUMPTION A.2.2 $[\Delta h^{gt} \mid \theta_{it}]^2 \neq 0$,
where,

$$[\Delta h^{gt} \mid \theta_{it}] = h(s_{it} \mid \mathbf{X}_{it}, p(g_i) \times t, p(g_i), t) - h(s_{it} \mid \mathbf{X}_{it}, p(g_i), t)$$
$$= h(s_{it} \mid \mathbf{X}_{it}, p(g_i) \times t, p(g_i), t, \theta_{it}) - h(s_{it} \mid \mathbf{X}_{it}, p(g_i), t, \theta_{it}),$$

and $p(g_i = \text{formal}_i) = \text{Prob}(g^* > 0) = \text{Prob}(\delta\mathbf{Z}_{it} + \varepsilon > 0) = \Phi(\delta\mathbf{Z}_{it})$ *and* $\text{Cov}(\theta_{it}, \mathbf{Z}_{it}) = 0$.

Assumption A.1.2 states that unobservables are a function of a group effect, a time effect, and a joint time-group effect. The time-group effect implies the presence of changes in

the composition of groups over time. Thus, one can no longer use the approach above to capture the effect of firing costs on turnover, because the difference in the hazards would now capture both the direct effect of the reform from a reduction in firing costs as well as an indirect composition effect. Assumption A.2.2 states that turnover must vary differentially across groups over time, over and above any turnover variation induced by changes in the composition of the two groups. An extra "reform" is, thus, required to control for the composition effect. This assumption requires the use of an exogenous source of variation that affects selection into the formal and informal sectors but that is independent of the unobservables. The estimator that imposes these assumptions is implemented, as before, by estimating the average difference in the hazards, but instrumenting for selection into the formal and informal sectors.

V. Empirical Analysis

This Section examines the impact of the Colombian Labour Market Reform of 1990, which reduced firing costs substantially, on the hazard rates of formal workers out of employment and out of unemployment.

A. Data

The data to analyse the effects of the reform on the exit rates out of employment and out of unemployment are drawn from the Colombian National Household Surveys (NHS) for June of 1988, 1992, and 1996. The June NHS's were administered in seven Colombian metropolitan areas.

The benefit of using the June waves of the NHS is that these include special modules on informality that allow to separate workers between formal workers (covered by the reform) and informal workers (uncovered). As discussed in the previous Section, the possibility of separating workers into these two groups helps to control for common shocks that may have affected the turnover of all workers. The June waves have information on whether a worker's employer pays social security taxes or not. This information provides a good proxy of formal and informal sector employment, as it indicates whether the employer complies or not with labour legislation.[12] Moreover, the June waves also include information about whether the worker is permanent or temporary, which allows distinguishing the effects of the extension of temporary contracts by the reform on the turnover of permanent and temporary workers. The Surveys also include information on gender, age, marital status, educational attainment, number of dependants, city and sector of employment, all of which are used to control for differences in turnover behaviour across individuals.

Table 1 in Appendix B presents summary statistics of formal and informal workers, before and after the reform. Columns 1 and 2 present the characteristics of formal workers and columns 3 and 4 present characteristics of informal workers, before and after the reform. The two groups are remarkably similar both before and after the reform with regards to gender and age composition, marital status, and household size. The two groups differ, however, on their educational composition. The formal sector has a greater share of workers with

university education than the informal sector, and this difference increased slightly after the reform.

These summary statistics suggest that the raw differences in the turnover patterns of covered and uncovered workers may reflect, in part, differential turnover behaviour of the two groups due to differences in composition. For this reason, the use of formal hazard models in the analysis below, which allows controlling for individual characteristics, will be crucial in identifying the effect of the labour market reform. Moreover, Table 1 shows an increase in the share of formal workers after 1990 (this share was 44.84% before and 51.05% after 1990) indicating that the reform could have induced changes in the composition of the two sectors and suggesting the potential presence of selection biases.

B. Tenure and Unemployment Spells, Before and After the Reform

Average Tenure

The framework above suggests that, if compositional changes were unimportant, the reform should have encouraged more firings and, thus, should have increased the hazard rate out of employment and reduced the average tenure of formal workers (covered by the reform) relative to informal workers (uncovered).[13]

Table 2 in Appendix B presents the average tenure of the covered and uncovered groups, before and after the Colombian Labour Market Reform of 1990. The first row corresponds to the average tenure prior to the reform, the second row corresponds to the average tenure after the reform, and the third row corresponds to the differences. The last row provides the sample difference of differences estimate of the effect of the reform on tenure, $\Delta\overline{s}^{gt}$. As expected, the average tenure of formal workers decreased relative to the average tenure of informal workers between 14.88 and 15.84 weeks after the reform. Moreover, the sample difference of differences estimates of the effect of the reform on the hazards out of employment indicate that the hazard out of employment went up between 7.18% and 7.54% for formal workers relative to informal workers after the reform.

Unemployment Duration

The theory above also suggests that, if compositional changes were unimportant, the reform should have encouraged more hirings and, thus, should have increased the hazard rate out of unemployment and reduced the average unemployment spells of formal workers (covered by the reform) relative to informal workers (uncovered).[14]

Table 3 in Appendix B presents the sample difference of differences estimates for unemployment spells, $\Delta\overline{s}^{gt}$.[15] The results show that the average unemployment spell of workers whose spell ended with a formal sector job decreased between 3.08 and 4.12 weeks relative to the average unemployment spell of workers whose spell ended in an informal sector job. In addition, the sample estimates of the effect of the reform on the hazard rate out of unemployment increased between 7.36% and 10.72% for formal workers relative to informal workers.

C. Hazard Models

As it is possible that tenure and unemployment spells as well as hazard rates changed after the reform due to changes in the characteristics of workers and firms, this Section considers formal duration models. As described in the previous section, the following exponential hazard model is considered,

$$h(s_{it} \mid \mathbf{X}_{it}, \theta_{it}) = \exp\{\beta \mathbf{X}_{it} + \gamma_0 \,\text{formal}_i + \gamma_1 \,\text{post90}_t + \gamma_2 \,\text{formal}_i \times \text{post90}_t\},$$

where $\mathbf{X}_{it}$ is a $1 \times k$ vector of regressors, and β is a $k \times 1$ vector of parameters. In the specifications considered below, the vector $\mathbf{X}_{it}$ includes: age, education, sex, marital status, number of dependants, the city where the person lives, and industry of employment. These variables help to control for observable differences between formal and informal workers that affect their turnover behaviour. The specification also includes the following variables to estimate the effect of job security legislation on the exit rates out of employment and out of unemployment. A variable formal is included that takes the value of one if worker i is formal (covered by the legislation) and zero if worker i is informal (uncovered). This variable controls for constant differences between these two groups. One would, thus, expect γ_0 to be negative since the dismissal of formal workers is more costly than that of informal workers, both before and after the reform. In addition, the specification includes a variable post90 that takes the value of one for post-1990 observations and the value of zero for pre-1990 observations. The coefficient on the post90 dummy controls for non-treatment shocks affecting the turnover behaviour of all workers after 1990. More importantly, an interaction term of the post90 and the formal variables is included in the estimation. A test of the impact of the labour market reform is a test that the coefficient on the interaction term, γ_2, is different from zero. This test considers whether workers covered by the legislation changed their turnover behaviour relative to uncovered workers after 1990. In particular, if one expects for the reduction in firing costs to have increased turnover, then one would expect for γ_2 to be positive. However, as described in the previous section, because the exponential hazard is a non-linear function, the coefficient γ_2 cannot be interpreted as the marginal effect of the reform. Instead, the marginal effect of the reform is the average of the difference between the hazard with the interaction variable set equal to 1 and the hazard with the interaction set equal to zero, $\Delta h^{\text{formal} \times \text{post90}}$, over the sample of workers affected by the reform.

Table 4 in Appendix B shows the results of the estimation of the exit hazard rates out of employment. Column (1) estimates the model without any covariates. The coefficient γ_2 is 0.083 in this specification and significantly different from zero at conventional levels. Column (2) includes the post-1990 dummy, the formal dummy, the interaction term, and all of the covariates mentioned above, except for the industry dummies. The results show that, after controlling for observables, the coefficient on the interaction term falls to 0.0582 and continues to be significant at the 1% significance level. Estimating the marginal effect indicates that the reduction in firing costs introduced by the reform increased the exit rates out of employment of formal workers by 0.85% relative to informal workers.[16] To control for the possibility that formal sector jobs were affected more by shocks after the reform because these jobs are in industries receiving different shocks after 1990, Column (3) includes industry dummies as additional covariates in the estimation. The results do not

change substantially and, furthermore, the predicted turnover response for the covered group increases to 0.9% and continues to be significant at the 1% level of significance.[17] Column (4) includes interactions with a permanent dummy to examine whether it is the extension in the use of temporary contracts or the reduction in severance payments that accounts for the increase in turnover. The results show that while the hazard out of employment increased by 1.22% for temporary formal workers relative to informal workers, the hazards out of employment also increased by 0.83% for permanent formal workers relative to informal workers.[18] Column (5) includes an alternative definition of informality to check for the robustness of the results to the choice of groups. This specification uses the standard definition of informality described above in footnote 12. The results are very similar. The hazard out of employment increased by 0.97% for formal workers relative to informal workers and the effect is significant at the 1% level. Finally, to control for time-variant groups, Column (6) uses the estimator proposed in Section III, in which the formal variable is instrumented with firm size and the skill requirement of the industry of employment. As expected, the marginal effect increases to 1.06% after controlling for selection bias and it remains significant.

Table 5 in Appendix B includes the results of exponential hazards out of unemployment. Column (1) shows that the exit hazard out of unemployment increased for formal workers relative to informal workers after the reform, when no controls are included. Columns (2) and (3) show that the coefficient on the interaction term increases, after controlling for observables, and the predicted turnover response of the covered group to the reform ranges between 0.77% and 0.84%. Column (4) shows that the escape rate out of unemployment increased for both temporary and permanent workers covered by the reform, but the hazard out of unemployment was higher for those who took permanent jobs. Column (5) shows that the predicted response for the covered group increases to 1.7% when using the alternative formal and informal groups. Finally, Column (6) shows that the hazards out of unemployment increased to 1.61% after controlling for selection bias.

VI. Conclusion

The Colombian labour market reform of 1990 provides an interesting quasi-experiment to analyse the effects of a reduction in firing costs. This paper exploited the temporal change in the Colombian labour legislation in 1990, which reduced severance payments, together with the variability in coverage between formal and informal sector workers to identify the effects of firing costs on turnover. Using micro-data from Colombia, I find that, after controlling for changes in composition, the hazard rate out of employment increased 1.06% and the hazard rate out of unemployment increased 1.61% for formal workers relative to informal workers after the reform.

The steady-state conditions of the model above, together with these estimates, indicate that the reform was responsible for a decrease in the unemployment rate of a third of a percentage point or a fourth of the total drop in unemployment between the late 1980's and the middle of the 1990's.[19] The reform contributed to reducing unemployment both because it generated greater flows out of unemployment than into unemployment, and because it induced a reallocation towards the formal sector, which has lower hazards out employment

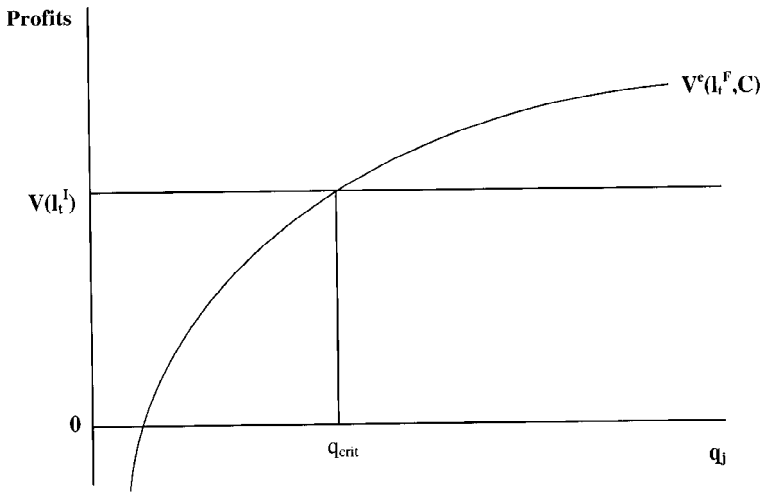

Figure 1. Critical value of the probability of catching a shirker.

and greater hazards out of unemployment than the informal sector. The importance of this reallocation effect, thus, indicates that welfare considerations of labour market reform should not only recognise the efficiency gains from greater mobility and the benefits from lower unemployment that may be brought about by a reform, but also the welfare gains of compositional changes towards better jobs.

Appendix A

Proof of Result 1: Cases 2F and 3F show that formal firms choose not to hire with probability $G(\overline{\theta}^{Fj})$, while they choose not to fire with probability $(1 - G(\underline{\theta}^{Fj}))$. The intersection of these two probabilities is the probability of not hiring and not firing. Since $\overline{\theta}^{Fj} > \underline{\theta}^{Fj}$, there is a non-null intersection of these two probabilities. A reduction in the firing cost reduces the probability of not hiring,

$$\partial\overline{\theta}^{Fj}/\partial C = \beta G(\underline{\theta}^{Fj})/f'(l_t^F)[1 - \beta(G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj}))] > 0,$$

as well as the probability of not firing,

$$\partial\underline{\theta}^{Fj}/\partial C = -(1 + \beta G(\underline{\theta}^{Fj}))(1 - \beta G(\overline{\theta}^{Fj}))/[1 - \beta(G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj}))] < 0$$

Thus, a reduction in firing costs reduces the probability of inaction,

$$\partial[G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj})]/\partial C > 0. \quad \blacksquare$$

Proof of Result 2: The RHS of the indifference condition (i.e., the expected discounted profits of informal firms) is independent of q_j, while the LHS (i.e., the expected discounted

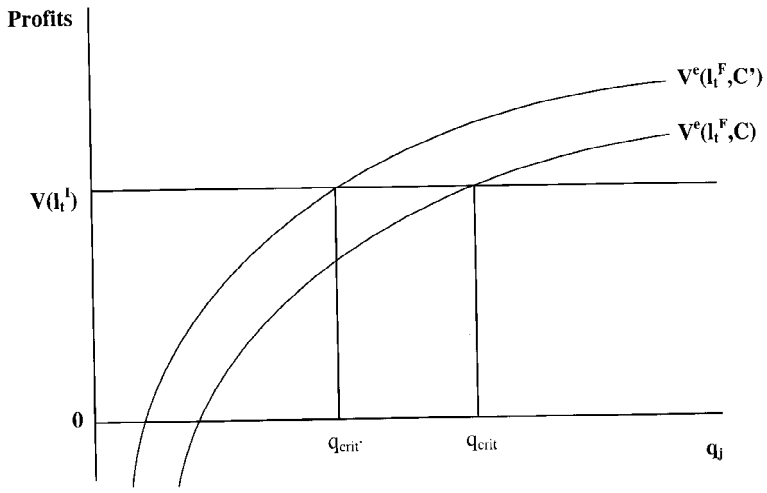

Figure 2. Effect of a change in firing costs on q_{crit}.

profits of formal firms) increases in q_j at a decreasing rate:

$$\partial V^e(l_t^{Fj}, \theta_{t+1})/\partial q_j = (1-\beta)(1-G(\underline{\theta}^{Fj}))/q_j^2 > 0,$$

$$\partial^2 V^e(l_t^{Fj}, \theta_{t+1})/\partial q_j^2 = -(1-\beta)(1-G(\underline{\theta}^{Fj}))/q_j^3 - (1-\beta)g(\underline{\theta}^{Fj})[\partial \underline{\theta}^{Fj}/\partial q_j]/q_j^2 < 0,$$

as,

$$\partial \underline{\theta}^{Fj}/\partial q_j = \beta[1+(1+\beta)G(\overline{\theta}^{Fj})(1-\beta G(\underline{\theta}^{Fj}))]/(1+\beta G(\underline{\theta}^{Fj})) > 0.$$

Moreover,

$$\lim_{q_j \to 0} V^e(l_t^{Fj}, \theta_{t+1}) = -\infty.$$ ■

Proof of Result 3: Completely differentiating the indifference condition with respect to C yields:

$$\partial q^{\text{crit}}/\partial C = (q^{\text{crit}})^2 G(\underline{\theta}^{Fj})/(1-\beta)(1-G(\underline{\theta}^{Fj})) > 0,$$

Also,

$$\partial \overline{\theta}^{Fj}/\partial q^{\text{crit}} = -[1-\beta(1-G(\underline{\theta}^{Fj}))]/[1+\beta G(\underline{\theta}^{Fj})] < 0$$

and

$$\partial \underline{\theta}^{Fj}/\partial q^{\text{crit}} = \beta[1+(1+\beta)G(\overline{\theta}^{Fj})(1-\beta G(\underline{\theta}^{Fj}))]/[1+\beta G(\underline{\theta}^{Fj})] > 0,$$

so that,

$$\partial[G(\overline{\theta}^{Fj}) - G(\underline{\theta}^{Fj})]/\partial q^{\text{crit}} < 0.$$ ■

Appendix B

Table 1. Basic characteristics of formal and informal workers (according to affiliation to the social security system), before and after the reform.

	Formal		Informal	
Variable	Pre-reform	Post-reform	Pre-reform	Post-reform
Share of Total Employment	44.84%	51.05%	55.16%	48.95%
Share of Men	68.69%	64.95%	69.6%	67.56%
Share of Married Workers	69.79%	73.38%	68.1%	72.17%
Average No. of Dependants	0.81	0.72	0.80	0.78
Average Age	35.52 yrs.	35.84 yrs.	36.01 yrs.	36.54 yrs.
Share with Age < 25 yrs.	15.37%	12.36%	22.9%	19.19%
Share with Age 25–54 yrs.	77.16%	81.2%	65.58%	69.79%
Share with Age > 55 yrs.	7.46%	6.44%	11.52%	11.03%
Average Education	8.97 yrs.	9.74 yrs.	6.09 yrs.	6.67 yrs.
Share with Education 0–5 yrs.	29.46%	22.35%	56.24%	49.17%
Share with Education 6–10 yrs.	27.52%	25.0%	27.45%	29.26%
Share with High School Degree	21.65%	27.02%	10.28%	14.36%
Share with Education 12–15 yrs.	8.77%	10.11%	3.06%	3.57%
Share with Education > 16 yrs.	12.59%	15.51%	2.97%	3.64%
Share of Permanent Workers	90.66%	88.84%	77.64%	74.5%

Table 2. Sample difference of differences estimates of the effect of the reform on average tenure.

	Definition 1*		Definition 2**	
Period	Formal	Informal	Formal	Informal
Pre-reform	5.60	4.52	4.82	4.28
Post-reform	5.31	4.54	4.55	4.34
Differences	−0.29	0.02	−0.27	0.06
Diff's-n-diff's	−0.31 years		− 0.33 years	
	(= −3.72 months = −14.88 weeks)		(= −3.96 months = −15.84 weeks)	

Table 3. Sample difference of differences estimates of the effect of the reform on average unemployment duration.

	Definition 1*		Definition 2**	
Period	Formal	Informal	Formal	Informal
Pre-reform	7.33	8.73	7.35	8.63
Post-reform	7.6	9.77	7.38	9.72
Differences	0.27	1.04	0.03	1.09
Diff's-n-diff's	−0.77 months		−1.03 months	
	(= −3.08 weeks)		(= −4.12 weeks)	

**Definition 1:* Formal workers are defined as those whose employer pays social security taxes and informal workers are defined as those whose employer does not pay social security contributions.

***Definition 2:* This is the standard definition of informality. Formal workers are defined as wage-earners employed by firms with more than 10 employees and informal workers are wage-earners employed by firms with less than 10 employees, family workers, domestic workers, and self-employed workers. In Colombia, the last three categories of informal workers are exempt from severance pay legislation.

Table 4. Exponential hazard models of employment duration[1] ($n = 55{,}683$).

Variable	(1)[2]	(2)	(3)	(4)	(5)[3]	(6)[4]
Age 17–24 yrs.	—	1.7506	1.7401	1.7192	1.7533	1.7624
		(0.0016)	(0.0016)	(0.0016)	(0.0016)	(0.0017)
Age 25–54 yrs.	—	0.7517	0.7460	0.7555	0.7400	0.7340
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)
Education 0–5 yrs.	—	0.0560	0.0438	0.0189	0.0921	0.1254
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)
Education 6–10 yrs.	—	0.1483	0.1388	0.1152	0.1710	0.1972
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)
High-School Degree	—	0.1131	0.1052	0.0896	0.1162	0.1297
		(0.0013)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Education 12–15 yrs.	—	0.1051	0.1034	0.0798	0.1063	0.1116
		(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Male	—	−0.1201	−0.1593	−0.1549	−0.1558	−0.1572
		(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Single	—	0.2602	0.2662	0.2587	0.2670	0.2675
		(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
No. of Dependants	—	−0.0045	−0.0037	−0.0017	−0.0028	−0.0049
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Formal	0.2344	−0.2393	−0.2286	0.1354	−0.1100	−0.0581
	(0.0013)	(0.0013)	(0.0013)	(0.0036)	(0.0013)	(0.0021)
Post90	−0.0244	−0.0070	−0.0124	−0.0508	−0.0111	−0.0397
	(0.0011)	(0.0011)	(0.0011)	(0.0022)	(0.0010)	(0.0014)
Formal*Post90	0.0830	0.0582	0.0617	0.0673	0.0592	0.1143
	(0.0015)	(0.0015)	(0.0015)	(0.0042)	(0.0015)	(0.0023)
Permanent	—	—	—	−0.3939	—	—
				(0.0021)		
Formal*Permanent	—	—	—	−0.3401	—	—
				(0.0039)		
Post90*Permanent	—	—	—	0.0268	—	—
				(0.0026)		
Formal*Post90*	—	—	—	−0.0062	—	—
Permanent				(0.0045)		
City dummies	NO	YES	YES	YES	YES	YES
Industry dummies	NO	NO	YES	YES	YES	YES
Log-likelihood	−13,307,220	−12,278,926	−12,256,412	−12,131,391	−12,280,735	−12,036,619
Predicted Turnover Response for Covered Group	—	0.85% (0.0007)	0.90% (0.0009)	0.83% (0.0010) 1.22% (0.0009)	0.97% (0.0009)	1.06% (0.0042)

[1]The numbers in brackets are asymptotic standard errors.

[2]Columns (1)–(4), and (6) use the social security definition of informality. Formal workers are those whose employers make social security contributions and informal workers are those whose employers do not contribute to the social security system.

[3] This column uses the standard definition of informality. Formal workers include wage-earners employed by firms with more than 10 employees. Informal workers include wage-earners employed by firms with less than 10 employees, family workers, domestic workers, and self-employed workers (except for professionals).

[4]This column instruments the formal dummy using the skill requirements of the sector and the size of the firm where the worker is employed. While one cannot fail to reject the significance of these variables in the hazards, these are the only variables with information on firm and sector characteristics which capture firms' incentives to hire in the formal and informal sectors.

Table 5. Exponential hazard models of unemployment duration[1] ($n = 55,683$).

Variable	(1)[2]	(2)	(3)	(4)	(5)[3]	(6)[4]
Age 17–24 yrs.	—	1.0320	1.0080	1.0138	0.9866	1.0185
		(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Age 25–54 yrs.	—	0.5108	0.4966	0.4849	0.4918	0.4843
		(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Education 0–5 yrs.	—	−0.3210	−0.3280	−0.3178	−0.3398	−0.2445
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)
Education 6–10 yrs.	—	−0.3957	−0.3932	−0.3799	−0.3992	−0.3338
		(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0014)
High-School Degree	—	−0.3551	−0.3472	−0.3429	−0.3427	−0.3245
		(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Education 12–15 yrs.	—	−0.2529	−0.2483	−0.2423	−0.2425	−0.2284
		(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)
Male	—	0.5055	0.4702	0.4658	0.4727	0.4701
		(0.0008)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Single	—	0.1497	0.1538	0.1618	0.1527	0.1437
		(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
No. of Dependants	—	0.0785	0.0781	0.0766	0.0762	0.0754
		(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
Formal	0.2402	0.1537	0.1509	−0.0070	0.0716	0.2707
	(0.0013)	(0.0013)	(0.0013)	(0.0036)	(0.0013)	(0.0021)
Post-1990	−0.0588	−0.0424	−0.0450	−0.0255	−0.0569	−0.1075
	(0.0011)	(0.0011)	(0.0011)	(0.0023)	(0.0011)	(0.0014)
Formal*Post90	0.0314	0.0532	0.0575	0.0400	0.1030	0.1742
	(0.0015)	(0.0015)	(0.0016)	(0.0042)	(0.0016)	(0.0024)
Permanent	—	—	—	0.2676	—	—
				(0.0022)		
Formal*Permanent	—	—	—	0.1335	—	—
				(0.0039)		
Post90*Permanent	—	—	—	−0.0092	—	—
				(0.0026)		
Formal*Post90*Permanent	—	—	—	0.0208 (0.0046)	—	—
City dummies	NO	YES	YES	YES	YES	YES
Industry dummies	NO	NO	YES	YES	YES	YES
Log-likelihood	−18,308,392	−17,696,036	−17,671,211	−17,613,645	−17,683,818	−17,320,337
Predicted Turnover Response for Covered Group	—	0.77% (0.0007)	0.84% (0.0008)	0.82% (0.0009) 0.74% (0.0009)	1.7% (0.0017)	1.61% (0.0063)

[1]The numbers in brackets are asymptotic standard errors.

[2]Columns (1)–(4), and (6) use the social security definition of informality. Formal workers are those whose employers make social security contributions and informal workers are those whose employers do not contribute to the social security system.

[3]This column uses the standard definition of informality. Formal workers include wage-earners employed by firms with more than 10 employees. Informal workers include wage-earners employed by firms with less than 10 employees, family workers, domestic workers, and self-employed workers (except for professionals).

[4]This column instruments the formal dummy using the skill requirements of the sector and the size of the firm where the worker is employed. While one cannot fail to reject the significance of these variables in the hazards, these are the only variables with information on firm and sector characteristics which capture firms' incentives to hire in the formal and informal sectors.

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Notes

1. Theoretically, the net effects of hirings and firings on employment and unemployment are very sensitive to the assumptions of the model. For instance, the net effects of firing costs depend crucially on whether the entry-exit margin is considered. Using a general equilibrium framework with firm entry and exit, Hopenhayn and Rogerson (1993) find that an increase in firing costs reduces employment, because firing costs cause firms to be more cautious not only about hiring but also about entry, thus, also reducing the need for job destruction. On the contrary, Bentolila and Bertola (1990) consider a partial equilibrium model with a monopolistic firm and find that employment increases slightly with firing costs, because the firing effect dominates the hiring effect.
2. An alternative approach would consist of choosing groups that are affected differently by the reform, but whose composition cannot change in response to the reform. This is the ingeneous approach taken in Blundell, Duncan, and Meghir (1998). However, there are no natural groups that fulfill these conditions in the context considered here.
3. Moreover, the reform introduced other changes in the legislation that also contributed to lowering firing costs. First, while prior to 1990 the legislation allowed the use of fixed-term contracts for a minimum duration of a year, the reform extended the use of fixed-term contracts for less than a year. Second, the 1990 reform widened the legal definition of 'just cause' dismissals to include economic conditions. Third, while the reform increased the cost of 'unjustly' dismissing workers with more than ten years of tenure, it also eliminated the ability for these workers to sue for backpay and reinstatement.
4. Prior to the 1990 Labor Market Reform, workers could withdraw money out of their severance payment before job break-up to use for investments in education and housing.
5. This can be seen in a simple two-period model, where firms maximise their expected present discounted profits,

$$f(l_1) - wl_1 + E\{\theta f(l_2) - wl_2 - C\max(l_1 - l_2, 0)\},$$

and where θ is a demand shock in the second period, which is distributed uniformly between $[\underline{\theta}, \overline{\theta}]$. Firms hire if $\theta f'(l_1) > w$, they fire if $w > \theta f'(l_1) + C$, and thus they do not adjust their employment if the demand shock $\theta \in [\theta_{\min}, \theta_{\max}]$, where $\theta_{\min} \equiv (w - C)/f'(l_1)$ and $\theta_{\max} \equiv w/f'(l_1)$. Hence, it is easy to show that the probability of remaining inactive, $G(\theta_{\max}) - G(\theta_{\min})$, increases as firing costs increase.
6. Previous studies have estimated that the additional cost from paying severance based on the salary at the time of separation, together with the real cost of withdrawals to the employers, implied an additional 35% of the average cost of severance payments in the manufacturing sector before 1990 (Ocampo, 1990).
7. In the context of the two-period model in footnote 5, this change implied an increase in both $\theta_{\max}$ and $\theta_{\min}$, but a greater increase in $\theta_{\min}$, since $\theta_{\max} \equiv 1.093^* w/f'(l_1)$ and $\theta_{\min} \equiv [1.093^* w - (C - SP)]/f'(l_1)$ after the reform, where SP stands for severance pay. Thus, this change should have decreased the corridor of inaction, $G(\theta_{\max}) - G(\theta_{\min})$.

8. The NHS provides information about whether one's employer pays social security contributions. This information is a good proxy of formality, as it provides an indication of whether the employer complies or not with labour legislation.
9. Formal firms may also prefer paying efficiency wages rather than monitoring costs if they are subject to minimum wage legislation.
10. The cost of purchasing this technology for formal sector firms is $s = \infty$.
11. For simplicity, it is assumed that workers are allocated randomly to the formal and informal sectors.
12. Below, I also use the standard definition of informality to separate the sample into covered and uncovered groups and to check the robustness of the results to the definition of informality being used. According to this definition, formal workers are wage-earners employed in firms with more than ten employees, and informal workers are wage-earners employed in firms with less than ten employees, family workers, domestic workers and self-employed workers (except for professionals). The benefit from using this definition is that the last three categories of informal workers (family, domestic and self-employed workers) are exempt from severance payments.
13. In addition, the reform should have increased hirings, the hazard out of unemployment and the fraction of workers with short tenures (those just hired) and, thus, should have decreased the average tenure among formal workers after the reform.
14. As indicated above, the reform should have also increased the hazard out of employment, thus, increasing the fraction of unemployed workers with short spells (those just fired) and decreasing the average unemployment spells among unemployed formal workers after the reform.
15. Unemployed workers are defined as formal if the job subsequent to their spell was in the formal sector and as informal if the job subsequent to their spell was in the informal sector.
16. Exit hazards out of employment are likely to have increased after the reform both because of increased layoffs and quits. Quits are likely to have increased after the reform because of the increased availability of alternative job opportunities. Unfortunatelly, however, the data does not allow to distinguish between layoff and quit hazard rates.
17. In addition, another specification was estimated which included an interaction of the formal $\times$ post90 interaction with the various industry dummies and the results did not change substantially. Moreover, while one would have expected tradable industries to have been affected differently by shocks after 1990 due to trade liberalization, this is not confirmed by the data.
18. The possibility of hiring temporary workers would be expected to generate a dual labour market within the firm, in which temporary workers are used as a margin of adjustment to demand fluctuations and allow firms to insulate permanent workers (see Saint-Paul, 1996). Thus, if the extension in the use of temporary contracts allowed by the reform was alone responsible for the increased turnover in the formal sector, then we would have expected a decrease in the hazards of formal permanent workers and not an increase as it was observed.
19. The steady-state conditions of the model above with separate formal and informal markets imply that the flows into unemployment must equal the flows out of unemployment in each sector, that is $\int_{\forall j \in s} x_{sj} e_s d_j = \int_{\forall j \in s} a_{sj} u_s d_j$ and $e_s + u_s = 1$ for $s = F, I$, where x_{sj} is the hazard out of employment and a_{sj} is the hazard out of unemployment of firm j in sector s. The aggregate unemployment rate is $u = p_{F*} u_F + (1 - p_F) * u_I$, where p_F is the proportion of formal workers.

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