Flex Time or Flex Work? Can Employment Protection Account for Hours Variability?*

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Abstract

I model a firm's input choice between workers and hours following output demand variations in the presence of hiring and firing costs. These costs to labor adjustment generate variability in work time. I also study the impact of limits to work hours reductions which, interacted with employment protection, can shed light on stylized differences between North American and European labor markets.

These mechanisms are tested empirically using two predictions from the model: 1. Labor adjustment costs increase work hours variability, especially in sectors with high layoff rates; 2. A temporary rise in labor requirements increases demand for work hours, especially when workforce adjustment is costly. These predictions are tested on Canadian labor force survey data using differences in individual and collective advance notice requirements between provinces. Both predictions are verified for individual notice requirements, while collective notice requirements are not significant. Going from a province with short individual notice to one with a longer notice leads to a 36.7% increase in paid overtime work for sectors with high layoff rates, but has no impact for those with low layoff rate. Also, a one point increase in the quarterly employment rate is associated with a 2% increase of paid overtime work in provinces with long individual notice, but not in short notice jurisdictions.

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1 Introduction

Hiring and firing workers is an essential margin of adjustment to ever-changing market conditions. But for workers, a layoff often entails short run and long run income losses, as well as psychological and emotional stress. In consequence, western countries have adopted several employment protection laws (EPL) such as severance payments, advance notice requirements and legal oversight of the dismissal processes. The theoretical and empirical literature on EPL has shown that by limiting the freedom to dismiss employees, it reduces labor market fluidity (OECD Employment Outlook 2004), and affect firms ability to adjust output to changing economic conditions. For workers, EPL should ceteris paribus benefit employees holding a permanent contract (insiders) by augmenting their job security, but make permanent contracts harder to obtain for outsiders.

But hiring and firing is not the only margin of adjustment for firms. Managers can also adjust output through capital or through changes in working hours or intensity. If so, the extent to which EPL limits firms' freedom of operations could be overstated. At the same time, it may have adverse consequences for employed workers, such as less stable work schedules and more overtime shifts, possibly leading to psychological and physical health consequences.[1]

To show how EPL can increase working hours variability, this paper proposes a simple theoretical model and tests empirically two of its predictions. First, a firm's labor adjustment problem is considered in the presence of hiring and firing costs. Adjustment can occur through the extensive margin, number of workers, or intensive margin, hours per workers. I show that no matter the stochastic process or the form of labor adjustment costs, limits to the labor force adjustment lead to hours variations.

Contrary to earlier literature,[2] I propose an intertemporal decision problem with a product market that varies only between a high and a low demand level, as in Bertola (1990). With instantaneous labor adjustment, this stochastic process allows for closed-form solutions and general functional forms. Within the same setting, I also consider limits to hours reductions, a feature more akin to North American labor markets. Combined with EPL, limits on hours adjustments help understand key stylized differences between North-American and European labor markets.

From the model, I also derive two stylized predictions: 1. Labor adjustment costs increase work hours variability, especially in sectors with high layoff rates; 2. A temporary rise in labor requirements increases demand for work hours, especially when workforce adjustment is costly. These predictions serve as identification strategies in the empirical part of the paper.

The link between employment protection and work hours variability has been scarcely studied empirically.[3] In the macroeconomics literature, Abraham and Houseman (1995) find that the speed of employment adjustment following output variations is slower in France, Belgium

[1] A recent meta-analysis on the impact of overtime work on health points to "poorer perceived general health, increased injury rates, more illnesses, or increased mortality", among others. Also, see, Wasmer (2006) for a thorough investigation of the link between EPL and stress at work.

[2] Nickell (1978) is the first to explore a firm's choice of workers, hours and capital with a fluctuating demand and dynamic costs to adjustment, assuming perfect foresight. This assumption is criticized by Chen and Funke (2004) who stress the importance of uncertainty and draw upon real options literature for a more realistic model. The realism of their assumptions allows for several meaningful results, such as a description of a range of prices where only hours are adjusted, a consequence of linear labor adjustment costs.

[3] The most recent macroeconomics literature on work hours has documented the significant decrease in average working hours in several European countries compared to America, but few papers have looked at hours variations over time.

and Germany than in the United States, but they cannot measure any difference for hours adjustments. Merkl and Wesselbaum (2009) compare the relative importance of the extensive and intensive margins in German and American labor markets and do not find significant differences.

In contrast, the present empirical analysis is based on micro data within a single country, Canada. Using information on employment and paid overtime from the Canadian Labor Force Survey, I test whether advance notice requirements affect the demand for paid overtime work. Notice requirements are an important part of labor protection laws and vary measurably between Canadian provinces on two dimensions: notice for individual dismissal and additional notice in case of collective dismissal. In the spirit of difference in differences techniques, I compare the impact of EPL on various subsamples of workers, using strategies devised from the model's predictions. This allows to include province dummies controlling for unobserved province differences in the use of overtime work. The first strategy interacts employment protection with the average layoff rate specific to each activity sector. Employment protection should be more binding for firms who often need to lay off workers. The second strategy interacts advance notice requirements with employment rate variations. This interaction term should be positive since EPL's impact on overtime work should not be uniform over time. Rather, EPL increases the need for overtime work when labor demand is high, and may decrease it when labor demand is lower. In other words, labor adjustment costs should amplify the correlation between labor demand and overtime hours. A third approach exploits the fact that collective notice also depends on the number of workers laid off, allowing to compare firms of different sizes within provinces.

The results generally confirm the link between employment protection and hours variability. Individual notice requirements have a positive and statistically significant impact on overtime work through their interaction with layoff rates or employment rate variations. Going from a province with short individual notice to one with a longer notice leads to a 36.7% increase in paid overtime work for sectors with high layoff rates, but no impact for those with low layoff rate. Also, a one point increase in the quarterly employment rate is associated with a 2% increase of paid overtime work in provinces with long individual notice, but not in short notice jurisdictions. As for collective notice requirements are not significant. I present placebo regressions on public sector workers, other subgroups of workers and robustness checks.

The rest of the paper is as follows: section 2 presents the model, section 3 exposes the empirical analysis and section 4 concludes the paper.

2 A model of labor force and work time adjustment under uncertainty

2.1 Structure of the model

The static model

Labor n and hours h are perfect substitutes in the production function

$$y = y\left(nh\right)$$

with $y\left(nh\right)$ continuous, $y' > 0$ and $y'' < 0$ embodying decreasing returns to scale. The labor cost is

$$C = nw\left(h\right)$$

with $w(h)$ continuous, $w(0) > 0$, $w' > 0$ and $w'' > 0$. Here, h represents the average number of *effective* hours worked in the firm and $w'' > 0$ means that for a given number of employees, longer average hours increase the portion of employees who will work for an overtime pay. A similar wage function is used by Nickell (1978). This approach differs from the traditional kinked wage function with every hour under a threshold paid at normal rate and a premium paid for every overtime hour. Since key conclusions of the following model depend on this smooth convex wage function, appendix 5 provides three microeconomic justifications for it. I assume an endless supply of workers willing to work for the given wage structure $w(h)$.

The firm is a price taker on the product market. The instantaneous profits are

$$\Pi = py(nh) - nw(h). \tag{1}$$

In the benchmark case, work hours can be adjusted at will without cost. However, after solving the benchmark model, I explore the case where hours cannot be set lower than a floor $h_{\min}$, which is probably a more appropriate model for the North American labor market. Note that assuming market power would accentuate the decreasing value of labor (nh), but would not qualitatively affect the tradeoff between workers and hours.

Static solution

The first order conditions are for hours:

$$npy'(nh) = nw'(h) \tag{2}$$

and for labor:

$$hpy'(nh) = w(h)$$

A simple substitution shows that hours per worker would be independent of the price level, labor or output, a realistic result given the lack of correlation between firm size and average work hours per worker:

$$hw'(h) = w(h)$$

Using equation 2, it is now easy to see how the firm wants to increase its staff to take advantage of a price increase:

$$\frac{dn}{dp} = \frac{y'(nh)}{-py''(nh)h} > 0 \tag{3}$$

Before considering any dynamic, it is already possible to consider what would happen to work hours if the firm was prevented to fully adjust its workforce following a price change. To see this, instead of the full adjustment $\frac{dn}{dp}$ of equation 3, we can assume that the firm only adjusts partially a fraction $1-\alpha$ of its full desired adjustment: $(1-\alpha)\frac{y'(nh)}{-py''(nh)h}$, with $0 \leq \alpha \leq 1$. Taking the total derivative of 2 and substituting $\frac{dn}{dp} = (1-\alpha)\frac{y'(nh)}{-py''(nh)h}$, we get:

$$\frac{dh}{dp} = \frac{py''(nh)h\frac{dn}{dp} + y'(nh)}{w''(h) - py''(nh)n}$$

$$\frac{dh}{dp} = \frac{\alpha y'(nh)}{w''(h) - py''(nh)\, n} > 0 \tag{4}$$

we can see that following a price increase (decrease), the if the firm cannot increase its laborforce sufficiently, it will compensate by also increasing (decreasing) hours per workers. This result applies to any dynamic setup and any type of labor adjustment cost. With this in mind, the goal of the next section is to express this result in a simple dynamic setting with general functionnal forms for adjustment costs.

Demand fluctuation

The demand for the firm's output, as reflected by its sales price, varies between a high price $\overline{p}$ and a low price $\underline{p}$ following a Markov process, as in Bertola (1990). There is a probability $\overline{q}$ of switching from $\overline{p}$ to $\underline{p}$ and probability $\underline{q}$ of switching from $\underline{p}$ to $\overline{p}$. This high and low bar notation designating a variable when prices are high ($\overline{p}$) or low ($\underline{p}$) will be kept throughout the model for consistency.

Labor adjustment costs

The model considers infinitely lived firms over continuous time. In period t, the firm inherits workers from an instant ago n_{t-dt} and gets a price $p_t \in \{\overline{p}, \underline{p}\}$. The firm is free to adjust its labor force by $\Delta n_t = n_t - n_{t-dt}$. Adjustment costs are allowed to be asymetrical and have general functional forms. If the firm wishes to hire workers ($\Delta n > 0$), it will cost $c_h(\Delta n)$ with $c_h \geq 0$, $c_h' > 0$, while if the firm wants to fire workers ($\Delta n < 0$), it costs $c_f(\Delta n)$ with $c_f \geq 0$, $c_f' > 0$. We can therefore express adjustment costs as $c_A(\Delta n) = c_h(\Delta n)$ if $\Delta n > 0$, and $c_A(\Delta n) = c_f(\Delta n)$ if $\Delta n < 0$. Both c_h and c_f are twice differentiable.

The shape of these costs will determine the amount and speed of adjustment (see Durlauf and Blume, 2008 for a review of the most common adjustment costs used in macroeconomics). Two cases are possible: 1. gradual adjustment, which is typically the result of convex adjustment costs, or 2. instantaneous adjustment, a corner solution that generally results from weakly concave adjustment costs or the presence of fixed adjustment costs.

With only two price levels, if the firm adjusts instantly after a price shock there will also be only two levels of workers, and hours. This will allow for closed form solutions and analytical results, derived in appendix 5.

In the presence of convex costs however, the firm can instead prefer to delay labor adjustment over time. Appart from specific cases[4], gradual labor adjustment will be solved through numerical simulations. Nevertheless, the results of section 2.1 guarantee that following a price shock, the more a firm delays labor adjustment, the more it will compensate by temporarily adjusting hours in the direction of the price change.

2.1.1 The dynamic optimization problem

In terms of Bellman equation, the value of the firm $V_t(p_t, n_{t-dt})$ is its instantaneous profits over the instant dt, $\Pi(p_t, n_t)\, dt$, minus labor adjustment costs over the period dt , $c_A(\Delta n_t)\, dt$ plus

[4]With gradual labor adjustment, analytical results are possible for the steady state values of labor and hours when $p = \overline{p}$ if firing costs are linear, or when $p = \overline{p}$ if hiring costs are linear.

its expected future value $V_{t+dt}(p_{t+dt}, n_t)$, discounted by interest rates r. In time $t+dt$, if $p_t = \overline{p}$, there is a probability $\overline{q}$ that it will have changed to $\underline{p}$, while conversely, if $p_t = \underline{p}$, there is a probability $\underline{q}$ that it will have changed to $\overline{p}$. The values of the firm for each price level can thus be expressed for $\overline{p}$ and $\underline{p}$ are, respectively:

$$V_t(\overline{p}, n_{t-dt}) = \Pi(\overline{p}, n_t)\, dt - c_A(\Delta n_t) + \frac{1}{1+r}\left\{\overline{q} V_{t+dt}\left(\underline{p}, n_t\right) + (1-\overline{q}) V_{t+dt}(\overline{p}, n_t)\right\} \tag{5}$$

$$V_t\left(\underline{p}, n_{t-dt}\right) = \Pi\left(\underline{p}, n_t\right) dt - c_A(\Delta n_t) + \frac{1}{1+r}\left\{\overline{q} V_{t+dt}(\overline{p}, n_t) + (1-\overline{q}) V_{t+dt}\left(\underline{p}, n_t\right)\right\} \tag{6}$$

For simplicity, there is no workers quit, the hiring process is instantaneous and I ignore alternative means of output smoothing, such as shift work or inventory adjustments. The full derivation of the model is shown in technical appendix 5.

2.2 Benchmark results

To summarize the results, figure 1 presents the firm's decisions for various values of linear firing costs. But note that these results will hold for general functional forms of labor adjustment costs, so long as they are neither too concave or too convex (see appendix 5 for the derivations).

Figure 1 shows the firm's choice of labor force, hours and output for $\overline{p}$ and $\underline{p}$ as a function of linear firing costs. Plain lines are the benchmark model while dotted lines show the firm's reaction if hours were fixed. Looking at the labor force adjustments with fixed hours, as seen in dotted lines on the upper graph of figure , when firing costs are zero ($c_f = 0$), the firm can freely choose the optimal labor force. But for larger c_f, the firm limits its staff movements. At point B, firing workers is simply too expensive and the work force is kept constant regardless of the price level. Since hours and output are fixed, the output $y(nh)$ is fixed as well.

Plain lines show the same firm adjusting using hours as well as workers. At $c_f = 0$, no adjustment cost prevents the use of the workers at their marginal instantaneous value, therefore hours are kept steady at their optimal level. But for positive c_f, the firm adjusts its output using work hours changes and less turnover. Consequently, the point where workers are kept constant, point A, occurs for a smaller c_f. Finally, the impact of flexible hours on output is initially ambiguous. Close to point B however, flexible hours clearly allow the firm to adjust its output more flexibly.

The main results regarding firing costs can be summarized as follows:

- Firing costs:
  - Increase the variation of work hours
  - Decrease the variation of the number of workers and the variation in firm output
- The probabilities of shocks $\overline{q}$ and $\underline{q}$ and the interest rate r:
  - Reduce the incentives to make temporary staff adjustments and instead have firms rely more on hours adjustment.
  - Magnify the impact of adjustment costs on hours

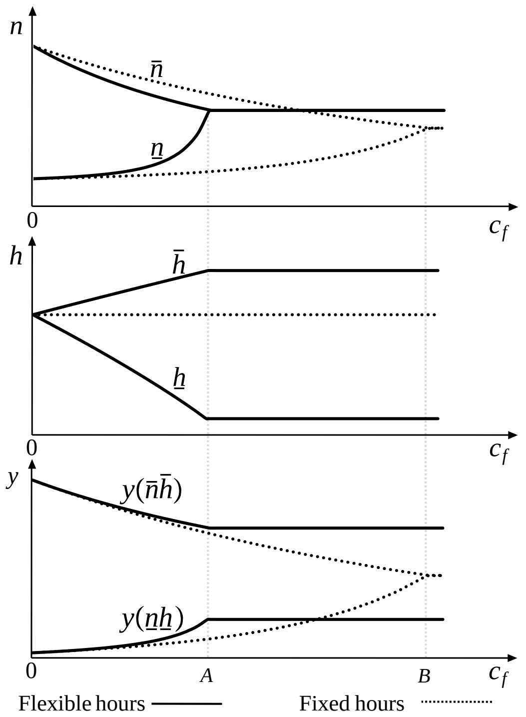

Figure 1: Labor, hours and output as a function of firing costs c_f, with fixed or flexible work hours.

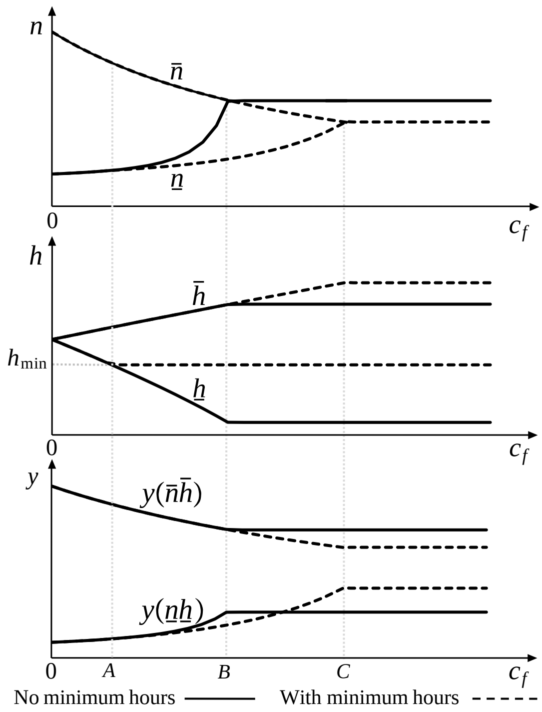

Figure 2: Labor, hours and output as a function of firing costs c_f, with flexible work hours or with minimum hours.

Note: The functional forms are $y(nh) = (nh)^{\alpha}$ and $w(h) = w_{\min} + wh^{\gamma}$. The parameters are $\gamma = 1.5$, $\alpha = 0.8$, $c_h = 0$, $c_f \in [0, 7]$, $\bar{q} = \underline{q} = r = 0.1$, $w_{\min} = w = 1$.

As discussed by Bertola (1990), the effect of adjustment costs on average employment is ambiguous and depends on the functional forms of the production function. The effect on average hours is also ambiguous.

If adjustment costs are too large, price fluctuations too small or shocks too frequent, the firm keeps its workforce constant. Output adjustment is only done through hours. Obviously, in this regime, additional adjustment costs have no impact.

2.3 Hours regulations: minimum hours

Freely adjustable work hours are probably a strong assumption. As pointed out by Huberman and Lacroix (1996), hours cuts are more common in Europe than North America. While European workers are more open to hours reductions if they can stabilize employment, American labor unions since the 1930's have viewed them as arbitrary concessions asked from workers. As North-American collective agreements progressively included guaranties of minimum hours, tenure has become the accepted path to job security. Hence, work sharing agreements and collective hours reductions have remained mostly out of favor.

Since the following empirical section uses Canadian data, where hour reductions are uncommon, it is advisable to verify that the model's results hold even if the firm cannot freely reduce work hours. The derivations of this extension are presented in Appendix 5.

Figure 2 shows how a floor to hours affect the firm's decisions with the same parameters as the benchmark case with free hours adjustments. In the center panel of figure 2, we see that for firing costs c_f superior to point A, for the minimum hours requirements become binding when the price is $\underline{p}$. To compensate for these longer then desired work hours, the firm reduces its labor $\underline{n}$. With a floor on hours, the firm adjusts labor until point $C > B$. Consequently, past point B, $\overline{n}$ is lower and $\overline{h}$ is higher with a price floor.

To sum up, the price floor

- forces the firm to keep more workers when the price is low and when the price is high (past point B);
- increases the turnover rate ($\overline{n} - \underline{n}$) (between points A and C);
- induces a shift toward longer hours, even when the price is high (past point B).

As shown in Appendix 5, these results hold with adjustment costs of any functionnal forms, as long as they are not too convex or too concave.

In jurisdictions with minimum hours institutions, work hours should be longer on average and worker flows should be greater. We are easily reminded of the contrast between European workers enjoying strong employment security, but accepting temporary reductions in weekly hours while their American counterpart enjoy a more dynamic labor market, but with longer and more stable hours.

Note that *maximum* hours regulations also exist in most jurisdictions. For example, the European Union member states introduced the Working Time Directive in 1993 that caps the work week at 48 hours. When binding, a limit on weekly hours forces a firm to compensate by hiring more workers and have them work shorter hours during low demand periods. It also forces the firm to rely more on staff adjustments. However, these effects should not be overstated since overtime work is already costly and seldom involves more than a fraction of the workforce.

2.4 Two testable predictions

The main claim of this paper is that employment protection should increase the variation of work hours. Although a simple cross section analysis would be of great value, confounding factors or the interplay of many different labor market institutions could cause spurious correlations. Instead, in the spirit of difference in differences strategies, I address this risk by exploiting its different effect on different subsamples.

First prediction: Employment protection should increase hours variations more in sectors with higher layoff rates.

Pioneered by Rajan and Zingales (1998), the first mechanism exploits the different effect c_f should have on various activity sectors. If layoffs are by nature uncommon in a certain, employment protection should have little impact on their overtime decision compared to others.

In terms of the model, consider the different impact that higher firing costs c_f will have on a firm that fires workers compared to one that does not. From the derivations of appendix 5, it is easy to see that an increase of linear firing costs L on hours variations for a firm that fires workers is

$$\frac{d\left(\overline{h}-\underline{h}\right)}{dL}=\frac{1}{|J|}\left[\frac{\overline{q}}{\overline{h}w''\left(\overline{h}\right)}+\frac{\underline{q}+r}{\underline{h}w''\left(\underline{h}\right)}+c_h''\left(\Delta n\right)\Psi\right]>0$$

where $c_h''\left(\Delta n\right)\Psi$ is a second order term that should be small if hiring costs are not too convex or concave (see appendix 5 for details). On the other hand, if a firm never adjusts its workforce, the impact of additional firing costs is zero. Hence, sectors in which more firms lay off employees will be more affected by higher layoff rates.

Second prediction: Employment protection should increase work hours, especially when demand for workers is high.

The second mechanism exploits the time dimension. As seen on figure 1, there is a positive co-movement between employees and hours ($\overline{h}\geq\underline{h}$) and ($\overline{n}\geq\underline{n}$). Moreover, with low c_f, large variations in workers are accompanied by low variations in hours, whereas for larger c_f, hours variations get larger and employment variations get smaller. The 'effect' of employment on hours is $\frac{\Delta h}{\Delta n}=\frac{\overline{h}-\underline{h}}{\overline{n}-\underline{n}}$ and the impact of firing costs on this effect is

$$\frac{d}{dL}\left(\frac{\Delta h}{\Delta n}\right)=\frac{1}{\overline{n}-\underline{n}}\frac{d\left(\overline{h}-\underline{h}\right)}{dL}-\frac{\overline{h}-\underline{h}}{\left(\overline{n}-\underline{n}\right)^2}\frac{d\left(\overline{n}-\underline{n}\right)}{dL}>0$$

3 Empirical section

This section uses Canadian employee-level survey data to test empirically whether employment protection increases work hours variations. Canada is a good context to test hypotheses related to employment protection because Statistics Canada collects highly detailed labor market data that can be compared between provinces and employment protection differs between provinces on an important dimension, advance notice requirements, that was exploited by several authors.[5]

3.1 Dependent variable: Paid overtime

Information from a single worker is not enough to deduce employment and hours variations of his employer. Individual variations in hours, especially working fewer hours, often reflect personal choices like vacations or illness. What is needed is a variable that specifically reflects variability in a firm's demand for work hours. Luckily, the Labor Force Survey has one such item: paid overtime. In most types of jobs, paid overtime is a sign of higher than normal demand for work. It also signals that a firm would rather have a limited number of workers paid more than the regular wage rather than more workers paid at the regular wage. In other words, for the firm, the price of overtime is smaller than the price of extra workers. Of course, labor schedules of different sectors may be affected by other factors, but these should be common for the whole sector across Canadian provinces and be accounted for by activity sector dummies.

The precise question regarding paid overtime was introduced in 1997 with the wording: "Last week, how many hours of paid overtime did he/she work at this job?" The definition of paid overtime is: "any hours worked during the reference week over and above standard or scheduled paid hours, for overtime pay or compensation (including time off in lieu)."

[5]For example Friesen (2001) or Kuhn (1993).

Almost 60% of employees worked no paid overtime in the reference week, while for those who did, the mode was eight hours. If the objective was to model the exact number of overtime hours, the best way to do it would be with a selection model. However, since the interest is the demand for overtime hours, not the exact number of hours for a particular individual, I collapse the problem in a binary response model: overtime work or no overtime work. If a firm needs more hours to complete the daily work, it can extend the overtime hours of a handful of workers, but it is also very likely to ask for a greater number of them to stay longer. This is especially true if their tasks are complementary. Note also that each province has laws imposing minimum rest periods, capping the amount of overtime available for per employee.

Although I consider this binary response model to be more adequate, I also fit a linear model on the number of overtime hours as robustness check.

3.2 Advance notice requirements in Canada

In Canada, most dimensions of employment protection law have been shaped by case law and are generally difficult to quantify. Fortunately, the advanced notice requirements adopted during the 1970's and 1980's are a notable exception. As shown in table 6 of appendix 5, they vary between provinces along two dimensions: protection against individual dismissals and protection against collective dismissals.

The length of individual notice requirements is proportional to a worker's seniority. But this dimension will not be used in the identification of its effect on overtime hours for the simple reason that there is no reason for a firm to target specifically for overtime work employees enjoying more employment protection. Hence, provincial averages will be used.[6]

Contrary to individual notice, advance notice for collective dismissal is a function of the number of dismissed employees. With only the firm size as relevant information, the simplest approach is to assume that a firm with n employees faces potential notice requirements for layoffs of up to n employees. Given that mass layoffs often occur as a result of firm closures, this does not seem like an unfair assumption.

The construction of individual and collective advance notice requirement indices from the specific legislations is shown in table 7. Note that since advance notice is not required for employees in seasonal jobs, temporary contracts or construction sector contracts, they are removed from the sample.

3.3 Empirical approach

Given that advanced notice requirements in Canada have not changed since the mid 1980's, the time dimension cannot be used as a source of variation for EPL to measure the impact of employment protection on work hours. To do so, I propose three empirical strategies which rely

[6]To compute these averages, the most natural set of weights is the proportion of layoffs in each seniority category, since it accounts for both the average fraction of workers in each category and the actual chance of being fired. But obviously, different employment protection between provinces will influence workers' seniority. In a province with higher EPL, workers will be fired less often, accumulate more tenure and enjoy even more protection through this feedback mechanism. Computing average individual protection using province specific weights on tenure lengths would de facto take this into account. This might be fine in principle, but since I am interested in the impact of legislations themselves - and this effect is itself part of their impact - I will instead weight by country average layoff ratios for each tenure. Still, I will use province specific weights as robustness checks, noting that either set of weights changes the average only very slightly. As for the measure of layoffs, it will be discussed thoroughly in the following section.

on the variation of EPL's effect on different subgroups of observations: the two strategies derived from theory in section 2.4 and, for collective notice requirements, its impact that varies between provinces and firm size.

The goal of these approaches is to allow the inclusion of province fixed effects to addresses the problem of confounding factors or unobserved province characteristics. Differing cultural attitudes of workers, labor unions and judicial decisions could both affect the stringency of employment protection and the average work hours within a province. But it would be harder to argue that the difference of overtime work hours between subgroups of workers in the 2000's would be linked to a province's legislative process in the 1970's and early 1980's other than by the causal relationship implied by the current model.

First strategy: Overtime should be used more often when employment protection is stringent, especially in activity sectors with a high layoff rate.

As detailed in the previous section, the first strategy assumes that employment protection should be especially stringent for activity sectors that rely heavily on layoffs. This approach was pioneered by Rajan and Zingales (1998) in finance, and used ever since in many contexts.[7] In a difference in difference analogy, the high layoff sectors is the treatment group and the low layoff sectors is the control group. Employment protection is province common to all sectors within a province, but its impact will be felt differently according to the layoff rate of each sector.

The latent propensity model for overtime work can be expressed as

$$\text{Overtime}^*_{i,p,s} = \begin{array}{c} \beta_1 \text{Ind. not.}_p \times \text{Layoff Rate}_s + \beta_2 \text{Coll. not.}_{pf} \times \text{Layoff Rate}_s + \beta_3 \text{Coll. not.}_{pf} \\ +\gamma_1 \text{Empl. rate}_{ps} + \gamma_2 \text{Empl. dev.}_{pst} \\ +\phi \textbf{ind. controls}_i + FE_p + FE_t + FE_s + \nu_{ps} \end{array}$$

where $\text{Overtime}^*_{i,p,s}$ is the propensity for overtime work for individual i in province p working in sector s.[8] Ind. not.$_p$ is the average advance notice requirement for individual dismissal in province p, weighted by average layoff rate for each tenure length., Coll. not.$_{pf}$ is the advance notification period for collective dismissals in province p for a firm of size f (note that since province×firm size dummies are not included, Coll. not.$_{pf}$ also has to be included on its own), Layoff Rate$_s$ is the Canadian average "frictionless" layoff rate of activity sector s, Empl. rate$_{ps}$ is the average employment rate for province p and sector s, Empl. dev.$_{pst}$ is the quarterly deviation at time t of the employment level of sector s in province p from its period average: Empl. dev.$_{pst}$ = Empl. rate$_{pst}$− Empl. Rate$_{ps}$, **prov. controls**$_p$ is the vector of province specific controls, **controls**$_i$ is the vector individual specific controls. FE_p, FE_t and $FE_s$are sets of province dummies, time dummies (11 year dummies and 12 month dummies) and of activity sector dummies. The error term is $u_{ip} = \nu_{pi} + \epsilon_i$, where ν_p is an error term that can be correlated within province p and the error term ϵ_i is assumed asymptotically normal.

Second strategy: Employment protection should increase the positive 'impact' of employment variations and overtime variations.

The model predicts that hours and the labor force used by a firm should both be correlated with the demand for its product. But with small adjustment costs, the firm should adjust mostly

[7] See for example Micco and Pagés (2006), Cingano et al. (2009) or Ciccone and Papaioannou (2006).

[8] Individuals can be in the sample more than once, but since the time dimension is irrelevant for the identification, it is not indicated for clarity's sake.

through the extensive margin, hiring and firing workers, while if firing costs are high it should adjust mostly using the intensive margin, work hours. Hence, this second identification strategy looks at how EPL affects the 'impact' of employment on overtime work.

The Labor Force Survey does not provide any information on the labor demand of the worker's employer. However, it is perfectly reasonable to expect the demand for firms' output to be correlated, say within a particular province and industrial sector. If so, the demand for workers should be correlated accordingly and have an impact on the aggregate labor market. Overtime hours should thus be positively correlated to aggregate employment levels. Since the goal is to identify temporary demand shocks, I use the quarterly deviation of the employment rate from its sample average.

The model evaluated becomes:

$$\text{Overtime}^*_{ipst} = \begin{array}{c} \beta_1 \text{Ind. not.}_p \times \text{Empl. dev.}_{pst} + \beta_2 \text{Coll. not.}_{pf} \times \text{Empl. dev.}_{pst} + \beta_3 \text{Coll. not.}_{pf} \\ +\gamma_1 \text{Empl. rate}_{ps} + \gamma_2 \text{Empl. dev.}_{pst} \\ +\phi \textbf{ind. controls}_i + FE_p + FE_t + FE_s + u_{ip}. \end{array}$$

Third Strategy: Comparing the impact of collective notice between provinces and firm sizes

Since collective notice depend on the number of employees fired, this dimension can be used on its own to allow for province dummies as well. The model is

$$\text{Overtime}^*_{ipf} = \begin{array}{c} \beta_1 \text{Coll. not.}_{pf} + \gamma_1 \text{Empl. rate}_{ps} + \gamma_2 \text{Empl. dev.}_{pst} \\ +\phi \textbf{ind. controls}_i + FE_p + FE_t + FE_s + u_{ip}. \end{array}$$

Additional evidence: Cross province estimates

Finally, in addition to the two formal identification strategies, I verify whether employment protection increases average overtime hours in a simple cross-province model. Of course, the fundamental assumption is that the province-specific error term be uncorrelated with advanced notice and the other regressors. To make sure that it is the case, we must control for factors that may affect the average use of overtime between provinces. In particular, Canadian provinces differ substantially in their legislations on overtime per se. Among the most important ones, the overtime wage is 1.5 times the normal wage rate in seven provinces whereas in Newfoundland, Nova Scotia and New Brunswick, it is 1.5 times the minimum wage. Additionally, overtime starts after a 40 hours week in Newfoundland, Manitoba, Saskatchewan and British Columbia, after 44 hours in New Brunswick, Quebec, Ontario and Alberta and after 48 hours in Prince Edward Island and Nova Scotia. To control for these legislations, I include in the regression the length of the standard work week, along with a dummy for Newfoundland, Nova Scotia and New Brunswick. More specific laws exist, but they are of secondary importance (see Friesen (2001) for more details). I also control for the province's GDP per capita. The cross province model is

$$\text{Overtime}^*_{ip} = \begin{array}{c} \beta_1 \text{Ind. not.}_p + \beta_2 \text{Coll. not.}_{pf} + \gamma_1 \text{Empl. rate}_{ps} + \gamma_2 \text{Empl. dev.}_{pst} \\ +\phi \textbf{ind. controls}_i + \psi \textbf{prov. controls}_p + FE_t + FE_s + u_{ip}. \end{array}$$

3.4 Estimation

Cluster robust standard errors Since Moulton (1986), it is well known that the standard errors of institutional variables tend to be seriously downward biased when they are regressed on micro data. The standard procedure is to correct them by accounting for within-group correlation at the level of the variable of interest, which is the province level. Keeping in mind that Moulton's intragroup correlation corrected standard errors are quite restrictive in their assumptions, the cluster-robust formula introduced by Huber (1967), White (1980) and Liang and Zeger (1986)[9] are preferred for the benchmark estimates since they correct for more general forms of heteroscedasticity[10]. This also accounts for the autocorrelation within province over time, especially individual overtime decisions since households stay in the survey for several consecutive months.

Probit and two step estimation procedures To have uniform framework in which all the strategies can be included simultaneously, the empirical models will first be estimated by probit. Unfortunately, with few clusters and institutional variables that are fixed within cluster, there is still a risk that cluster-robust standard errors be biased, a serious concern with only ten provinces. With a fixed variable at the cluster level, the cluster-specific error term do not average out even as the within-cluster number of observations goes to infinity (see Donald and Lang, 2007 or Wooldridge, 2003). As advocated by the authors, a minimum distance approach will be implemented.

Note that the marginal effect of interacted variables (second order terms) can be misleading when part of a non-linear model like probit. To make the marginal effects interpretation more transparent the first stage of these two step estimates will be modeled as a linear probability model. The detailed estimation procedure will be described in appendix 5.

Robustness checks and counterfactuals

As previously stated, although the probit model is considered more appropriate, I verify that the results hold under simple OLS regressions on the number of overtime hours. Since the interaction of collective notice with layoff rates or employment rates always turned out insignificant, I make sure that the results still hold with individual notice alone. I also exclude the employment rate from the regression since it is potentially related to both employment protection and overtime work.

Another potent test is to do the estimations on public sector employees, who are deemed to be more isolated from the business cycle and have much more stable contracts than in the private sector. If the same effects were observed, it could suggest that some other underlying common effect is at work.

Finally, I perform estimations on subsamples of the data, looking at union members and non-members and various firm sizes.

[9] The estimated covariance structure for N observations within J groups is

$$\widehat{Var}\widehat{\beta} = \frac{J}{J-1}\frac{N-1}{N-K}\left(\frac{1}{N}\sum_j X_j'X_j\right)^{-1}\left(\frac{1}{N}\sum_j X_j'\widehat{u}_j\widehat{u}_j'X_j\right)\left(\frac{1}{N}\sum_j X_j'X_j\right)^{-1}$$

[10] See Hoxby 2005 for a discussion of the difference between the two cluster corrections.

3.5 Other right hand side variables

Layoff rates A good measure can be obtained from the LFS database. The layoff rate is simply the workers who have been fired (i.e. have been unemployed for a certain time lap after a lay off) divided by the number of employed workers. Since layoffs are a flow, the shortest time lap is best. Otherwise, unemployed workers start to find new jobs and the flow becomes a stock. The best compromise between a short time lap and an appreciable sample size must be based on the rate at which unemployed workers find new jobs. Figure 5 shows the distribution of unemployment durations for workers who suffered a permanent layoff due to business conditions (categories 12 and 13 of table 8) from a private sector job with permanent contract. Whereas workers who quit or end a fixed term contract tend to find new work quickly, we see that it can be much longer for permanent workers after a layoff. Up to four weeks in unemployment, the frequency is stable, suggesting that few of them find work. This pattern is the same for every sector taken separately. Hence, layoff rates are computed with workers who lost their job within two weeks ago. Note however that using a longer period does not affect the results significantly. Formally, the layoff rate is

$$LR = \frac{\sum U_{i<2\ wks}}{\sum W_i}$$

where $\sum U_{i<2\ wks}$ is the sum of all workers who declare being unemployed since less than two weeks and $\sum W_i$ is the sum of employed workers.

A net advantage of layoff rates computed from the LFS is that it records the precise reason of the job termination. By contrast, firm-level data rarely states when a layoff was motivated by economic conditions. Instead, researchers often use the net number of separation or turnover as a proxy for it, lumping layoffs for any causes and quits together. But as shown by table 8, economic layoffs only represent a mere 16% of all job separations.

Unfortunately, there is no way in the Labor Force Survey to detect layoffs for multiple job holders or layoffs during the period if a new job was found before answering the survey. Additionally, with layoff questions, there is always a risk of bias from misreporting the reason of job termination. However, without a priori reason why such bias should be different between provinces, it should not affect the outcomes of interest.

Since almost no provinces require advance notice requirements for temporary layoffs, tI exclude them from the computation of the layoff rates. Of course, seasonal jobs, temporary contracts, self-employed and public sector workers are also excluded.

Since EPL affects layoff rates, authors have argued for the use of layoff rates from an important low-EPL jurisdiction. In Canada, it there are no such jurisdictions since the largest provinces, Ontario and Quebec, have important levels of protection. Instead, an alternative approach is to net out the linear impact of EPL on each sector, as advocated by Cingano et al. (2009), Ciccone and Papaioannou (2006) and Ciccone and Papaioannou (2009), to obtain 'frictionless rates'. Formally the layoff rates to be used will be obtained by estimating:

$$LR_{p,s} = \alpha_{1,s}\text{Ind. not.}_p + \alpha_{2,s}\text{Coll. not.}_p + \beta_s + FE_p + \epsilon_{p,s}$$

where $LR_{p,s}$ is the province×sector layoff rate, $\alpha_{1,s}$ and $\alpha_{2,s}$ are sector specific coefficients for Ind. not.$_p$ and Coll. not.$_p$ and β_s captures the sector specific layoff rate of interest in a hypothetical jurisdiction where Ind. not.$_p$ and Coll. not.$_p$ would be zero. The weights used are the number of worker in each province×sector cell. Note that after this regression, there is no guarantee that the β_s will be positive.

Controls The employment rate is a necessary control. In the theoretical model of section 2, the labor supply is assumed infinite. In general equilibrium however, if firms have a hard time meeting their labor needs purely because of labor market tightness, they could use overtime out of necessity, not choice. The risk, though, is that the employment rate be itself affected by employment protection, although the literature is not settled on this issue (see OECD Employment Outlook 2004). To address this uncertainty, I split the employment rate into long term province×activity sector specific employment rate (Empl. Rate_{ps}) and its quarterly deviation from the sample mean (Empl. dev._{pst}): Empl. dev._{pst} = Empl. $\text{rate}_{pst}-$ Empl. Rate_{ps}. The quarterly deviation does not present any problem because it is orthogonal to the time invariant provincial legislations. The average unemployment rate is potentially endogenous, therefore I it will be included, but estimates without it will be presented as robustness checks.

I use employment rates that are activity sector specific to make sure that the diversity of industrial compositions in each Canadian provinces is accounted for and because the sector×province is the fundamental unit of identification.

At the individual level, controls include respondent's sex, age dummies, employee tenure, firm size dummies, sector dummies (43 sectors classification), occupation type dummies (25 occupations classification), and the type of union membership, all described in appendix 5.

To increase the model's precision, I also add nine year and twelve month dummies to capture seasonal variation.

3.6 Results

The table 1 shows all the probit estimates for all the identification strategies. Table 2 shows the same models estimated by two-step linear probability model. Table 3 shows marginal effects for the first two strategies derived from table 2. Finally, the various other specifications, also estimated by probit, are shown in table 4.

First identification strategy

Table 1 shows the benchmark results of the probit estimation. Column 2 of table 1 shows the first identification strategy which interacts advance notice requirements with sectorial layoff rates. The coefficient for individual notice×Layoff Rate is highly significant, but the interaction of collective notice with layoff rates is not significant.

Column 1 of table 2 confirms the previous result, with individual notice×Layoff rate still being significantly positive. We have to be careful when interpreting the coefficient, keeping that it is only an interacted term. The first order impact of layoff rates cannot be identified in the presence of province dummies. To do so, we must remove the province fixed effects, replacing them with individual notice, collective notice and province-level controls, as shown in column 2. Using this specification, table 3 computes the marginal effect of notice requirements for a sector with low layoff rate and for a sector with high layoff rate.

For a high layoff rate sector (such as the Petroleum and Coal Products Manufacturing sector), the impact of an additional week of individual notice on the probability of overtime work is 0.034. It means that a worker of this sector moving from the province of Newfoundland to the province of Saskatchewan would increase the likelihood of overtime work by $(2.36 - 1.28) * .034 = .0367$, roughly 3.67 percentage points, or 36.7%, since 10% of workers work paid overtime on average. For a low layoff rate sector, the impact is insignificant, as should be expected.

Second identification strategy

Column 3 of table 1 presents the second identification strategy interacting advance notice requirements with the deviation of the employment rate. In agreement with the model, the correlation between overtime work and employment deviation is amplified by individual notice requirements. Notice for mass layoff interacted with employment rate deviation has no effect.

Again, column 3 of table 2 showing the 2-step linear probability estimation confirms the probit results of the previous table. The estimates of column 3 are used to compute the average 'impact' of an increase in the employment rate for a province with low and with high individual advance notice requirements, shown in columns 3 and 4 of table 3. They show that for province with low EPL such as Newfoundland, there is no measurable link between employment fluctuation and paid overtime work, whereas for a province such as Saskatchewan, a 1 point increase in employment rate comes with a .194 point increase in the probability of working overtime, or roughly a 2% increase in the number of overtime workers.

Column 1 of table 1 presents both strategies within the same regression, confirming that they are independent and one does not affect the other.

Third identification strategy

Column 4 of table 1 suggests that collective notice on its own increases the number of overtime workers. But the 2-step linear probability estimation casts doubt on the robustness of this result. Note that the general significativity of individual notice requirements and the non-significativity of collective requirements echo Friesen (2005)'s results. She found that individual notice requirements greatly reduced the likelihood of layoffs for Canadian workers, but that collective notice requirements had no discernible impact.

Cross-province estimates

Column 5 of table 1 show that neither individual nor collective notice requirements are significant in a cross province setting. It confirms the intuition from *4* that shows a cross section of the fraction of employees working paid overtime against average individual and average collective notice requirements for each province. The relation is slightly positive with individual notice requirements, and inexistent for collective layoffs. All else being equal, a positive relation could have been expected, although as previously discussed, many econometric problems are present and other factors could be at play here.

Robustness checks, counterfactuals and sub sample regressions

Table 4 show various robustness checks, counterfactuals and subsample regressions for the most general probit specification.

Column 1 fits the model, but through a linear model on the exact number overtime hours, including the zeros. Although less significant, especially for individual notice interacted with employment deviation, the results are qualitatively similar.

Column 2 confirms that the interacted individual notice is still significant, even when excluding collective notice from the regression.

Column 3 excludes average employment rate, likely to be correlated both with notice requirements and overtime, but this has no discernible impact.

In column 4, the same regressions are performed, but on public sector employees, who should in principle be more isolated from the impact of notice requirements compared to their private sector counterparts. This is indeed what is found. The negative signs for the individual and collective notice interacted with layoff rates are difficult to interpret, although it should be noted that the layoff rates were computed using only private sector employees.

Column 5 and 6 compare the impact of notice requirements on overtime for union members (or those covered by a union) or non-members. There is no a priori reason to expect stronger results for one or the other since unions may have multiple effects. They may protect their members from abusive layoffs, but they may also negotiate on the use of overtime hours as well, and shift the burden of adjustment on non-members. Columns 5 and 6 show that there is no major difference between them.

Finally, columns 7 through 9 split the sample between firm size, with column 9 lumping together the firms of 100 to 500 employees with those of over 500. The effect of collective notice is absorbed by the province effect for column 7 and 8, but remains for column 9. The impact of individual notice is clearly stronger for larger firms, although the coefficient of individual notice×employment deviation is less precise for large firms. The most likely explanation is that paid overtime is more common in larger firms, which will mechanically increase the impact of EPL on its use. In the regression sample, the average number of workers working paid overtime is for firms of less than 20 employees: 7%, for 20 to 99: 10%, for 100 to 500: 14% and for firms of more than 500 employees: 17%.

Finally, one has to be careful when interpreting the impact of collective notice for small firms, since only four provinces have provisions for less than 50 employees and that in the case of small firms, a mass layoff is most of the time associated with firm closure rather than a temporary staff reduction.

3.7 Discussion

Outside the realm of proper experimental settings, it is always risky to speak of causal links. However, thanks to these three identification strategies, a confounding factor linked to employment protection and overtime work would have to be felt especially by workers in sector with high layoff rates, in high labor demand periods, or in larger firms. As for reverse causality, it seems even more unlikely since these legislations have existed since the 1980's and would have to assume that overtime work in a single sector had influence on the legislative process of an entire province.

One could still ask whether the coefficient of advance notice requirements captures a real relationship or could they be due to pure chance. Are advance notice requirements really binding for firms? In the Canadian context, the general consensus is that they are. Friesen (2005) points out that notice periods may force the firm to employ a worker under its marginal productivity, especially since the prospect of being laid off may reduce his motivation. The worker could also leave abruptly if he finds a new job before the end of the notice period. She also cites Jones and Kuhn (1995) who note that many Ontarian firms prefer to pay the wage equivalent of the notice period in severance payments instead of keeping them for the mandatory period, a sign that advance notice periods are a significant burden for them.

Furthermore, Wasmer (2006) points out that notice requirements do not stand alone, but are part of a larger body of employment protection laws and customs. They are the end product of several legal decisions that reflect the general attitude of each province vis-à-vis layoffs for economic reasons. He also shows how individual and collective advance requirements are correlated of with the Index of labor Market Regulation compiled by the Fraser Institute. This index incorporates several dimensions such as the processes of certification and decertification; arbitration process; union security; successor rights; treatment of technology; replacement workers; third-party picketing; and openness of the provincial labor Relations Boards."[11]

Finally, thanks to LFS data on layoffs, it is actually possible to use the present data to verify the link empirically. Figure 4 shows monthly permanent layoff rates as a function of the provincial individual and collective advance notice requirements. For individual dismissals, the relationship is clearly negative, whereas it is unclear for collective dismissal. These stylized results match the more formal conclusions of Friesen (2005) that individual advance notice requirements reduces layoffs in the Canadian context.

4 Conclusion

By restricting the leeway of labor management, employment protection reduces the risk of layoffs for employed workers, as documented by ample empirical research. However, if firms try to offset these restrictions by tampering with work schedule and increasing overtime work, these laws can have adverse side effects for employees. In a simple model of labor adjustment under fluctuating prices, I showed how an increase in dynamic costs to labor adjustment generates larger fluctuations in work time. I tested two stylized predictions from the model, using overtime data from the Canadian Labor Force Survey and differences in Canadian advance notice requirements legislations. The impact of individual advanced notice requirements on overtime work is positive and statistically significant when interacted with layoff rates or with employment rate variation. The extra notice requirement in case of mass layoff is also significant when controlling for province and firm size effects.

Of course, Canada is a North American economy with rather low employment protection. This analysis should be replicated in other contexts such as OECD countries, ideally using high frequency firm level data on employment and hours. However, since firm data of this kind is seldom available, this paper showed how to approach the question indirectly using detailed employee data from labor surveys.

These results help explain how firms in highly regulated labor markets can remain competitive by adjusting labor through the intensive margin. They also show how "at-will" employment doctrines combined with restrictions to downward work hours adjustments can explain the high turnover rates observed in American labor markets.

Finally, these findings should not be construed as advocating for the withdrawal of employment protection laws. Rather, they highlight additional concerns that policy makers and labor unions should keep in mind when choosing between EPL and other labor market institutions such as unemployment insurance. For workers, they reflect the trade-off between the risk of becoming unemployed and variable work schedules.

[11] See Clemens et al. (2003).

Do workers prefer stable hours or stable employment? Modeling this trade-off more formally should be part of future work. For now, the increasing popularity of work-sharing programs[12] suggests that a growing number of Canadian workers may prefer collective reductions in work hours instead of selective layoffs, especially during economic downturns. For employers, work sharing is a way of avoiding costly layoffs and the loss of experienced workforce while waiting for demand to rise again. These programs should stabilize employment during economic slowdown. Their macroeconomic impact has received little attention to this date also point to future research paths.

Tables

[12] Work-Sharing programs are designed to allow managers and employees to agree on a temporary reduction of work hours to avoid temporary layoffs during economic downturns. They must be approved by the Employment Insurance Commission and range between 6 and 26 weeks, up to at most 38 weeks.

Similar programs also exist in other OECD countries. They are present in 17 U.S. States, but few companies use them because the state contribution is not large enough to make them attractive. On the contrary, they are important in many European country's strategy to stabilize employment. For example, in Germany, if a worker sees his work hours reduced, the program replaces 60% of his lost income.

Table 1: Paid overtime, probit

Dep. Variable:			Probit		
Works overtime[a]	**All**	**Strat 1**	**Strat 2**	**Coll.**	**Between**
	1	2	3	4	5
Ind. not.$_p$[b]×Layoff rate$_s$[c]	32.21***	32.35***			
	(8.34)	(8.34)			
Coll. not.$_{pf}$[d]×Layoff rate$_s$	0.42	0.42			
	(0.35)	(0.35)			
Ind. not.$_p$×Empl. dev.$_{pst}$[e]	1.03***		1.07***		
	(0.36)		(0.37)		
Coll. not.$_{pf}$×Empl. dev.$_{pst}$	0.00		0.00		
	(0.03)		(0.03)		
Collective notice$_{pf}$	0.02	0.02	0.01**	0.01**	0.003
	(0.01)	(0.01)	(0.00)	(0.00)	(0.003)
Empl. dev.$_{pst}$	-1.37*	0.69***	-1.47*	0.68***	0.70***
	(0.76)	(0.17)	(0.78)	(0.17)	(0.17)
Individual notice$_p$					-0.07
					(0.05)
Ind. controls[f]	Y	Y	Y	Y	Y
Activity sector dummies	Y	Y	Y	Y	Y
Firm size dummies	Y	Y	Y	Y	Y
Province dummies	Y	Y	Y	Y	
Time dummies[g]	Y	Y	Y	Y	Y
Province controls[h]					Y
Number of observations	4 379 873	4 379 873	4 379 873	4 379 873	4 379 873
Number of clusters	10	10	10	10	10
Adjusted R^2	0.09	0.09	0.09	0.09	0.09

(cluster robust std. error in parenthesis); *** p<0.01, ** p<0.05, * p<0.1

[a] Dummy for overtime work

[b] Average provincial advance notice requirement for individual layoffs, weighted by the countrywide tenure layoff rate.

[c] 'Frictionless' activity sector layoff rate

[d] Provincial advance notice requirement for individual layoffs, firm size specific

[e] Quarterly deviation from the province×activity sector specific average employment rate for the period.

[f] Controls includes employee tenure, firm size dummies, age dummies, occupation type dummies and contract type dummies. It aso includes province×activity sector specific average employment rate for the period.

[g] Include year and quarter dummies

[h] Includes a dummy for NS, NB and NF, where the overtime premium is equal to one and a half times the minimum wage and also for the provincial standard work week.

Only include private sector employees with permanent contract in non-seasonal jobs. Excludes construction workers.

Table 2: Paid overtime, 2-step linear probability model

Dep. Variable:	2^{nd} stage of 2-step linear probability model				
Works overtime[a]	**Strat 1**	**Strat 1, marg.**	**Strat 2**	**Coll.**	**Between**
	1	2	3	4	5
Ind. not.$_p$[b]×Layoff rate$_s$[c]	5.695***	4.177**			
	(1.601)	(1.615)			
Coll. not.$_p$[d]×Layoff rate$_s$	-0.205	-0.201			
	(0.164)	(0.131)			
Ind. not.$_p$×Empl. dev.$_{pst}$[e]			0.195**		
			(0.077)		
Coll. not.$_p$×Empl. dev.$_{pst}$			-0.020		
			(0.012)		
Individual notice$_p$		0.154**			-0.011
		(0.060)			(0.012)
Collective notice$_{pf}$				0.000	
				(0.001)	
Collective notice$_p$		-0.008			-0.000
		(0.005)			(0.001)
Empl. dev.$_{pst}$			-0.158		
			(0.139)		
Ind. controls[f]	Y	Y	Y	Y	Y
Activity sector dummies	Y	Y	Y	Y	Y
Firm size dummies	Y	Y	Y	Y	Y
Province dummies	Y		Y	Y	
Province controls		Y			Y
Time dummies[g]	Y	Y	Y	Y	Y
Province controls[h]	Y	Y	Y	Y	Y
Number of observations	312	312	509	40	10
Number of clusters	10	10	10	10	.
R^2	0.823	0.805	0.675	0.901	0.747

(std. error in parenthesis); *** p<0.01, ** p<0.05, * p<0.1

For all footnotes, see table 1.

Table 3: Paid overtime, marginal effects (2-step lin proba model)

Var.	Strategy 1 (col. 2)		Strategy 2 (col. 3)	
At	Layoff rate_s $= -.0410$	Layoff rate_s $= -.0287$	Ind. $\text{not.}_{\cdot p}$ $= 1.28$	Ind. $\text{not.}_{\cdot p}$ $= 2.36$
	1	2	3	4
Ind. notice	-.017	.034***		
	(.012)	(.016)		
Coll notice_p	.0003	-.0022		
	(.0004)	(.0016)		
Empl. $\text{dev.}_{\cdot pst}$			-.015	.194***
			(.051)	(.045)

(std. error in parenthesis); *** p<0.01, ** p<0.05, * p<0.1

Table 4: Results: Various specifications and subgroup regressions

Works paid overtime[a]	**OLS**[i]	**Only**	**No emp.**	**Public**	**Union member**			**Firm size**	
Probit estimation	**notice**	**ind. not.rate**	**rate**	**sector**	**Yes**	**No**	**small**	**medium**	**large**
	1	2	3	4	5	6	7	8	9
Ind. $\text{not.}_p{}^b \times$Layoff $\text{rate}_s{}^c$	79.85**	31.56***	31.50***	-2.34**	33.26***	27.40***	21.35***	18.93***	30.67***
	(26.17)	(7.51)	(9.37)	(1.05)	(10.81)	(7.87)	(5.63)	(6.29)	(9.45)
Coll. $\text{not.}_{pf}{}^d \times$Layoff rate_s	1.73		0.42	-0.13**	0.54	0.53	-2.06***	-0.98	0.07
	(1.64)		(0.35)	(0.06)	(0.35)	(0.45)	(0.59)	(0.69)	(0.43)
Ind. $\text{not.}_p \times$Empl. $\text{dev.}_{pst}{}^e$	2.72*	1.03***	1.03***	0.42*	1.22*	1.10***	0.66***	0.97***	1.29*
	(1.35)	(0.37)	(0.35)	(0.22)	(0.66)	(0.35)	(0.22)	(0.30)	(0.74)
Coll. $\text{not.}_{pf} \times$Empl. dev._{pst}	0.10		0.00	0.02	0.05	-0.03	-0.21***	-0.08*	0.01
	(0.13)		(0.03)	(0.02)	(0.05)	(0.02)	(0.06)	(0.05)	(0.03)
Coll. not._{pf}	0.07		0.02	-0.01*	0.03**	0.03			0.02
	(0.07)		(0.01)	(0.00)	(0.01)	(0.02)			(0.01)
Activity sector dum.	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ind. controls[g]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Province dummies	Y	Y	Y	Y	Y	Y	Y	Y	Y
Time dummies[h]	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	4 060 582	4 379 873	4 379 873	1 822 402	897 070	3 482 786	1 700 175	1 411 799	1 267 747
Number of clusters	10	10	10	10	10	10	10	10	10
R^2 (coll. 1) / Pseudo R^2	0.06	0.09	0.09	0.09	0.07	0.09	0.08	0.08	0.08

note: *** p<0.01, ** p<0.05, * p<0.1 (std. error for probit estimate in parenthesis)

note: Probit (dF / dx at regressors mean) in italics

[a] Dummy for overtime work

[b] Average provincial advance notice requirement for individual layoffs, weighted by the countrywide tenure layoff rate.

[c] 'Frictionless' activity sector layoff rate

[d] Provincial advance notice requirement for individual layoffs, firm size specific

[e] Quarterly deviation from the province×activity sector specific average employment rate for the period.

[f] Province×activity sector specific average employment rate for the period.

[g] Controls includes employee tenure, firm size dummies, age dummies, occupation type dummies and contract type dummies.

[h] Includes 11 year dummies and 12 month dummies.

[i] Contrary to other columns, the dependent variable is the number of overtime hours, zeros included.

note: Only include private sector employees with permanent contract in non-seasonal jobs. Excludes construction workers.

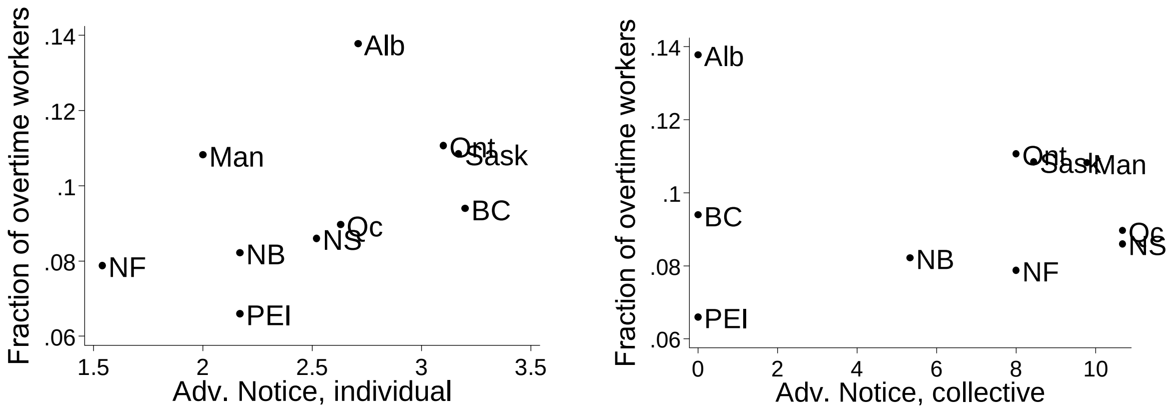

Figure 3: Ratio of employees working paid overtime and average individual and collective notice requirement, excluding public sector, construction workers, seasonal workers and temporary contracts.

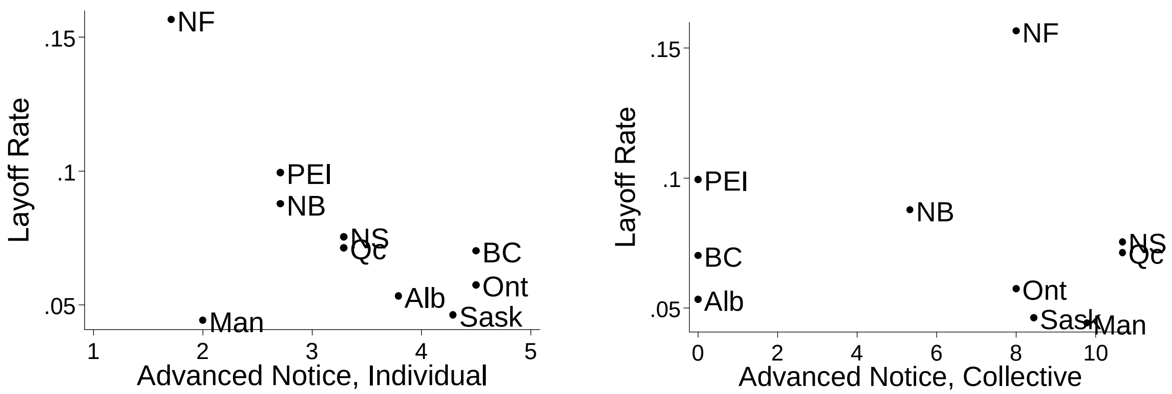

Figure 4: Layoff rates and provincial Individual and Collective notice requirements. (excluding temporary layoffs, public sector employees, construction workers, seasonal workers and temporary contracts)

5 Appendix

A Technical Appendix

A 1 Solving analytically the benchmark model when adjustment is instantaneous

When adjustment is instantaneous, the number of choice variables is reduced to four: labor and hours when the price is high or when price is low: $\overline{n}$, $\underline{n}$, $\overline{h}$, $\underline{h}$, and $\overline{n} - \underline{n} = \Delta n$. Value functions 5 and 6 can be written as timeless state variables in which hiring and firing is done only following a shock. For clarity, we can already substitute $a(\Delta n)$ by $c_h(\Delta n)$ and $c_f(\Delta n)$, anticipating the fact that the firm will find it optimal to hire workers when the price changes to $\overline{p}$ and to fire workers when the price changes to $\underline{p}$.

$$V(\overline{n},\overline{p}) = \Pi(\overline{n},\overline{p})\,dt + \frac{1}{1+rdt}\left\{(1-\overline{q}dt)\,V(\overline{n},\overline{p}) + \overline{q}dt\left[V\left(\underline{n},\underline{p}\right) - c_f(\Delta n)\right]\right\} \tag{7}$$

$$V\left(\underline{n},\underline{p}\right) = \Pi\left(\underline{n},\underline{p}\right)dt + \frac{1}{1+rdt}\left\{\left(1-\underline{q}dt\right)V\left(\underline{n},\underline{p}\right) + \underline{q}dt\left[V(\overline{n},\overline{p}) - c_h(\Delta n)\right]\right\} \tag{8}$$

Solving for each value,

$$(\overline{q}+r)\,V(\overline{n},\overline{p}) = \Pi(\overline{n},\overline{p}) + \overline{q}dt\left[V\left(\underline{n},\underline{p}\right) - c_f(\Delta n)\right]$$
$$\left(\underline{q}+r\right)V\left(\underline{n},\underline{p}\right) = \Pi\left(\underline{n},\underline{p}\right) + \underline{q}dt\left[V(\overline{n},\overline{p}) - c_h(\Delta n)\right]$$

When facing a price increase or decrease, the firm's optimization problems are

$$max_{\overline{n},\overline{h}}V(\overline{n},\overline{p}) - c_h(\Delta n)$$
$$max_{\underline{n},\underline{h}}V\left(\underline{n},\underline{p}\right) - c_f(\Delta n)$$

A 1.1 First order conditions The first order conditions for hours are

$$\frac{\partial V(\overline{n},\overline{p})}{\overline{h}} = \frac{1}{\overline{q}+r}\frac{\partial\Pi(\overline{n},\overline{p})}{\overline{h}} = 0 \tag{9}$$

$$\frac{\partial V\left(\underline{n},\underline{p}\right)}{\underline{h}} = \frac{1}{\underline{q}+r}\frac{\partial\Pi\left(\underline{n},\underline{p}\right)}{\underline{h}} = 0 \tag{10}$$

And the first order conditions for labor are

$$\frac{\partial V(\overline{n},\overline{p})}{\overline{n}} = \frac{1}{\overline{q}+r}\left[\frac{\partial\Pi(\overline{n},\overline{p})}{\overline{n}} - \overline{q}c_f'(\Delta n)\right] - c_h'(\Delta n) = 0 \tag{11}$$

$$\frac{\partial V\left(\underline{n},\underline{p}\right)}{\underline{n}} = \frac{1}{\underline{q}+r}\left[\frac{\partial\Pi\left(\underline{n},\underline{p}\right)}{\underline{n}} + \underline{q}c_h'(\Delta n)\right] + c_f'(\Delta n) = 0 \tag{12}$$

Note that the second order conditions for a maximum are satisfied for convex or concave adjustment costs, as long as they are not jointly too concave.[13]

A 1.2 Optimal hours and labor Combining equations first order conditions 9, 10, 11, 12 and the first order derivative of the profit functions $\Pi(\overline{n}, \overline{p})$ and $\Pi(\underline{n}, \underline{p})$, we see how optimal adjustment costs affect the optimality conditions for firms.

Optimal hours are now different for different price levels.

$$\overline{h}w'\left(\overline{h}\right) = w\left(\overline{h}\right) + (\overline{q}+r)\,c_h'(\Delta n) + \overline{q}c_f'(\Delta n) \tag{13}$$

$$\underline{h}w'\left(\underline{h}\right) = w\left(\underline{h}\right) - \underline{q}c_h'(\Delta n) - \left(\underline{q}+r\right)c_f'(\Delta n) \tag{14}$$

The reason is that the marginal cost of increasing work hours $\overline{h}$, $\overline{h}w'\left(\overline{h}\right)$, has to equal the wage tag of an extra worker, $w\left(\overline{h}\right)$, plus its immediate discounted hiring cost $(\overline{q}+r)\,c_h'(\Delta n)$ and its future discounted firing cost $\overline{q}c_f'(\Delta n)$. On the contrary, when the price falls to $\underline{p}$, keeping an extra worker is 'cheaper' since doing so saves on immediate discounted firing costs $\left(\underline{q}+r\right)c_f'(\Delta n)$ and future rehiring costs $\underline{q}c_h'(\Delta n)$.

The optimal labor force now solves

$$\overline{p}\overline{h}y'\left(\overline{n}\overline{h}\right) = w\left(\overline{h}\right) + (\overline{q}+r)\,c_h'(\Delta n) + \overline{q}c_f'(\Delta n) \tag{15}$$

$$\underline{p}\underline{h}y'\left(\underline{n}\underline{h}\right) = w\left(\underline{h}\right) - \underline{q}c_h'(\Delta n) - \left(\underline{q}+r\right)c_f'(\Delta n) \tag{16}$$

which is the equivalent of the optimal labor condition (8) in Bertola (1990) equating the marginal return of a worker's output to its marginal cost.

A 1.3 Comparative statics for firing costs To discuss the impact of changes to firing costs, let us redefine the function $c_f(\Delta n) \equiv c_{f0}(\Delta n) + L \times \Delta n$, where L is simply a linear component of c_f that will be allowed to vary. Taking the total derivative of 13, 14, 15, 16 with respect to $\overline{n}$, $\underline{n}$, $\overline{h}$, $\underline{h}$ and L, we find that the impact of an increase in linear firing costs on hours are

$$\frac{d\overline{h}}{dL} = \frac{1}{\overline{h}w''\left(\overline{h}\right)|J|}\left[\overline{q} - \frac{1}{\overline{h}^2}\left[\frac{\overline{n}}{w''\left(\overline{h}\right)} - \frac{1}{\overline{p}y''\left(\overline{n}\overline{h}\right)}\right]\left(\overline{q}+\underline{q}+r\right)rc_h''(\Delta n)\right]$$

$$\frac{d\underline{h}}{dL} = -\frac{1}{\underline{h}w''\left(\underline{h}\right)|J|}\left[\underline{q}+r+\frac{1}{\underline{h}^2}\left[\frac{\underline{n}}{w''\left(\underline{h}\right)} - \frac{1}{\underline{p}y''\left(\underline{n}\underline{h}\right)}\right]\left(\overline{q}+\underline{q}+r\right)rc_h''(\Delta n)\right]$$

[13]Second order conditions require for a maximum that

$$(\overline{q}+r)\,c_h''(\Delta n) + \overline{q}c_f''(\Delta n) + \overline{h}^2\left[\frac{\overline{n}}{w''\left(\overline{h}\right)} - \frac{1}{\overline{p}y''\left(\overline{n}\overline{h}\right)}\right]^{-1} > 0$$

and

$$\underline{q}c_h''(\Delta n) + \left(\underline{q}+r\right)c_f''(\Delta n) + \underline{h}^2\left[\frac{\underline{n}}{w''\left(\underline{h}\right)} - \frac{1}{\overline{p}y''\left(\underline{n}\underline{h}\right)}\right]^{-1} > 0$$

, where $|J| = 1 + \begin{array}{c} \frac{1}{\overline{h}^2}\left[\frac{\overline{n}}{w''(\overline{h})} - \frac{1}{\overline{p}y''(\overline{n}\overline{h})}\right]\left[(\overline{q}+r)\,c_h''(\Delta n) + \overline{q}c_f''(\Delta n)\right] \\ +\frac{1}{\underline{h}^2}\left[\frac{\underline{n}}{w''(\underline{h})} - \frac{1}{\underline{p}y''(\underline{n}\underline{h})}\right]\left[\underline{q}c_h''(\Delta n) + \left(\underline{q}+r\right)c_f''(\Delta n)\right] \end{array}$ is the determinant of the Jacobian. Hence, $\frac{d\overline{h}}{dL}$ should be positive, as long as c_h is not too convex, and $\frac{d\underline{h}}{dL}$ should be negative as long as c_h is not too concave (and $|J|$ is positive, which requires that both costs functions not be too concave at Δn). Hence, linear firing costs increase the gap between $\overline{h}$ and $\underline{h}$.

Note that the magnitude of these effects depend on $\overline{q}$, $\underline{q}$ and r, which has an intuitive interpretation. A firm is less inclined to adjust its workforce if shocks are short-lived or if the future is discounted more.

Price variation $(\overline{p}-\underline{p})$ increase both hours and employment fluctuations, again provided that the second order derivatives of adjustment costs are not too large. Similarly, shock probabilities $\overline{q}$ and $\underline{q}$ and interest rates decrease employment variation and increase hours variations, provided modest second order effects of adjustment costs.

A 1.4 No labor adjustment If prices vary little, if adjustment costs are important or if shocks are too frequent, the marginal productive gain to adjust the work force may not justify the cost of hiring and firing workers. In this case, the best option for the firm is to keep a constant staff $\overline{n} = \underline{n} = n$, within a certain band of n such that the frm does not hire when the price is $\overline{p}$ or $\underline{p}$. This is the equivalent of the inaction condition in Bertola (1990) or the "no-action-zone" in Chen and Funke (2002). In that regime, hours vary according to equation 4 with $\alpha = 1$. Obviously, hours are not affected by additional adjustment costs.

Minimum hours Adding minimum hours h_{min} adds two constraints to the optimization problem. , $\overline{h} \geq h_{min}$ and $\underline{h} \geq h_{min}$. The interesting case is when $\underline{h} \geq h_{min}$ is binding and $\overline{h} \geq h_{min}$ is not. Considering this case, conditions 13 and 15 are the same, 14 becomes $\underline{h} = h_{min}$ and 16 becomes $\underline{p}h_{min}y'(\underline{n}h_{min}) = w(h_{min}) - \underline{q}c_h'(\Delta n) - \left(\underline{q}+r\right)c_f'(\Delta n)$.

The impact of h_{min} differs whether the firm adjusts or not its labor force to shocks. If it does, h_{min} only has a first order impact on $\underline{n}$: that should be negative, again, provided that adjustment costs are not too concave.

$$\frac{d\underline{n}}{dh_{min}} = \begin{array}{c} -\frac{1}{|J|}\left[\underline{p}y'(\underline{n}h_{min}) - w'(h_{min}) + h_{min}\underline{n}\underline{p}y''(\underline{n}h_{min})\right] \\ \times\left[\overline{p}y'(\overline{n}\overline{h})\,\overline{h}^2 w''(\overline{h}) + \left[(\overline{q}+r)\,c_h''(\Delta n) + \overline{q}c_f''(\Delta n)\right]\left[\overline{p}y'(\overline{n}\overline{h})\,\overline{n} - w''(\overline{h})\right]\right] \end{array}$$

where

$$|J| = \begin{array}{c} \overline{h}w''(\overline{h})\,h_{min}^2\underline{p}y''(\underline{n}h_{min}) \\ -\overline{h}w''(\overline{h})\left[\underline{q}c_h''(\Delta n) + \left(\underline{q}+r\right)c_f''(\Delta n)\right] \\ \left[\frac{\overline{n}}{\overline{h}} + \frac{w''(\overline{h})}{\overline{h}\overline{p}y''(\overline{n}\overline{h})}\right]\left[(\overline{q}+r)\,c_h''(\Delta n) + \overline{q}c_f''(\Delta n)\right]h_{min}^2\underline{p}y''(\underline{n}h_{min}) \end{array}$$

The only direct effect of minimum hours h_{min} on firm's decisions when prices are high depends on the concavity or convexity of adjustment costs.

As can be seen clearly on figure 2, a direct impact of h_{min} is to force the firm to adjust labor on a range of adjustment costs larger than it would have otherwise. At these values, the impact of h_{min} is to lower labor $\overline{n}$ and increase $\overline{h}$.

A 2 Microfoundations for a convex wage function

Since many key conclusions of the model rely on a smooth convex wage function $w(h)$ with $w'(h) > 0$ and $w''(h) > 0$, this assumption should not go without support. I provide three justifications for this assumption.

A 2.1 A natural trade-off between consumption and leisure Under very general assumptions, a convex wage function should be the natural outcome of an unregulated labor market. Assume a representative worker who enjoys consumption C and leisure L with utility function

$$U = U(C, L).$$

He enjoys both consumption and leisure, but with decreasing returns, and consumption and leisure are complements: $U_1 > 0$, $U_2 > 0$, $U_{11} < 0$, $U_{22} < 0$ and $U_{12} > 0$. His consumption depends on his real wage w: $C = w$ and his leisure depends on his total time endowment H minus his work hours h: $L = H - h$. Substituting both:

$$U = U(w, H - h)$$

Suppose a firm employing him wishes to increase his work hours, how much should his wage be increased in order to keep him indifferent?

$$dU = U_1(w, H-h)\,dw - U_2(w, H-h)\,dh = 0$$

$$\frac{dw}{dh} = \frac{U_2(w, H-h)}{U_1(w, H-h)}$$

And the wage rate increases with the length of hours:

$$\frac{d^2w}{(dh)^2} = \frac{-U_{22}(w, H-h)\,U_1(w, H-h) + U_{12}(w, H-h)\,U_2(w, H-h)}{U_1(w, H-h)^2} > 0$$

A 2.2 Decreasing returns to hours: an alternative to a convex wage function Instead of a convex wage function, the same conclusions could be reached with a constant wage rate, simply assuming a declining marginal productivity of hours.

To see this, consider the production function with decreasing returns to hours

$$y = y(nf(h^*))$$

where h^* are real hours and $f(h^*)$ are effective hours, with $f' > 0$ and $f'' < 0$, capturing worker fatigue from long shifts. The profits would be

$$\Pi = py(nf(h^*)) - nwh^*$$

where w is now a fixed wage rate.

To see that the model is equivalent, simply rewrite the profits in terms of effective hours with $h = f(h^*)$ and $f^{-1}(h) = h^*$:

$$\Pi = py(nh) - nwf^{-1}(h)$$

The problem is the same as the benchmark version if the wage rate function has the same properties as the original one. Noting that $f^{-1\prime}(h) > 0$ and $f^{-1\prime\prime}(h) > 0$, we see that it is indeed the case:

$$\frac{\partial w f^{-1}(h)}{\partial h} = w f^{-1\prime}(h) > 0$$
$$\frac{\partial^2 w f^{-1}(h)}{(\partial h)^2} = w f^{-1\prime\prime}(h) > 0$$

Of course, assuming both an increasing wage rate and a decreasing marginal productivity would yield similar results since they both work in the same way.

A 2.3 A 'standard' wage function with overtime premium and uncertainty In reality, standard wage agreements are usually made of two parts: every hour worked under a threshold, say H_0, is paid the standard wage W^- and every hour worked after H_0 is paid W^+ (this section will use capital letters to define the wage function avoiding any confusion with previous sections). In this context, the overtime premium is $W^+ - W^-$. Although this function is a common assumption in the working time literature, it is difficult to include it in the present model because hours and labor are perfect productive substitutes ($y = y(nh)$). The maximization problem would result in corner solutions, the optimal hours being either zero, H_0, or infinitely many.

The trick will be to add uncertainty to the firm's daily labor need. If the exact number of hours is uncertain, the wage bill will also be uncertain. Denote H and W as the effective hours worked and wage paid. Assuming the firm is risk neutral, hours h and wage $w(h)$ will be

$$h = E(H)$$
$$w(h) = E(W)$$

For simplicity, assume a firm with a single employee with an uncertain hourly productivity ψ. The manager chooses its optimal and mandatory level of output for the day Q, which should be produced in $\frac{Q}{\psi}$ hours. Q is an intermediary variable relating hours and wage, it must not be confused with the general output level $y(nh)$. The productivity level ψ is uncertain, and can vary between 0 and ∞, however unlikely are these extreme values. The probability density function is $f(\psi)$ and the cumulative function is $F(\psi)$.

Work hours are expected to be

$$E(H) = \int_0^\infty \frac{Q}{\psi} dF(\psi). \tag{A.12}$$

Since hours are uncertain, so is the total wage bill at the end of the day. First, note that we must assume a fixed wage W^f paid regardless of the work time. Otherwise, without fixed cost per worker, the optimal solution is an infinite work force working for infinitely short hours. This too is a direct consequence of the perfect substitutability of both inputs in production.

If the productivity level is high, all the work can be completed before H_0 and the total wage bill is $W = W^f + \frac{Q}{\psi} W^-$. But if the daily productivity is low, the time needed to complete Q will exceed H_0 and the wage bill will include an overtime premium for overtime hours: $W = W^f + W^- H_0 + \left(\frac{Q}{\psi} - H_0\right) W^+$. The expected wage bill is thus

$$E(W) = \int_0^{\frac{Q}{H_0}} \left[W^f + W^- H_0 + \left(\frac{Q}{\psi} - H_0\right) W^+\right] dF(\psi) + \int_{\frac{Q}{H_0}}^\infty \left[W^f + \frac{Q}{\psi} W^-\right] dF(\psi) \tag{A.13}$$

We now have a function relating the expected wage bill, $E(W)$ to the expected number of hours $E(H)$. All that is needed is to verify that it is concave, that is to say $w'(h) = \frac{dE(W)}{dE(H)} > 0$ and $w''(h) = \frac{d^2E(W)}{(dE(H))^2} > 0$. This is indeed the case:

$$\frac{dE(W)}{dE(H)} = \frac{\partial E(w)}{\partial Q}\frac{\partial Q}{\partial E(H)} = W^- + \left(W^+ - W^-\right)\frac{\int_0^{\frac{Q}{H_0}} \frac{1}{\psi} dF(\psi)}{\int_0^{\infty} \frac{1}{\psi} dF(\psi)} > 0 \tag{A14}$$

and

$$\frac{d^2E(W)}{(dE(H))^2} = \frac{\partial\left(\frac{dE(W)}{dE(H)}\right)}{\partial Q}\frac{\partial Q}{\partial E(H)} = \frac{\left(W^+ - W^-\right) f\left(\frac{Q}{H_0}\right)}{Q\left(\int_0^{\infty} \frac{1}{\psi} dF(\psi)\right)^2} > 0. \tag{A.15}$$

Note from equation A14 that the wage rate is bounded between W^- and W^+. Are corner solutions possible? If W^- was too high, the optimal work hours would be zero and there would be no labor market. Thus, the market wage would have to decrease. As for the upper bound, the marginal value of an extra hour could in principle always be superior to W^+, which would lead to an infinite number of hours. But in reality, other factors such as extra overtime premiums, workers fatigue or simple labor legislation effectively prevent this from happening. Thus, an interior solution can be safely assumed.

B Two-step estimation procedure

For strategy 1, the procedure is the following. Stage one aggregates the data at the province×sector level assuming a linear probability model:[14]

$$p\left(\text{Overtime}_i \mid p, s, t, \textbf{ind. controls}_i; d_{ps}, \gamma_2, \phi, FE_t\right) = d_{ps} + \gamma_2 \text{Empl. dev.}_{pst} + \phi\,\textbf{ind. controls}_i + FE_t$$

Stage two, estimate by feasible GLS:

$$\widehat{d_{ps}} = \begin{array}{c} \beta_1 \text{Ind. not.}_p \times \text{Layoff rate}_s + \beta_2 \text{Coll. not.}_p \times \text{Layoff rate}_s \\ FE_p + FE_s + \nu_p + \eta_{ps} \end{array}$$

where Ind. Not.$_p$ and Coll. Not.$_p$ are a province level notice requirement legislation, Layoff rate$_s$ is the sectoral layoff rate, **ind controls**$_i$ is a vector of individual level controls, ν_p is a province specific error component and η_{ps} is the province×sector error component. Each observation is weighted by the number of observations in each province×sector cell used to compute stage 1 (again, see Donald and Lang (2001) or Wooldridge 2003 for details and justifications). Again, cluster-robust standard errors are reported for the stage two to account for the within province autocorrelation. Note that since this estimation is at the province×sector level, the firm size dimension is lost and we must use province average values of collective notice requirements.

To implement strategy 2, we must first discretize the variable Empl. dev.$_{pst}$, deviding it in 77 categories, bounded between plus and minus 0.2, and then proceed in the same way as for

[14] As described in ?, p. 455, the model is first estimated by ordinary least squares to produce unbiased estimates of $Var\left(\text{Overtime}_i \mid p, s, \textbf{ind. controls}_i\right) = \hat{\sigma}_i^2 = \widehat{\text{Overtime}}_i * \left(1 - \widehat{\text{Overtime}}_i\right)$, where values of $\widehat{\text{Overtime}}_i$ larger than 0.99 are set to 0.99 and values lower than 0.01 are set to 0.01 to maintain predicted probabilities within the unit interval and avoid probabilities of zero or one. Then, we use $\hat{\sigma}_i^2$ to produce feasible GLS estimates to re-estimate $p\left(\text{Overtime}_i \mid p, s, \textbf{ind. controls}_i\right)$ by weighted least squares.

strategy 1, estimate a first stage at the province×empl. dev. level. Strategy 3 aggregates data at the province×firm size, and finally, the cross-province estimation simply aggregates at the province level.

B The data

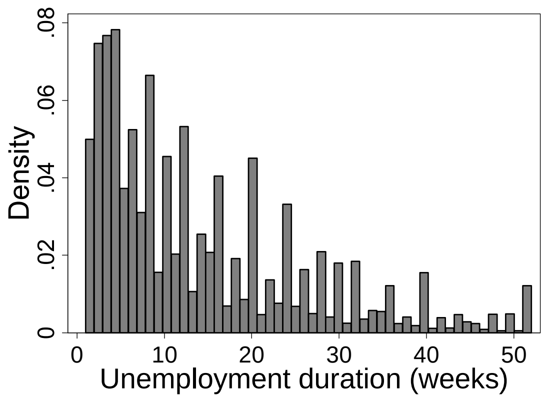

Figure 5: Unemployment Durations Distribution. Only permanent layoffs due to business conditions (categories 12 and 13 of table 9) from a private sector job with permanent contract.

Table 5: Sample Statistics

Variable	Mean	Std. Dev.
Dummy for "working paid overtime"	0,10	0,30
Number of overtime hours worked if > 0	8,33	7,31
Unemployment rate by province*sector	0,06	0,04
Dummy for Newfoundland	0,02	0,15
Dummy for Prince Edward Island	0,02	0,14
Dummy for Nova Scotia	0,05	0,22
Dummy for New Brunswick	0,05	0,22
Dummy for Québec	0,18	0,39
Dummy for Ontario	0,34	0,47
Dummy for Manitoba	0,07	0,26
Dummy for Saskatchewan	0,06	0,25
Dummy for Alberta	0,10	0,30
Dummy for British Columbia	0,09	0,29
Job tenure in months	81,73	80,06
Firm of less than 20 employees	0,39	0,49
Firm of 20 to 99 employees	0,32	0,47
Firm of 100 to 500 employees	0,20	0,40
Firm of More than 500 employees	0,09	0,28
Age 15 to 19	0,07	0,25
Age 20 to 24	0,11	0,31
Age 25 to 29	0,12	0,32
Age 30 to 34	0,12	0,33
Age 35 to 39	0,14	0,35
Age 40 to 44	0,14	0,35
Age 45 to 49	0,12	0,33
Age 50 to 54	0,09	0,29
Age 55 to 59	0,06	0,23
Age 60 to 64	0,03	0,16
Age 65 to 69	0,01	0,08
Age 70 and over	0,00	0,05
Union member	0,19	0,39
Not member of a union but covered by collective agreement	0,02	0,13
Neither union member nor covered by collective agreement	0,79	0,41
Nb of obs.		3 297 825

Table 6: Notice requirements for individual and collective dismissal, various Canadian jurisdictions, 1995

Individual			Mass	
Jurisdiction	**Tenure**	**Notice (wks)**	**Number laid off**	**Notice (wks)**
Federal	3 months +	2	50 +	16
Alberta	3 mos - 2 yrs	1	No special provision	
	2 yrs - 4 yrs	2		
	4 yrs - 6 yrs	4		
	6 yrs - 8 yrs	5		
	8yrs-10yrs	6		
	10 yrs +	8		
British Columbia	6 mos - 3 yrs	2	No special provision	
	3 yrs	3		
	+1 wk/yr up to 8 wks	8		
Manitoba	1 month +	1 pay period	50 - 100	10
			101 - 300	14
			300 +	18
New Brunswick	6 mos - 5 yrs	2	10 +, if they repr. 25% of the workforce	6
	5 yrs +	4		
Newfoundland	1 mo - 2 yrs	1	50 - 199	8
	2 yrs +	2	200 - 499	12
			500 +	16
Nova Scotia	< 2 yrs	1	10 - 99	8
	2 yrs - 5 yrs	2	100 - 299	12
	5 yrs - 10 yrs	4	300 +	16
	l0 yrs +	8		
Ontario	3 mos - 1 yr	1	50 - 199	8
	1 yr-3yrs	2	200 - 499	12
	3 yrs - 4 yrs	3	500 +	16
	4 yrs - 5 yrs	4		
	5 yrs - 6 yrs	5		
	6 yrs - 7 yrs	6		
	7 yrs - 8 yrs	7		
	8 yrs +	8		
Prince Edward Island	6 mos - 5 yrs	2	no special provision	
	5 yrs+	4		
Quebec	3 mos - 1 yr	1	10 - 99	2 mths
	1 yr-5yrs	2	100 - 299	3 mths
	5 yrs-10 yrs	4	300 +	4 mths
	10 yrs +	8		
Saskatchewan	3 mos - 1 yr	1	10 - 49	4
	1 yr - 3 yrs	2	50 - 99	8
	3 yrs - 5 yrs	4	100 +	12
	5 yrs -10 yrs	6		
	10 yrs +	8		

Source: labor Canada, Employment Standards Legislation in Canada.

Table 7: Construction of regional indices of employment protection

Individual dismissal

senior.	Alb	BC	Man	NB	NF	NS	Ont	PEI	QC	Sask	% lay-offs
0,083	0	0	2	0	1	1	0	0	0	0	3,8
0,25	1	0	2	0	1	1	1	0	1	1	12,3
0,5	1	2	2	2	1	1	1	2	1	1	14,5
1	1	2	2	2	1	1	2	2	2	2	15,4
2	2	2	2	2	2	2	2	2	2	2	15,0
3	2	3	2	2	2	2	3	2	2	4	8,7
4	4	4	2	2	2	2	4	2	2	4	5,9
5	4	5	2	4	2	4	5	4	4	6	3,9
6	5	6	2	4	2	4	6	4	4	6	2,8
7	5	7	2	4	2	4	7	4	4	6	2,2
8	6	8	2	4	2	4	8	4	4	6	1,7
9	6	8	2	4	2	4	8	4	4	6	1,6
10+	8	8	2	4	2	8	8	4	8	8	12,2
W. mean	2.02	2.32	1.92	1.66	1.28	1.97	2.34	1.66	2.03	2.36	

Collective dismissal

size	Alb	BC	Man	NB	NF	NS	Ont	PEI	QC	Sask
0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	6	0	8	0	0	8	4
25	0	0	0	6	0	8	0	0	8	4
50	0	0	10	6	8	8	8	0	8	8
100	0	0	14	6	8	12	8	0	12	12
200	0	0	14	6	12	12	12	0	12	12
300	0	0	14	6	12	16	12	0	16	12
500	0	0	18	6	16	16	16	0	16	12
1000	0	0	18	6	16	16	16	0	16	12

Source: Wasmer (2006) and author's own calculations.

Table 8: Reasons for Leaving the Job

Reason for leaving job, (less than one year ago)		Freq.	Percent	Cum.
1	Left job, Other reasons	29105	2,9%	2,9%
2	Left job, Own illness or disability	49415	5,0%	7,9%
3	Left job, caring for own children	12687	1,3%	9,1%
4	Left job, pregnancy	14468	1,4%	10,6%
5	Left job, other personal or family responsibilities	18966	1,9%	12,5%
6	Left job, going to school	203928	20,4%	32,9%
7	Left job, dissatisfied	62514	6,3%	39,2%
8	Left job, retired	69742	7,0%	46,2%
9	Left job, business sold or closed down (self-employed)	37757	3,8%	50,0%
10	Lost job, end of seasonal job (employee)	153271	15,4%	65,3%
11	Lost job, end of temporary or casual (employee)	159409	16,0%	81,3%
12*	Lost job, company moved or out of business (employee)	22245	2,2%	83,5%
13*	Lost job, business conditions (employee)	139114	13,9%	97,5%
14	Lost job, dismissal or other reasons	25253	2,5%	100,0%
Total		997874	100,0%	

*Categories used in computing layoff rates

Table 9: Mean Weekly Hours by Provinces

	NF	PEI	NS	NB	Qc	Ont	Man	Sas	Alb	BC
Regular	34.64	34.30	34.33	34.85	32.96	34.08	33.76	33.36	35.52	32.60
Hours	(16.28)	(15.28)	(15.88)	(15.02)	(14.59)	(15.10)	(15.29)	(16.16)	(16.57)	(15.35)
Overtime	8.98	8.23	8.33	8.10	7.44	8.36	7.62	8.93	9.98	7.61
Hours (>0)	(8.10)	(6.93)	(7.49)	(7.00)	(6.54)	(6.42)	(6.94)	(8.39)	(9.48)	(7.38)
Ratio Working	0.08	0.07	0.09	0.08	0.09	0.11	0.11	0.10	0.13	0.09
Overtime	(0.27)	(0.25)	(0.28)	(0.27)	(0.29)	(0.31)	(0.31)	(0.30)	(0.34)	(0.29)
Nb of obs.	77 906	67 986	173 622	169 092	601 037	1 117 175	234 922	212 459	330 890	312 736

note: standard deviations in parenthesis

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