MICHIGAN
ROSS SCHOOL OF BUSINESS

Working Paper

Do Labor Market Rigidities have Microeconomic Effects? Evidence from Within the Firm

Francine Lafontaine
Stephen M. Ross School of Business
at the University of Michigan

Jagadeesh Sivadasan
Stephen M. Ross School of Business
at the University of Michigan

Ross School of Business Working Paper Series
Working Paper No. 1069
February 2007
This Revision August 2007

(Formerly Titled *The Microeconomic Implications of Input Market Regulations: Cross-Country Evidence from Within the Firm*)

UNIVERSITY OF MICHIGAN

Do Labor Market Rigidities have Microeconomic Effects? Evidence from Within the Firm

Francine Lafontaine
Jagadeesh Sivadasan*

Revised July 2007

Abstract

We investigate the microeconomic effects of labor regulations that protect employment and are expected to increase rigidity in labor markets. We exploit a unique outlet-level dataset obtained from a multinational food chain operating 2,525 similar retail outlets in 43 countries outside the United States. The dataset contains information on output, input costs and labor costs at a weekly frequency over several years, allowing us to examine the consequences of increased rigidity at a much more detailed level than has been possible with commonly available annual frequency or aggregate data. We find that higher levels of the index of labor market rigidity are associated with significantly lower output elasticity of labor demand, as well as significantly higher levels of hysteresis (measured as the elasticity of current labor costs with respect to the previous week's). Specifically, an increase of one standard deviation in the labor regulation rigidity index (1) reduces the response of labor cost to a one standard deviation increase in output (revenue) by about 4.5 percentage points (from 26.8 percent to 22.3 percent); and (2) increases the response of labor cost to a one standard deviation increase in lagged labor cost by about 9.6 percentage points (from 17.0 percent to 26.6 percent). Our estimates imply that the dampening factor (the ratio of actual to optimal labor adjustment) goes down by about 25 percent (from 0.68 to 0.50) for an increase in the index of labor regulation from its 25th to 75th percentile. Finally, we find evidence that the Company delayed entry and operates fewer outlets in countries with more rigid labor laws. Overall, the data imply a significant impact of labor laws on labor adjustment and related decisions at the micro level.

Keywords: Severance pay, adjustment costs, labor flexibility, retailing

JEL codes: J08, J23, K31, L51

*Stephen M. Ross School of Business, University of Michigan, email: laf@umich.edu, jagadees@umich.edu. We thank Kathryn Shaw, Nick Bloom, Oriana Bandiera, Lee Branstetter, Richard Freeman, Jan Svejnar, Katherine Terrell and participants at seminars at the University of Colorado, the University of California, Berkeley, Ohio State University, the University of Michigan as well as the NBER productivity group and the 2007 AEA for their comments. We thank Steve Kang for excellent research assistance. All remaining errors are our own.

1 Introduction

Labor market regulations that constrain the ability of firms to adjust employment levels are an important and controversial public policy issue in many countries around the world. Popular support for such regulation is quite high, and proposed changes in such regulations often give rise to strong emotional reactions by both opponents and proponents. For example, a recent proposed relaxation of firing rules for younger workers in France had to be withdrawn in the face of mass demonstrations.

There is considerable variation in the extent of labor regulation across countries (see Figure 1). Given this variation, the impact of these policies on growth and employment at the national level is an important question for research. While a number of papers have examined this at a macro level (e.g., Botero, Djankov, La Porta, Lopez-de-Silanes and Shleifer, 2004; Lazear, 1990), there have been very few microeconomic cross-country empirical studies of the impact of labor market rigidities on firm level outcomes.

An important channel through which labor market rigidities could affect aggregate growth would be by impeding reallocation of resources across firms, which should be reflected in labor choices made at the firm level. In this paper, we exploit a unique cross-country dataset to examine whether and how labor regulations affect flexibility and input decisions at a microeconomic level. Our dataset, obtained from an international fast-food chain, provides us information on labor choices at a *weekly* frequency across 2,840 outlets in 43 countries over multiple years.

These data present some unique advantages that we utilize in this study. First, the data cover outlets of the same firm operating under a single, common brand worldwide. In other words, we are comparing decisions at outlets that produce basically the same output using the same technology around the world. These comparisons thus are unaffected by firm specific policy and technology differences that could confound other firm-level cross-country studies. Second, the availability of high frequency data at the outlet level allows us to include outlet, outlet year and outlet-year-season fixed effects in our analyses, thereby controlling for a variety of factors that could confound analyses of more aggregate data. Finally, most firm-level studies of labor rigidity and adjustment costs use annual data, which as pointed out by Hamermesh and Pfann (1996) can hide a lot of turnover that occurs within the year.[1] Our data allow us to examine weekly employment decisions and thus capture changes in these within the year.

Confidentiality restrictions prevent us from disclosing the name of the company and also specific information on some of the variables in the dataset. Hereafter, we refer to the firm as the "Company" and its main product as "the product."[2]

[1] However, Anderson (1993) and Hamermesh (1989) used weekly and monthly data respectively.

[2] The product is a common fast-food item and for the purposes of thinking about our results, the reader may

We model the effect of an increase in the rigidity of labor regulation as an increase in the cost of adjusting labor levels. We first examine a simple model of optimal labor choice based on a Cobb-Douglas production function, combined with quadratic adjustment costs and quadratic costs of being off-equilibrium. This model yields two important implications that we bring to the data, namely: (1) increases in rigidity reduce the responsiveness of labor demand to changes in output (revenue), and (2) increases in rigidity increase the persistence of labor decisions, as reflected in an increased elasticity of labor demand with respect to lagged labor.[3] Both of these implications are intuitive, and the latter has been tested extensively in a number of previous studies (see Heckman and Pagés, 2004 for a review). Our tests on simulated data of firms following the optimal policy rules in a more general dynamic optimization framework show that our predictions hold also for asymmetric linear adjustment costs and for lump sum, hence non-convex, adjustment costs.

Results from our baseline econometric specifications suggest a strong effect of labor regulations on labor choice at the outlet level. Using the labor regulation index developed by Botero et al. (2004), we find that the effect of a one standard deviation change in revenue on labor demand is lower by 4.48 percentage points (change from 26.74 percent to 22.26 percent) in a country whose regulation index is one standard deviation above the mean. For lagged labor, our estimates imply that the effect of a one standard deviation change in lagged labor on current labor demand is higher by 9.56 percentage points (increased from 17.10 per cent to 26.67 per cent) in a country that has the regulation index one standard deviation above the mean. The statistical significance and the magnitude of the effects are very similar when we use an alternative measure of hiring/firing inflexibility obtained from the 2002 Global Competitiveness Survey. We also use a number of other strategies, including GMM estimation and within-country analyses, to address various identification issues, and our basic findings are quite robust across these alternatives.

We use results from our baseline regressions to estimate the parameters of our underlying model, and quantify the implied dampening of labor cost adjustments as well as the misallocation of labor. Our results imply that labor regulations dampen adjustments in labor by a factor of 0.68 at the 25th percentile of the labor regulation index, and 0.50 at the 75th percentile of the labor regulation index, a reduction of about 25% in labor cost adjustments. Similarly, defining gross misallocation as the absolute difference between the implied optimal and the actual log labor level, we estimate that, for those outlets operating in countries where the labor regulation index is in the top quartile of its distribution, a decrease in the labor regulation index from its

consider her favorite fast-food item as the product here.

[3] We modify the standard model slightly to yield a regression specification of log labor *costs* on lagged log labor costs and log revenue.

75th to its 25th percentile (a difference of 0.31) would decrease gross misallocation of labor by 4.2 percentage points on average.

Given the large measured impact of labor regulation on weekly labor adjustment, we next look at how labor regulation affects the Company's decision to enter a country, and also the extent of its operations within countries. Consistent with the negative impact of rigid regulations on outlet level labor choice, we find some evidence that the Company enters later and operates fewer outlets in countries where it faces more rigid labor regulations.

To our knowledge, ours is the first cross-country study to use establishment level data to examine the consequences of rigidity in labor market regulations on firm behavior. The paper closest in spirit to ours is Cabellero, Cowan, Engel and Micco (2004), who use cross-country 3-digit ISIC UN data to test for the effects of labor regulation (also measured per the Botero et al., 2004 index) on adjustment costs. They find that adjustment costs are greater in countries with more rigid labor regulation, and that these effects are stronger for countries that have better law enforcement. In recent work, Haltiwanger, Scarpetta and Schweiger (2006) also find that gross industry-level job turnover is affected by labor regulations.[4]

The rest of the paper is organized as follows. Section 2 describes the theoretical motivation for our empirical analysis. Section 3 discusses the data and key variables. Section 4 reports results from the baseline specification and the robustness to using an alternative measure of the rigidity of labor regulations. Section 5 discusses potential identification issues and reports the results from robustness checks to address these issues. Section 6 reports estimates of the extent of dampening of labor adjustment induced by labor market regulations. Section 7 focuses on the effect of labor regulations on entry and size of operations. Section 8 concludes.

2 Theory and econometric specification

In this paper, we are interested in understanding the microeconomic implications of national labor regulations that hinder the ability of firms to flexibly adjust their labor levels. In particular, in our empirical work we examine two indices of labor regulations (discussed in more detail in Section 3 and Section 4.1). In theory, if the national labor regulations captured by these indices have an impact on the day-to-day operations of firms, we expect the impact to be analogous to that of an increase in the adjustment costs for labor.

A standard test for the presence of labor adjustment costs in the literature is to examine

[4] A large literature has examined the effect of labor regulation on overall employment levels, labor turnover and unemployment duration, using household survey data (see Heckman and Pagés, 2004, or Addison and Teixera, 2001, for reviews of this literature). Petrin and Sivadasan (2006) and Aguirregabiria and Alonso-Borrego (2004) consider the effect of increasing labor regulation on firm behavior within a country. A separate literature has looked at various aspects of labor adjustment costs, including whether they are symmetric, convex (smooth) or non-convex (s, S) (see Bond and Van Reenen, forthcoming, for a review).

hysteresis in labor demand (Abraham and Houseman, 1994; several studies in Heckman and Pagés, 2004). That is, increased adjustment costs are expected to increase the elasticity of labor demand with respect to labor level choices made in the prior period. The intuition behind this result is that with increased adjustment costs, firms facing demand or productivity shocks would not adjust fully from previously chosen labor levels.[5]

Similar reasoning suggests that the observed elasticity of labor demand with respect to output would be lower in the presence of adjustment costs. While small demand or productivity shocks would shift output levels, in the presence of adjustment costs we could expect relatively less change in labor, dampening the observed elasticity of labor demand with respect to output.

To formalize these intuitive predictions, and develop an econometric framework to more carefully address the relationship between labor costs and output, in the next section we examine a simple model which draws on Heckman and Pagés (2004) (who drew on the work of Holt, Modigliani, Muth and Simon, 1960).

2.1 A simple model of labor demand with adjustment costs

Let the optimal labor choice at date t be determined by a static theory. Assuming a Cobb-Douglas production function, outlet-level output is given by:

$$Q_t = \Theta_t L_t^{\alpha} M_t^{\beta},$$

where Q_t is the quantity of output produced by the outlet in period t, L_t is the level of labor used, and M_t represents materials. This specification assumes that the capital stock is fixed, so that the productivity term Θ_t can be considered a Hicks-neutral total factor productivity term augmented by firm-specific capital stock.[6] Assume the outlet faces an iso-elastic demand curve:

$$P_t = \Lambda_t Q_t^{\frac{1}{\mu}},$$

where P_t is the price per unit of output in period t, Λ_t represents demand shifters, and μ is the own-price elasticity of demand.[7] The outlet's profit function is:

$$\Pi_t = P_t Q_t - W_t L_t - S_t M_t,$$

[5]Another interpretation is that when faced with adjustment costs, firms would not adjust at all unless the shocks are sufficiently large. The former (partial adjustment) occurs in models with symmetric strictly convex adjustment costs, while the latter (lumpy adjustment) is the case in models with fixed costs. In either case, taking an average over a number of firms facing uncorrelated shocks, the correlation of current period labor with prior period labor would be higher when adjustment costs are higher (see Section 2.2).

[6]That is, the actual production function may be a three input production function: $Q_t = \Theta_t^{'} L_t^{\alpha} M_t^{\beta} K_t^{\gamma}$. Then in our two input production function, $\Theta_t = \Theta_t^{'} K_t^{\gamma}$.

[7]If μ is finite, then the outlet faces a downward sloping demand curve and enjoys some market power. The case of a perfectly competitive output market in this context corresponds to $\mu = -\infty$.

where W_t is the wage rate per unit of labor input in period t, and S_t is the price per unit of material input.

Assuming inputs are supplied competitively, first-order conditions yield optimal labor and materials input demand functions conditional on output (sales revenue) and input prices as follows:

$$l_t^* = \log \alpha' + r_t - w_t \tag{1}$$

$$m_t^* = \log \beta' + r_t - s_t, \tag{2}$$

where small cap variables indicate logs and $r_t = \log(P_t Q_t)$ represents log of sales revenue. Since input prices and quantities are not separately observable in our data (see Section 3 below), we rewrite these equations in terms of labor and materials cost, which are observable. Denoting the log labor cost as $b_t = \log(W_t L_t)$ and the log materials cost as $f_t = \log(S_t M_t)$, we get:

$$b_t^* = \log \alpha' + r_t \tag{3}$$

$$f_t^* = \log \beta' + r_t. \tag{4}$$

Equations 3 and 4 represent the optimal input costs in a static equilibrium with no adjustment costs. In the presence of adjustment costs, however, at any time t the outlet may not choose labor levels corresponding to the static (zero adjustment cost) equilibrium. Let the cost of being off the static optimum be quadratic in log labor costs:[8]

$$c_t^o = \gamma_o (b_t^* - b_t)^2,$$

where $\gamma_o > 0$. Thus this cost is increasing in the parameter γ_o and also in the magnitude of the difference between actual labor and optimal static labor choice in period t. Additionally, we assume a cost of adjustment that is again quadratic in log labor costs:

$$c_t^a = \gamma_a (b_t - b_{t-1})^2.$$

As discussed earlier, labor regulations that affect labor market flexibility would be expected to increase adjustment costs. Hence, in the above equation, we expect the adjustment cost parameter in country j, γ_a^j, to be an increasing function of the labor regulation index (i.e., $\gamma_a^j = f(\tau^j), \frac{\partial f}{\partial \tau} > 0$, where τ^j = index of labor regulation in country j).

The optimal policy in the presence of adjustment costs minimizes the sum of the cost of being out of static equilibrium (c_t^o) and the adjustment cost (c_t^a). This yields the following equation for optimal labor cost in the presence of adjustment costs:

$$b_t = (1 - \omega^j) b_t^* + \omega^j b_{t-1}, \tag{5}$$

[8]This is a convenient simplifying assumption that makes this model very tractable. In the next section, we check if the predictions derived here are robust to using a more general dynamic optimization model.

where $\omega^j = \frac{\gamma_a^j}{\gamma_a^j + \gamma_o}$. Combining equations 3 and 5 yields:

$$b_t = (1 - \omega^j) r_t + \omega^j b_{t-1} + (1 - \omega^j) \log \alpha^{'} . \quad (6)$$

Since ω^j is an increasing function of adjustment costs, it is also an increasing function of the index of labor regulation. We write down a first-order approximation for ω^j as $\omega^j \simeq a_o + a_1 \tau^j$. Then equation 6 yields the following econometric specification:

$$\begin{aligned} b_{it} &= (1 - a_0 - a_1 \tau^j) r_{it} + (a_0 + a_1 \tau^j) b_{i,t-1} + (1 - a_0 - a_1 \tau^j) \log \alpha' \\ &= \beta r_{it} + \gamma b_{i,t-1} + \delta_r \tau^j r_{it} + \delta_b \tau^j b_{i,t-1} + \eta_{is} + \varepsilon_{it}, \quad (7) \end{aligned}$$

where b_{it} represents log labor cost, and r_{it} is log revenue, both for outlet i in period t, while τ_j represents the index of labor regulation for country j, where outlet i is located. In this equation, the η_{is} are outlet, outlet-year or outlet-year-season fixed effects, while ε_{it} represents the residual error term.

The parameters of interest are the coefficients on the interaction terms, δ_r and δ_b. Our theory implies that $\delta_r = -a_1 < 0$, and $\delta_b = a_1 > 0$.[9] Thus our model predicts that if labor regulations increase the labor adjustments costs faced by outlets, then in countries with a larger index of labor regulation: (1) the elasticity of total labor cost with respect to output will be lower; and (2) the elasticity of labor cost with respect to last period's labor cost will be higher.

2.2 An infinite horizon asymmetric cost dynamic model

One potential concern with the predicted effects in Section 2.1 is that the specification and implied effects on labor demand may be driven by the assumption of symmetric, quadratic adjustment costs, and/or by the simplification of the complex dynamic labor choice problem to the simpler problem of minimizing the sum of quadratic adjustment and off the optimum path costs (Heckman and Pagés, 2004). In this section, we briefly examine a dynamic stochastic programming model with three alternative specifications for the adjustment costs. While this model does not yield closed form solutions, for each of the specifications we numerically estimate optimal policy functions for specified parameter values. We then use these optimal policy functions to simulate the actions of firms operating under different adjustment costs regimes, and use the simulated data to test whether the empirical specification in Section 2.1 holds in this more complicated and realistic environment.

The details of the stochastic dynamic model and the simulation procedure are discussed in Appendix 1. We choose the alternative adjustment cost specifications to address two issues

[9]Note that $\delta_r = -\delta_b = -a_1$. However this prediction holds only if our model specification is exactly correct. In particular, if the adjustment cost or the cost of being off equilibrium is not quadratic, or if our first-order approximation for ω above is inexact, then this relation would not hold. This is illustrated in the results from our simulations using a more general dynamic optimization model in Section 2.2 below.

raised in the literature (see the review by Bond and Van Reenen, forthcoming). First, a number of studies have looked at whether labor adjustment costs are symmetric or asymmetric, as this has implications for firm behavior and for macroeconomic models of the economy. They have generally found evidence for asymmetries (Hamermesh and Pfann, 1996). Second, Hamermesh (1989) showed that in contrast to aggregate data, labor dynamics at the plant level are very lumpy. Davis and Haltiwanger (1992) showed that there was significant heterogeneity in plant level employment adjustment both in times of recessions as well as booms. These findings have motivated the modelling of adjustment costs as non-convex, usually captured by a fixed or lump sum adjustment cost (e.g., Cooper and Willis, 2004; Caballero, Engel and Haltiwanger, 1997; Rota, 2004).

To understand the impact of the nature of adjustment costs on our predictions, we obtain the optimal policy function and simulate data for four different scenarios: (1) a benchmark case with zero adjustment costs; (2) symmetric, quadratic adjustment costs, as in our model above; (3) asymmetric, linear adjustment costs; and (4) non-convex (lump-sum) adjustment costs. For each scenario, we choose 45 adjustment cost regimes and simulate data for 75 firms over 104 periods (corresponding to two years at weekly frequency) in each regime, to match our data where we have information for about 45 countries, and a total sample size of about 350,000.[10] In all scenarios we assume the demand and productivity shock processes are iid across firms and over time. We then run a regression per equation 7 using the simulated data (see Appendix 1, Section D for details) for each scenario. The results are summarized in Table 1.

Consistent with the model in Section 2.1, in the absence of adjustment costs the coefficient on lagged labor is zero while the coefficient on revenue is almost one.[11] Also, as expected, with zero adjustment costs, the coefficient on the interaction terms are zero. The results in columns 3 to 8 indicate that, across alternative functional forms for the adjustment costs (and across different types of fixed effects), the predictions of the simple model in Section 2.1 hold also in our simulated data. Across all specifications, the coefficient on lagged labor is higher and the coefficient on revenue is lower when adjustment costs are higher. Interestingly, the reduction in the revenue elasticity with increases in adjustment costs is greatest when adjustment costs are non-convex (fixed cost case). The increase in hysteresis (elasticity with respect to prior period's labor cost) with adjustment costs is highest for the scenario where adjustment costs are asymmetric, but remains a feature of the data in the alternative scenarios nonetheless.

The main conclusion we draw from our simulation results is that the predictions in Section 2.1 are not artifacts of our simple modelling framework, but are robust to modelling optimal

[10] All 45 regimes have zero adjustment costs in the benchmark zero adjustment cost case.

[11] The small discrepancy from a coefficient equal to one arises because the optimal labor choices are rounded to increments of 0.2 when we solve for the optimal policy function.

responses in a more complex infinite horizon framework with different forms of adjustment costs.

3 Data description and definition of variables

The main data source for this study is an internal dataset from a US-based international fast-food chain, which operates in over 43 countries around the world.[12] This dataset contains weekly outlet-level financial data on inputs and outputs. Specifically, we observe sales revenue, labor costs and material costs each week for every outlet in every foreign country over a number of years. For our baseline analyses, we rely on labor regulation indices defined and assessed in the early 2000s, and hence focus on the 4-year period 2000-2003.[13]

In our empirical analyses, we want to ensure that we compare outcomes obtained under similar circumstances. For that reason, we eliminate all observations that pertain to potentially unusual situations, such as outlets operating with a different type of facility (e.g., limited menu facilities), or observations related to unusual time periods (i.e., at start-up or within a short time from the closing of an outlet). Specifically, we exclude those outlets in operation for less than one year by the time we observe them, and dropped those observations pertaining to the last year of operation of an outlet as well.

Our main measure of cross-country labor regulation inflexibility is an index of labor regulation constructed by Botero et al. (2004). As noted earlier, the variation in this index across countries is shown in Figure 1. This index is constructed using information on regulations governing alternative employment contracts, regulatory costs of increasing work hours, regulatory cost of firing workers and mandated dismissal procedures. Detailed information on the different components that make up this index are given in Appendix 2a. One attractive feature of this index is that it summarizes detailed information on regulations affecting the ability of firms to adjust labor flexibly. Since a common basis is used to evaluate the laws across all countries, this index has the advantage of being comparable across countries.

Summary statistics for our key variables are shown in Table 2. The statistics are reported for the subsample of the dataset that appears in our baseline analyses in Table 3 (i.e., observations for which we have data on labor costs, lagged labor costs, revenue and the Botero et al. (2004) index of labor regulation).

In Panel A, we show that the Company operated a different number of outlets in different numbers of countries each year, but a total of 2,525 outlets in 43 countries are included overall

[12]Our data excludes the United States, where the Company is headquartered. The Company actually operated in over 55 foreign countries during the period of the study. However, data availability constraints on the labor regulation variables limit our sample to 43 countries for most of our analyses.

[13]To analyze reforms in South Korea, we make use of data from earlier years (see Section 5.3). However, 2003 is the last year in the data.

in our data. Panels B and C show the mean, standard deviation and some percentiles of labor cost, revenue, and materials cost, all of which are shown in a rescaled version of U.S. dollars, to preserve confidentiality. The number of observations and countries where relevant data are available is higher when we rely on the GCS index of inflexibility, as reflected in Table 4. Data for the GCS index are available for 48 of the countries where the firm operates, and the number of observations (outlets) thus goes up to 337,128 (2840).

A number of other outlet characteristics are available also from the parent Company for various subsets of our data. In our analyses in Section 4, however, these characteristics are controlled for by outlet, outlet-year and outlet-season-year fixed effects as most are fixed over time, or only vary once every few months. For example, the form of corporate governance varies across outlets, but remains fixed over time during the period of our data. Hence these are absorbed by outlet-level fixed effects in our analyses below.[14]

4 Empirical results: Baseline specification

In our baseline regressions, in Table 3, we examine the specification in equation 7, using the index of labor regulation constructed by Botero et al. (2004). Because the variation in the regulatory index is at the country level, we cluster standard errors at that level.

In the first three columns of Table 3, we show estimates of the labor cost specification without interaction terms. As can be seen, overall the elasticity of labor cost with respect to revenue is between 32.6 and 38.8 percent (depending on what fixed effects are controlled for). The hysteresis (elasticity of labor demand in period t with respect to labor demand in period $t-1$) varies from 0.535 to 0.2, decreasing as we move from outlet to outlet-year-season fixed effects.[15]

Results in columns 4, 5 and 6 imply that the elasticity of labor demand with respect to revenue is significantly lower in countries with more rigid labor regulation, as predicted by theory. Also consistent with the theory, we find greater hysteresis in countries with more regulated labor markets. These effects are all statistically significant at the 5 percent level or better.

The economic importance of the effects can be gauged using the coefficients combined with summary statistics, as shown in the bottom panel of Table 3. From column 4, where we control for outlet fixed effects, we see that in a country with the mean level of labor regulation (0.41), a one standard deviation increase in log revenue (0.69) is associated with a 23.44 percent (0.69*[0.573 - 0.569*0.41]) increase in labor cost. By comparison, in a country with labor regulation one standard deviation above the mean (0.41+ 0.16=0.57), a one standard deviation

[14] Some additional variables are used in our analyses in Section 7, and discussed therein.

[15] The reduction in the coefficient of lagged labor as we include more fixed effects is not surprising given the downward bias of within estimators for the coefficient of lagged dependent variables in shorter panels. See discussion in section 5.4.

increase in log revenue is associated with a 17.16 percent (0.69*[0.573 - 0.569*0.57]) increase in labor cost. Thus, the estimates imply that the effect of a one standard deviation change in revenue on labor cost is lower by 6.28 percentage points in a country that has the regulation index one standard deviation above the mean. This effect is 5.38 percentage points (a reduction from 24.72 percent to 19.35 percent) under the specification in column 5, which includes outlet-year fixed effects, and 4.48 percentage points (a reduction from 26.74 percent to 22.26 percent) using column 6 estimates which are obtained using outlet-year-season fixed effects.

As to the influence of lagged labor, estimates in column 4 with outlet fixed effects imply that the effect of a one standard deviation increase in lagged labor on current labor demand is higher by 13.89 percentage points (increase from 42.47 per cent to 56.35 per cent) in a country that has the regulation index one standard deviation above the mean. When we control for outlet-year fixed effects in column 5, the estimate is 12.48 percentage points (increased from 29.44 percent to 41.93 percent). Controlling for outlet-year-season fixed effects in column 6 yields an estimated effect of 9.56 percentage points (increased from 17.10 percent to 26.67 percent).

In sum, in all the specifications, we find that labor regulation has a statistically significant and economically important impact on the elasticity of labor demand with respect to revenue, and contributes significantly to labor cost hysteresis. The proportional impact is higher for lagged labor (e.g., 9.56 percentage points relative to 17.10 percent at the mean), but is also large for sales revenue (4.48 percent relative to 26.74 percent). We interpret the results as strong evidence that differences in labor market rigidities across countries have real effects on the operations and labor decisions of the individual fast-food outlets that comprise the Company.

4.1 Robustness to alternative measure of labor rigidity

The index of labor regulation used in our baseline specification is from Botero et al. (2004) who constructed it by examining the details of laws and regulations that affect the flexibility of hiring and firing employees. As we discussed earlier, a key advantage of this index is that it is assessed on a similar basis across countries. Not surprisingly then, a number of authors have relied on this measure of labor regulation in their analyses (e.g., Caballero et al., 2004). However, one potentially serious disadvantage of the Botero et al (2004) measure is that the enforcement of legal rules may vary across countries, either due to lack of resources or to lobbying by business or labor interest groups. Also, in reality, some non-regulatory factors, such as the strength of labor unions for example, could affect the flexibility in hiring and firing.

We address these concerns by verifying the robustness of our results to an alternative measure that is meant to capture the operational reality relating to the flexibility in hiring and firing faced by businesses. This measure is obtained from the 2002 Global Competitiveness Survey, which polls executives regarding business conditions in their country.[16] One of the questions asked is whether the hiring and firing of workers is impeded by regulations or flexibly determined by employers. The response is given on a scale from one to seven, with a higher score reflecting a higher degree of labor market flexibility. We use the responses to this question to construct an index of the inflexibility of the labor market, which is defined for a particular country j as the minimum reported flexibility score, across all countries, divided by the flexibility score for country j. (Note that this sets the maximum value of the inflexibility index equal to one.) One potential drawback of this and similar measures based on surveys of managers in different countries is that the ratings across countries are not done on a common basis, and hence may suffer from pessimism or optimism biases.[17]

A scatter plot of the two measures of labor market rigidities for the 64 countries where data are available on both indices is presented in Appendix 3. The two measures are positively correlated but they do differ importantly for many countries, possibly for the reasons just described. The correlation between the two measures is stronger however for the subsample of countries in our dataset, as reflected in the steeper slope of the dashed fitted line, which uses the square root of the number of observations for each country in our dataset as a weight for the correlations.

Results obtained with this alternative measure, shown in Table 4, are very consistent with those obtained with the Botero et al. (2004) index in Table 3. Here again, as expected from the theory, we find that in markets with higher perceived inflexibility in hiring and firing, the elasticity of labor demand with respect to revenue is lower, and the elasticity with respect to lagged labor is higher than in markets with more flexibility in hiring and firing. Moreover, the magnitude of the effects we find with this alternative measure is comparable to the effects shown in Table 3. Specifically, as shown in the bottom panel of Table 4, our estimates imply that the effect of a one standard deviation increase in revenue on labor demand is decreased – as a result of an increase in the index of hiring/firing inflexibility – by 6.63 percentage points when we include outlet fixed effects, by 6.49 percentage points when we include outlet-year effects, and by 5.83 percentage points when we include outlet-year-season fixed effects. The equivalent calculations for lagged labor imply increases of 10.95, 10.13, and 7.96 percentage points, respectively. Thus the estimated impact of a one standard deviation increase in the index of inflexibility is greater than for the index of labor regulation used in the baseline case (as reported in Table 3) when

[16]The survey is used to prepare the *Global Competitiveness Report (GCR)*, published by the World Economic Forum in collaboration with the Center for International Development (CID) at Harvard University and the Institute for Strategy and Competitiveness, Harvard Business School. We thank Richard Freeman for providing access to these data.

[17]For example, managers in one country may rate the flexibility of labor practices in their country low, even if it is higher than that in another country where managers rated their system as highly flexible. (The source of the bias could be cultural differences or could be recent macroeconomic events.)

we look at the effect of revenue changes, but somewhat smaller for labor cost hysteresis. In all cases, the effects are of similar importance, however.

5 Identification issues & other robustness checks

To understand potential identification issues in our analyses above, we turn our attention to the error term in equation 7. Defining the full error term as $e_{it} = \eta_{is} + \varepsilon_{it}$, equation 7 implies that:

$$e_{it} = (1 - a_0 - a_1\tau^j)\log \alpha'_{it} = (1 - a_0 - a_1\tau^j)\log\left(\alpha_{it}\left(1 + \frac{1}{\mu_{it}}\right)\right) \tag{8}$$

where we again use j to index the country where outlet i is located. Given this error structure and the assumptions of our model, there are five main potential sources of bias. In each case, however, it is important to note that the potential bias is controlled for to a large extent by the outlet-period fixed effects that we include in our model. Moreover, our parameters of interest are affected only if biases are systematically related to the differences in labor regulation, which we do not expect to be the case. Still, in this section we briefly discuss each of the potential source of bias, as well as the strategies we adopt to address them.

5.1 Potential Sources of Bias

As just noted, we have identified five reasons why our baseline estimates may be biased. We describe each of these here.

First, the production function parameter α, and the demand elasticity parameter μ could vary across countries, or even possibly between outlets within a country, and over time. Under the reasonable assumption that these parameters are fixed within an outlet or an outlet-year or outlet-year-season cell, however, our outlet-period fixed effects (η_{is}) will satisfactorily control for these omitted supply and demand parameters. Moreover, outlet-period fixed effects also control for differences in the level of the regulation index (τ^j) across countries.

Second, if labor, output price and materials for period t are chosen at some prior time $t - h$, where $h < 1$, and demand is subject to unanticipated shocks, then the error term e_{it} in equation 7 would include a prediction error term. Specifically, equation 6 is modified to:

$$b_{it} = (1 - \omega^j)r_{it} + \omega^j b_{it-1} + (1 - \omega^j)\log\alpha' - (1 - \omega^j)\epsilon^q_{it}. \tag{9}$$

where $\epsilon^q_{it} = q_{it} - E_{i,t-h}[q_t]$ is the prediction error. Here $cov(r_{it}, e_{it}) = cov(q_{it} + p_{it}, -(1-\omega^j)\epsilon^q_{it}) = -(1-\omega^j)Var(\epsilon^q)$. Thus, unexpected demand (and productivity) shocks would induce a negative correlation between the error term in equation 7 and the revenue variable, biasing the coefficient on the revenue variable downward.[18] The downward bias on the revenue term due to prediction errors does not affect our coefficients of interest, δ_r and δ_b, in equation 7 so long as the prediction bias is not systematically larger in countries with more rigid regulations, for reasons unrelated to changes in labor regulation. Since, *a priori*, we have no reason to believe that the prediction bias would be larger in countries with a larger labor regulation index, we expect our baseline results to be unaffected by prediction error.[19]

A third source of bias could arise if our model was misspecified. In particular, if the production function had a more general CES form $Q_t = (\alpha L_t^{\frac{\sigma-1}{\sigma}} + \beta M_t^{\frac{\sigma-1}{\sigma}})^{\frac{\sigma}{\sigma-1}}$, where σ is the elasticity of substitution between labor and materials, the error term (equation 8) would include output and input prices, as follows:

$$e_{it} = (1 - a_0 - a_1\tau^j)\left[\sigma \log\left(\alpha_{it}\left(1 + \frac{1}{\mu_{it}}\right)\right) + (1-\sigma)(w_t - p_t))\right]$$

where w_t is log wage and p_t is log output price. In general, the omitted wage and price variables would be correlated with the regressors (revenue and lagged labor cost), leading to biased estimates. Again our outlet-period fixed effects should control for these omitted variables, and if there remains some uncontrolled variability, our coefficients of interest are affected only if the size of the bias is systematically correlated with the regulation.

Fourth, as in all models with a lagged dependent variable, (see e.g. Heckman and Pagés, 2004), autocorrelation in the error term in equation 7 could induce an upward bias in the coefficient on lagged labor. Since the main sources of persistence in the labor demand equation are likely to be captured by our outlet-period fixed effects, we do not expect the autocorrelation issue to be severe. And even if the error terms are autocorrelated, our estimates are upward biased only if the autocorrelation is systematically stronger in countries with a larger index of labor regulation, which we do not expect to be the case.

Finally, another possible concern with our baseline results is that other country-specific fixed effects potentially correlated with cross-sectional variation in labor regulation could bias our comparisons. For example, if demand characteristics for the Company's products are systematically different in countries with higher levels of regulation, that could affect our results.

[18] The intuition for this downward bias is straightforward – since labor is chosen early, when actual quantity is below predicted levels due to unanticipated negative demand and/or productivity shocks, the labor variable is "too high" for the low quantity and hence low revenue realization. Thus large positive residuals in labor costs are correlated with low revenue values and vice versa. This is similar to the errors in variables model – see e.g. Griliches and Hausman 1986. However, since lagged labor costs are set already by $t-h$, this variable is orthogonal to the prediction error term (assuming $h < 1$.

[19] Similarly, unanticipated changes in wage rates could also affect equation 1 and hence equation 3, as could unanticipated voluntary quitting by workers. If shocks to wages and unanticipated quitting are uncorrelated with output quantity and prices once we control for outlet and outlet-period fixed effects, they will not induce any biases in our estimation. Moreover, they will not induce bias in our coefficients of interest so long as the shocks are not systematically greater in more regulated labor markets.

Again our detailed outlet-period fixed effects, directly control for many country-specific characteristics that may affect labor demand. However, there may be omitted factors that affect labor's responsiveness to sales or hysteresis in labor, and hence potentially bias our results.

Although we expect the biases above to be controlled for to a large extent by outlet-period fixed effects, and we do not expect the biases to be systematically related to the differences in labor regulation, we check the robustness of our results to these sources of bias in three ways. First, we use the information available in our data on the choice of material costs. Second, we rely on information concerning changes to labor rigidity within countries. Third, we use a GMM approach (based on Arellano and Bond, 1991 and Blundell and Bond, 1998). These three approaches and the results they yield are described in detail below.

5.2 Robustness check: Material costs specification

In this section, we use data on material costs and run the same regression as in 7 for these (f_{it}):

$$f_{it} \quad = \quad \beta^f r_{it} + \gamma^f f_{i,t-1} + \delta_r^f \tau^j r_{it} + \delta_b^f \tau^j f_{i,t-1} + \eta_{is}^f + \varepsilon_{it}^f. \tag{10}$$

If the estimates of δ_r and δ_b in our regression equation 7 are indeed driven by the effects of labor regulation on the adjustment costs for labor, our theory predicts that the corresponding coefficients in a regression for material costs should be statistically insignificant. That is, we expect $\delta_r^f = 0$ and $\delta_b^f = 0$ (and $\gamma_f = 0$).[20]

If our baseline results are biased, however, because unanticipated demand or productivity shocks are systematically greater in countries with poor regulation, then the coefficient on revenue interacted with labor regulation would be downward biased in the material costs regressions as well since the bias here is the same as for equation 9. Similarly, model misspecification would produce similar biases on the coefficient of revenue and lagged materials cost here as in our labor cost regressions. Also, if the larger hysteresis in labor demand is driven by a greater autocorrelation of the error term in countries with a larger labor regulation index, this should have a similar effect on the material costs specification (so long as this is induced by unobserved persistence in demand or productivity shocks). Finally a number of country specific factors that affect responsiveness to sales or hysteresis in labor costs are also likely to affect material costs in a similar way. For example, poor telecom infrastructure that could negatively affect the firms' ability to coordinate with their workers is also likely to affect the firm's ability to coordinate with the suppliers of material inputs.

[20]With strong complementarity between the inputs, adjustment costs to one input could affect the demand for the other input. For example, with a Leontief production function, if the first order condition for labor input was binding, the demand function for materials would simply be a scalar function of the demand for labor. Based on our understanding of the production process of the Company and examination of the raw data, we do not expect such a strong complementarity in the production function of the Company, and hence we predict a lower or zero effect of labor regulation on the materials demand function.

The results, in Table 5, show that the impact of labor regulation on materials demand (columns 4, 5 and 6) is never statistically significant. Moreover, the economic magnitude of the effects is very small, as shown in the bottom panel of Table 5. Specifically, the impact of a one standard deviation increase in the labor regulation index on the response of material demand to a one standard deviation change in revenue is -0.24, 0.00, and -0.79 percentage points in our specifications with outlet, outlet-year and outlet-year-season fixed effects respectively. Turning to the impact of regulation on the response to changes in lagged materials choice, again we find that the coefficients are insignificant. The magnitude of the effects are slightly larger, but they remain quite small – at 2.21, 1.74, and 0.86 percentage points, respectively, for our three specifications. Moreover, contrary to the case of labor demand where we found increased hysteresis, here we find decreased hysteresis when labor regulation becomes more rigid. This may reflect a more careful optimization of material costs when labor flexibility is low; however, as noted above, these effects are not statistically significant.[21]

In summary, the results from the material costs specification suggest that the estimated effects of labor regulation on labor costs are not driven by biases such as spurious correlation between unexpected demand/productivity shocks or persistence in demand/productivity shocks and the regulation index, but rather reflect real effects of increased regulation on labor costs.

5.3 Robustness check: Within country changes to labor rigidity

Finally, we want to address the concern that other country-specific fixed effects potentially correlated with cross-sectional variation in labor regulation could bias our comparisons in one further way. Specifically, we compare outcomes before and after a change in labor rigidity. This approach directly controls for a number of country-specific factors (such as relative wage and income levels, infrastructure, etc) as long as these remain fixed during the period of analysis.

Most countries, however, do not change regulation regimes very often. Moreover, indexes that are developed to capture the degree of regulation are not necessarily updated over time. Such is the case, for example, for the Botero et al. (2004) index. As a result, there is no useful variation in this index for us to explore. Given this, we gathered data on changes in labor flexibility in two ways. First, we looked at changes in the index constructed using the Global Competitiveness Surveys of 2002 and 2004. Given that the surveys were published in those years, we interpret them as reflecting conditions in 2001 and 2003 respectively. Second, we examined a number of secondary data sources on labor laws in countries in our dataset and identified important regulatory changes affecting labor flexibility in South Korea over the period

[21] In Appendix 4, Table A.1, we present results from the same specification using our alternative measure of labor market inflexibility (from the 2002 Global Competitiveness Survey). The results are very similar to those presented above, in both statistical and economic significance.

1996 to 1998.

Not surprisingly, the labor market inflexibility as indicated by the GCS does not change much over a 2-year period; there are significant changes only for a small number of countries. In order to minimize measurement error, we focus on countries with the largest changes. We adopt a difference-in-difference approach, comparing results for countries with the largest increase in the inflexibility index to countries with the largest decreases.[22] We then use our data for 2001 and 2003 and run the following regression:

$$\begin{aligned} b_{it} &= \beta r_{it} + \gamma b_{i,t-1} + \delta_1 D_{03} + \delta_2 D_{03} r_{it} + \delta_3 D_{03} b_{i,t-1} + \delta_4 D_{03} D_{90} + \\ &\quad \delta_5 D_{90} r_{it} + \delta_6 D_{90} b_{i,t-1} + \delta_7 D_{03} D_{90} r_{it} + \delta_8 D_{03} D_{90} b_{i,t-1} + \eta_{is} + \varepsilon_{it} \end{aligned}$$

where D_{03} is a dummy variable for 2003 and D_{90} is a dummy variable for observations belonging to countries in the top decile of changes in the inflexibility index. The omitted group are observations belonging to countries in the bottom decile of the change in inflexibility. The key coefficients of interest are δ_7 and δ_8, as these reflect the differences in responsiveness to sales and in hysteresis respectively, for the top decile countries relative to the bottom decile countries. Thus δ_7 and δ_8 are difference-in-difference estimates of the effect of increasing inflexibility, controlling for country specific fixed effects as well as common cross-country trends. We also examine the same specification for material costs, to rule out non-regulation related factors that could affect input demand.

The results are reported in Table 7a.[23] Consistent with our theory, we find that δ_7 is negative and significant in all specifications, suggesting a decrease in responsiveness to sales with increases in labor inflexibility. Similarly, δ_8 is positive and significant, confirming that hysteresis increases following an increase in labor inflexibility. As would be the case if changes for labor are driven by changes in rigidity, the results for materials (columns 3 and 4) confirms that materials demand is largely unaffected. While there is some evidence of an increase in responsiveness to sales in column 3, this drops in size and significance when outlet-year-season fixed effects are included in column 4.

Similarly, results from analyzing the Company's data in South Korea, where we found evidence of important regulatory changes affecting labor flexibility, further confirm our baseline results. Specifically, the South Korean government introduced legislation in 1996 to significantly relax labor laws, but modified these in 1997 in the face of strong resistance from labor unions (Kim, 1998). Following the Asian financial crisis in late 1997 and a "bail out" by the IMF,

[22]Since these are responses on a Likert scale in different survey years, we focus on the relative changes - specifically changes in rankings - as a measure of relative increase in inflexibility.

[23]Since we focus on changes over time for a small number of countries with the largest shifts in the inflexibility index, standard errors are clustered at the outlet level.

however, further flexibility was introduced in the Labor Standards Act (LSA) in 1998 (Kim, 2005). The LSA increased labor market flexibility in a number of ways, including by allowing flexible layoffs, flexible work hours, the hiring of substitute workers during disputes, and not compensating workers for wage losses due to strikes and multiple unions (Kim 1998). More information on the key changes to the South Korean labor laws is presented in Appendix 2b (which is taken from Table 3 in Kim, 1998).

We analyze the data on South Korea in four ways, as presented in Table 7b. One, in columns 1 and 2, look at the labor demand in South Korea before and after the passage of liberalized labor laws. Two, in columns 3 and 4, we examine changes to materials demand, to see if other contemporaneous changes may have affected input demand. Three, in columns 5 and 6, we look at the difference-in-differences impact on labor demand in the South Korea relative to other Asian countries in the Asia-Pacific region (as defined by the Company). These countries include (in order of Company presence in this period) Japan, Taiwan, Philippines, India, Guam, China and Malaysia. Finally, in columns 7 and 8, we control for other contemporaneous biases by looking at the difference-in-differences specification for materials demand. The difference-in-differences approach helps address potential biases from contemporaneous macroeconomic changes that affected the whole region (e.g. the Asian crisis in 1997).

We present results for South Korea in Table 7b. Since the years 1996, 1997 and 1998, witnessed changes to the labor laws, we define the pre-reform period as the years 1994 and 1995, and the post-reform period as the years 1999 and 2000. [24] As predicted by our theory, we find that the responsiveness of labor cost to revenue increased, whereas the hysteresis in labor costs decreased significantly after the reforms. Strikingly, there is no impact of the labor law liberalization on materials cost, both in the before-after and the difference-in-differences specifications.

We interpret the consistency of the difference-in-difference estimates and our case study of South Korea with our baseline findings as suggesting that the effects of labor rigidity on labor decisions are not driven by omitted country specific effects correlated with labor regulation. Combined with the evidence from our other robustness checks, we conclude that our baseline findings are a conservative assessment of the adjustments that outlets make based on the different regulatory regimes they face.[25]

[24] Also, eliminating 1997 and 1998 reduces potential biases from the 1997 Asian financial crisis. As discussed above, possible bias from the crisis is also controlled by comparing to other Asian countries. In any case, we examined a number of aggregate variables for South Korea during this time frame (1994 to 2000) and found no significant discontinuity in these or in out data around 1997, suggesting that the financial crisis did not directly impact the sales or operations of the fast-food outlets that we study.

[25] As mentioned above, a key assumption of our within-country analyses is that other important institutions did not undergo changes at the same time as labor regulations were changed; given the short time frame we use, large changes in other institutional factors may be less likely.

5.4 Robustness check: GMM specification

As discussed in Bond (2002), while fixed effects usefully address the issue of cross sectional heterogeneity in analyses such as ours, in an autoregressive model as in equation 7 there could be a bias when we use detailed fixed effects.[26] Another issue arises from the potential endogeneity of the regressors (e.g. due to possible mis-specification error, as discussed above). A solution to these issues is the GMM approach formulated by Arellano and Bond (1991) and refined by Blundell and Bond (1998). This approach also addresses the issue of autocorrelated error terms in such models, and proposes suitable autocorrelation tests to confirm the validity of instruments in the presence of possible autocorrelation.

Specifically, Arellano and Bond suggest first-differencing variables to eliminate the individual effects in the data, and then using suitably lagged levels of the endogenous variables as instruments. Blundell and Bond suggest augmenting this "difference" estimator with suitably lagged differences of endogenous variables as instruments for equations in levels. The moment conditions from the differenced equations combined with the moment conditions for the levels equations then yield a "system" estimator.

One attractive feature of this GMM approach is that in sufficiently long panels, a number of lags are available as potential instruments. Thus the model is generally overidentified, allowing for tests of the overidentifying restrictions using the Sargan/Hansen test.[27] In general, lags of order 2 and greater are available as instruments for the lagged (differenced) endogenous variable, while lags of order 1 and greater are available for other endogenous regressors. However, the validity of the lagged variables as instruments depends on the degree of autocorrelation in the error term (excluding the individual effects). For example, for the first-difference transformation of equation 7, $b_{i,t-2}$ is valid as an instrument for $\Delta b_{i,t-1}$ only if $\epsilon_{i,t}$ is not autocorrelated. If $\epsilon_{i,t}$ is MA(1), then $b_{i,t-3}$ and longer lags can be used as instruments.

We examined a number of alternative GMM instruments and approaches (differenced, level and system).[28] In addition to the lagged labor cost and lagged revenue, we also used lagged materials cost as possible instruments. While we found our results to be consistent generally

[26] In general, the within (fixed effects) estimator is downward biased in short panels (Nickell 1981). This is because the transformed lagged dependent variable is $(b_{i,t-1} - \frac{1}{T-1}\sum_{t=1}^{T-1} b_{i,t})$ and the transformed error term is $(\epsilon_{i,t} - \frac{1}{T-1}\sum_{t=1}^{T-1} \epsilon_{i,t})$. The term $\frac{-b_{i,t}}{T-1}$ in the former is correlated with $\epsilon_{i,t}$ in the latter. Thus, the bias is decreasing in the length of the panel T. (Other cross terms induce bias too, but these are smaller as they are divided by terms of the order of T^2.) In our estimates using outlet fixed effects, the panel length for most of the outlets is close to 208 (52*4). Thus our panel is long enough that this bias is unlikely to be severe in these regressions. The length is shorter with outlet-year (52) and outlet-year-season fixed effects (13), and so the within estimator coefficient is more likely to be biased downward in these regressions. Note that our parameter of interest is the coefficient of lagged labor interacted with regulation, which may not be systematically biased due to this.

[27] This advantage is somewhat offset by the fact that with too many instruments, the Sargan/Hansen test is considerably weakened (Roodman 2006). In our estimations, we limit the number of lags used as instruments.

[28] To implement the GMM approach, we use the Stata procedure developed by Roodman (2006).

with those from our baseline specifications, most specifications failed either the Hansen/Sargan tests, or the autocorrelation tests, or both. We found that shorter lags (of order less than 7) were invalid as the error term appears to have a high degree of autocorrelation. This is not surprising given the high frequency data that we use – at the weekly level, omitted shocks may be highly persistent and hence correlated across many periods.

A level GMM specification using lags 7 and 8 of the endogenous variables (revenue, lagged labor and these variables interacted with the regulation index) passed the overidentification test as well as the autocorrelation tests. The results for this specification are presented in Table 6. Here again the elasticity of labor cost with respect to revenue is significantly lower in countries with a larger regulation index, as seen from the negative and significant coefficient on the product of the regulation index and revenue. Similarly, there is evidence of greater hysteresis in countries with more rigid labor regulations, as the coefficient on the product of lagged labor and the regulation index is significant and positive. As expected, the AR(1) test fails, given that, by construction, the differenced error terms are AR(1). However, there is no evidence of autocorrelation of orders 7 or 8, implying that the use of these lags of the endogenous variables as instruments is valid. The coefficients on both interaction terms are stronger than in our baseline analyses above. This suggests that if anything, the potential endogeneity in our baseline regressions biases the estimates on the parameters of interest (coefficients on the interaction terms) downward rather than upward.

We find similar results using the GMM approach with the index of hiring/firing inflexibility obtained from the 2002 Global Competition Survey, as reported in Appendix 4, Table A.2. For the GCS measure, the specification that passed both the overidentification tests and the autocorrelation tests was a level GMM model where we used 7 to 8 lags of lagged labor, revenue and material costs, as well as their interactions with the inflexibility index, as instruments. Here too, the estimated effect of changes in inflexibility on the responsiveness to revenue and hysteresis of labor costs is larger when we correct for possible endogeneity using the difference GMM approach.[29]

We conclude that the results from our baseline analyses may be conservative, and that our

[29]Even in specifications that fail one or the other specification tests, the results are in general, very similar to what we find here. As an illustration, results from 3 alternative specifications are reported in Appendix 4, Table A.3. Columns 1, 2 and 3 report results from using level, difference and system GMM specifications respectively, with 3 to 4 lags of the lagged labor costs and revenue (and interactions with the regulation index) as instruments. In columns 1 and 2, both the overidentification test as well as the autocorrelation tests fail. In column 3, the overidentification test passes, but there is evidence of 3 and 4 order autocorrelation. However, in all the cases, the results are similar to our baseline results in Table 4 – the elasticity of labor cost with respect to revenue goes down and labor cost hysteresis goes up with increases in the regulation index across all these specifications. As in Table 6, the effect of regulation (coefficients on the cross-terms) are larger in Table A.2 compared to Table 4. For the GCS measure too, we found that other specifications that failed one or the other specification tests generally yielded results similar in spirit to those in Table 4.

baseline specifications were not biased upwards by endogeneity.

6 Estimated adjustment dampening and gross misallocation

In this section we take our estimates in Tables 3 and 4 more seriously, and translate these into parameters of the simple model set forth in Section 2.1.[30] This allows us to (1) assess the implied dampening in labor adjustment induced by rigidities in labor regulation, and (2) measure the optimal labor costs implied by the model, and, accordingly, the extent of misallocation of labor at each outlet.

6.1 Assessing the Dampening of Labor Adjustment

From equation 5, we get the following relationship between actual and optimal labor cost adjustments:

$$\frac{b_t - b_{t-1}}{b_t^* - b_{t-1}} = (1 - \omega^j). \tag{11}$$

Since b is the log of labor costs, the expression on the left-hand side is approximately the observed percentage change in labor costs divided by the percentage change in labor costs that would have occurred if there were no adjustment costs. Since $0 < \omega^j = \frac{\gamma_a^j}{\gamma_a^j + \gamma_o} < 1$, the RHS of equation 11 also is between 0 than 1. Thus, the theory implies that regulatory rigidity dampens all observed adjustments to labor, on both the hiring and the firing margins.

The expression $(1 - \omega^j)$, which we call the "dampening factor," provides a measure of the extent to which labor adjustments are reduced by the labor regulations. Note that $\omega^j = a_0 + a_1.\tau^j$. Moreover, we can obtain estimates of a_0 and a_1 from the coefficients in our regressions.

Table 8 presents alternative estimates of the dampening factor at different percentiles of the distribution of labor regulation. In panel 1, we use coefficient estimates from column 3 of Table 3 to derive a_0 and a_1, and then use these to calculate the dampening factor at different values of the Botero et al. (2004) regulation index. The estimated dampening factor is larger when we use the coefficients on the revenue variables compared to the coefficients on the lagged labor variables. Using the estimates in row 3 of panel 1, which represent the average of the coefficients attached to revenues and lagged labor, we find that labor regulations dampen adjustments in labor by a factor of 0.68 at the 25th percentile of the labor regulation index, and 0.50 at the 75th percentile of the labor regulation index, a reduction of about 25% in labor cost adjustments. In panel 2, we find very similar results using the GCS index results from Table 4.[31]

[30]Note that while our model is very simple, our estimates are consistent with many of its assumptions. For example, in most of our specifications, we cannot reject the hypothesis that $\delta_r = -\delta_b$, an implication from our very simple model.

[31]These estimates of the dampening factor – as well as the estimates below, of labor misallocation – are conservative, as the effects are larger if we use coefficients from the GMM specifications.

6.2 Assessing Labor Misallocation

Our simple model in Section 2.1 allows us to also measure how much misallocation of labor is caused by the dampening of the adjustment process. Specifically, equation 11 implies the following optimal labor choice for each outlet:

$$b_t^* = b_{t-1} + \frac{b_t - b_{t-1}}{1 - \omega^j}. \tag{12}$$

Note that, per our model, optimal labor choice is always higher (lower) than actual if labor levels are increased (decreased) relative to the prior period. Thus the net effect on employment is ambiguous – if the productivity and demand shocks across outlets and over time are mean zero, the mean net misallocation could well be about zero within countries.[32] To capture the inefficiency of holding too little or too much labor, however, we define "gross labor misallocation" ρ as:

$$\rho \equiv |b_t^* - b_t|. \tag{13}$$

This gross labor misallocation measure indicates how much distortion there is between the optimal and actual labor level in each outlet each week. Since this is a difference in logs, it can be thought of as the percentage difference between optimal and actual labor costs.[33]

To assess how the magnitude of misallocation relates to labor regulation, we estimate the decrease in gross misallocation resulting from a hypothetical decrease in labor regulation by the inter-quartile difference (p75 - p25, which is 0.31 in our data), for those outlets operating in countries in the top quartile of the labor regulation index. We do this in three steps. First, for outlet i in country j in period t, we estimate the optimal labor choice $b_{i,t}^*$ using the estimated ω_j (given the actual regulation index τ^j for country j) along with actual $b_{i,t}$ and $b_{i,t-1}$ in equation 12. Next we estimate what the labor cost ($b_{i,t}'$) would have been if the regulation index had been lower by 0.31 points, that is we recalculate ω^j for the hypothetical lower regulation index and use the relationship between $b_{i,t}$, $b_{i,t-1}$, $b_{i,t}^*$ and ω_j reflected in equation 11. Finally, we measure the difference between the gross misallocation at the current regulation index ($|b_{it}^* - b_{i,t}|$) and gross misallocation at the hypothetically lower regulation index ($|b_{it}^* - b_{i,t}'|$).

For the sample of outlets in the top quartile of the regulation index, we find a hypothetical decrease in the labor regulation index by 0.31 points (p75 - p25) would result in a mean decrease in gross misallocation of about 4.1 percentage points. Using similar calculations, for outlets in the bottom quartile of the labor regulation index, we find that an *increase* in the labor regulation

[32] In fact, we find that this is the case generally in our data.

[33] This interpretation is only an approximation, which holds better when the differences are small. However, redefining the reallocation term precisely as the percentage difference between optimal and actual labor levels (i.e., $\rho = \frac{B_t^* - B_t}{B_t}$), yields very similar estimates.

index by 0.31 points (p75-p25) would result in a mean increase in gross misallocation of about 2.5 percent. The results are similar when we use the GCS inflexibility measure – here, gross misallocation decreases by 3.2 percentage points for the top quartile of firms following a 0.22 (p75 - p25) decrease in inflexibility, and increases by 2.5 percentage points for the bottom quartile of firms following a 0.22 (p75 - p25) increase in the inflexibility index.

We interpret our results on the dampening factor above as indicating a very large effect of the regulation on labor adjustment. Our estimates imply that, when the labor regulation index is relatively low (at the 25th percentile), outlets adjust labor costs each week more than two-thirds of the way towards what would be optimal with zero adjustment costs. At the 75th percentile of regulation, they only adjust half of the way towards what is optimal. The reason these large dampening factors translate to relatively small estimates of gross misallocation (2.5 to 4.2 percent) is that the average optimal week to week gross adjustment is relatively small, roughly about 15 per cent of labor cost in our data. Thus the"misallocation" due to an increase in regulation from the 25th to 75th percentile can be expected to be about 2.6 percent ([0.676-0.504]*0.15).

Although our data are of a very different type, it is interesting that the magnitudes of the affects documented here are qualitatively similar to the findings in two related papers, subject to the strong caveat that our definition of the dampening factor and gross misallocation are not directly comparable to the variables examined by these authors. Our finding of a 25 percent increase in the dampening of adjustment when we move from the 25th to 75th percentile of labor regulations is of similar import as the 33 percent reduction in the speed of adjustment that Caballero et al, (2004) find for a change in the same labor regulation index from the 20th to the 80th percentile. Similarly, our estimates of the lower bounds of gross misallocation in the range of 2.5 to 4.2 percent, is in line with some of the effects calibrated by Hopenhayn and Rogerson (1993) for variables that could be interpreted similarly. They find that a severance pay equal to 6 to 12 months of wages results in a reduction in net employment of 1.7 to 2.5 percent, and a layoff cost to wage bill ratio of 2.6 to 4.4 percent respectively.

Note that our results in this section are obtained by taking the simple model set forth in Section 2.1 seriously. In particular, the optimal labor choice (equation 12) is driven by the assumptions of symmetric quadratic (convex) costs. With this assumption, once the parameter ω^j is recovered, any change to actual labor levels provides information for estimating the optimal or zero adjustment cost labor level. In a more general model, where costs are not strictly convex, adjustments would be lumpy, and hence the optimal labor levels would be more difficult to recover.

7 Impact on international expansion

Given the evidence above that labor regulation affects labor input choices at the outlet level, a reasonable implication would be that the Company might delay entry or expand more slowly in markets where labor regulations are relatively more constraining.

We test for such effects in Table 9. Other key variables that we expect to influence foreign entry and expansion, and hence must control for in our regressions, are the size of the market, which we proxy for using the population of the country and per capita income levels, and the distance of the country from the headquarters (United States). Note that these are the key factors typically used to explain international trade in the "gravity" model of trade. We obtain data on real GDP per capita (constant price: chain series) and population from the Penn World Tables. Data on the distance from the U.S. capital to the capital of other foreign countries are from Jon Haveman's Web site.[34] Further, since the Company is headquartered in the United States, one might expect it to find other countries where English is the primary language to be more attractive markets. Data on primary language are available also from Jon Haveman's Web site. Finally, the entry and expansion decisions are likely to be influenced by local regulatory requirements for starting new businesses. We capture this by including the log of the time (in days) to start a new business in different countries, which we obtain from the World Bank's World Development Indicators data.[35]

Our dependent variables of interest are the hazard of entry into a country, in columns 1 and 2 of Table 9, and the number of outlets in each country, in columns 3 and 4.

We analyze the entry decision using a Cox partial likelihood (proportional hazard) model, at a weekly frequency from the time of first entry into a foreign market to the end of 2003.[36] We include observations for all countries for which we have data on all variables in all periods, including countries where the Company had not established any operations by the end of our data period, namely the end of 2003. Since unobserved country-specific factors are likely to drive the error term, we adjust the standard errors for clustering at the country level.

Consistent with the gravity model of trade, the results, in columns 1 and 2 of Table 9, imply that the Company was quicker to enter countries with larger markets, as captured by high population levels and high per capita income. The Company also was slower to enter countries farther away from the United States. The effects of the English language dummy and of time to start a business on the entry decision are not significant.

[34] http://www.macalester.edu/research/ economics/PAGE/HAVEMAN/Trade.Resources/TradeData.html#Gravity

[35] http://devdata.worldbank.org/data-query/.

[36] We have data on the opening date of each outlet. We calculate the date of entry into each country from the date of opening of the oldest outlet in each country. Note that our results are robust to analyzing the entry decisions using just a single cross-section of the data, considering the time-varying variables to be fixed at their end of 2002 values.

Controlling for the above factors, in column 1 we also see that the Company has entered later into those markets with more rigid labor regulation, as measured by the Botero et al. (2004) index. The magnitude of this effect is large; a one standard deviation increase in the Botero et al. (2004) index leads to reduction in weekly entry rate of about half.[37] On the other hand, we find no significant effect of labor hiring/firing inflexibility using the GCS index in column 2.

Results are similar when we look at the effects of the same variables on the number of outlets established in foreign markets, conditional on entry (columns 3 and 4 of Table 9). First, we find that there are more outlets in countries with larger population and higher GDP per capita, and fewer outlets in countries further away from the United States. Here, the English language dummy continues to have no significant effect, but the number of outlets in operation is significantly lower in countries where regulatory and other requirements increase the time to start a business.

As in the entry regressions, in column 3, we find that labor regulation, as measured by the Botero et al. (2004) index, reduces the number of outlets established in foreign countries. The magnitude of the effect is large; a one standard deviation change in the index of labor regulation reduces the number of outlets by about 13 (-81.81*0.16), which is about one third of the mean number of outlets per country in this sample.[38] The result for the GCS index of hiring/firing inflexibility in column 4 is also negative, but again not statistically significant.

We surmise that the weak results for the GCS measure may reflect the difference in the timing of the survey versus the entry decisions, which were made throughout the mid-1980s and 1990s. The GCS measure we use is based on a survey of circumstances as perceived by managers in each country in 2002. Such a perception-based measure may exhibit more variance over time than an index such as the one constructed by Botero et al. (2004), which captures the presence or absence of various statutes and laws. Thus the measurement error on the GCS index when used to examine entry and expansion decisions made over a long period of time would likely bias the coefficient towards zero.

The results in this section should be interpreted under the caveat that a number of idiosyncratic and transient factors also may have influenced entry and expansion by the Company in foreign markets. Some of these omitted factors could be correlated with the regulation index, though we have no a priori reasons to expect them to be. Also, while the data on labor regulations and entry regulations (proxied using time to start a business) are valid for the early 2000s,

[37] Specifically, $e^{-3.676*0.16} = .55$. Given that the Company entered about 43 countries out of 68 potential destinations over 20*52=1040 weeks between 1983 and 2003, the weekly hazard rate into entry is quite low (mean value of 0.09 percent in the subsample). Our estimates suggest that this probability is lowered to about 0.05 percent by a one standard deviation increase in the Botero et al. (2004) index.

[38] The mean number of outlets in the subsample used in this analysis is 37.02 and the standard deviation is 68.32.

as just noted, the entry and expansion decisions were made over a long period in the 80s and 90s. Still, the results we find with respect to the Company's expansion decisions are consistent with our findings in the previous sections. We conclude that labor market rigidity appears to hamper international entry and expansion, in addition to affecting labor choices within outlets.

8 Conclusion

In this paper, we ask whether rigidities associated with labor regulation, as measured by an index of statutory requirements (constructed by Botero et al., 2004) or through surveys of executives, have a measurable impact on the day-to-day operations of firms. We address this question using data from a single fast-food chain with operations around the world. We find strong evidence that labor regulations dampen the responses to demand/supply shocks in our very micro-level data. To our knowledge, ours is the first establishment-level cross-country study to document such an effect.

We believe that our within-firm establishment data present several unique advantages for the type of analyses we carry out and thus strengthen our results in important ways. First, the fact that our data are from a single firm implies that we are holding constant a number of headquarters' policies that may confound comparisons of different firms across countries in other studies. Second, the outlets at this Company are producing the same product across different countries using similar technologies. Thus it is reasonable to assume that our results are not driven by differences in output decisions or technology and production function parameters across countries. Finally, our data are available at very high frequency (weekly) for a long period of time (four years), which has significant advantages relative to annual frequency firm level or aggregate data where considerable within-year or establishment-level variation may go unmeasured (Hamermesh, 1989; Hamermesh and Pfann, 1996). The very high frequency of our data also allows us to adopt estimation strategies involving outlet, outlet-year or even outlet-year-season fixed effects, and thereby control for many factors that might bias estimates otherwise.

In addition to showing a measurable impact of regulations on the day-to-day operations and labor decisions of existing outlets within this firm, we find some evidence that the Company has delayed entry and operates fewer outlets – conditional on the per capita income, population, entry barriers for new firms, and distance to the United States – in countries with more rigid labor regulations. This, in turn, implies a reduction in labor usage by the Company quite apart from the adjustment costs we focused on in this paper.[39]

[39] See Lafontaine and Sivadasan (forthcoming) for analyses of the productivity and labor choice decisions of the Company.

Our study focused on assessing the effect of labor regulation on the Company's operations. A major goal of labor policies, of course, is to protect labor. Our findings are consistent with the idea that incumbent workers benefit from the regulation, as the outlets do not reduce labor as much as they would otherwise when facing negative shocks. Thus such workers may benefit from longer employment tenure or reduced uncertainty. Of course, our results also imply that the outlets do not increase labor as much as they would under a less regulated regime when they face positive shocks. Moreover, employment is distorted because the Company delays entry and does not expand as much in markets with more rigid labor regulation.

Our findings of a negative impact of labor market rigidities on labor adjustment in fast-food outlets contrasts with the findings of zero impact of increased minimum wage laws on employment in fast-food stores documented by Card and Krueger in a number of studies (see Card and Krueger, 1997). The indices we focus on capture difficulties in adjusting labor levels due to labor regulations that are distinct from minimum wage laws. Also, while our results suggest a definitive impact of these labor regulations on labor choice as predicted by economic theory, our findings here relate to dampening of adjustments rather than net employment effects.

Within existing outlets, our results imply that increasing the index of regulation or of hiring/firing inflexibility from the 25th to the 75th percentile leads to an increase in gross misallocation of labor equivalent to about 4.2 percent of labor costs (for the top quartile of the regulation index). Past research (e.g., Foster, Haltiwanger and Krizan, 1998) has highlighted the importance of the reallocation of resources from less productive to more productive firms as a source of aggregate productivity growth, and hence national output growth and welfare. Our results suggest that labor regulations reduce the ability of firms to adjust labor levels in response to demand or productivity fluctuations, thus hampering the reallocation of resources and potentially impeding an important channel for aggregate productivity growth.

References

[1] Abraham, Katharine and Susan Houseman. 1994. "Does Employment Protection Inhibit Labor Market Flexibility: Lessons From Germany, France and Belgium." In Rebecca M. Blank, ed., *Social Protection Versus Economic Flexibility: Is There a Tradeoff?* (Chicago: University of Chicago Press).

[2] Addison, John and Paulino Teixeira. 2001. "The Economics of Employment Protection." IZA Discussion Paper No. 381. Institute for the Study of Labor, Bonn, Germany.

[3] Aguirregabiria, Victor and Cesar Alonso-Borrego. 2004. " Labor Contracts and Flexibility: Evidence from a Labor Market Reform in Spain." Working Paper. University of Toronto, Toronto.

[4] Anderson, Patricia M. 1993. "Linear Adjustment Costs and Seasonal Labor Demand: Evidence from Retail Trade Firms." *Quarterly Journal of Economics*, 108, no. 4 (November): 1015 - 42.

[5] Arellano, Manuel, and Stephen Bond. 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58, no. 194 (April): 277-97.

[6] Blundell, Richard and Stephen Bond. 1998. "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics* 87, no. 1 (November): 115-43.

[7] Bond, Stephen. 2002. "Dynamic panel data models: a guide to microdata methods and practice." *Portuguese Economic Journal*, Vol. 1, pp. 141-162

[8] Bond, Stephen and John Van Reenen. Forthcoming. "Microeconometric Models of Investment and Employment." In James J. Heckman and Edward E. Leamer, eds., *Handbook of Econometrics*, Vol 6. (Amsterdam: Elsevier).

[9] Botero, Juan C., Simeon Djankov, Rafael La Porta, Florencio Lopez-de-Silanes and Andrei Shleifer. 2004. "The Regulation of Labor." *Quarterly Journal of Economics* 119, no. 4 (November): 1339-82.

[10] Cabellero, Ricardo J., Kevin N. Cowan, Eduardo M.R.A. Engel and Alejandro Micco. 2004. "Effective Labor Regulation and Microeconomic Flexibility." *Economic Growth Center Discussion Paper No 893*. Yale University, New Haven, CT.

[11] Caballero, Ricardo J., Eduardo M.R.A. Engel and John Haltiwanger. 1997. "Aggregate Employment Dynamics: Building from Microeconomic Evidence." *American Economic Review* 87, no. 1(March): 115-37.

[12] Card, David and Alan B. Krueger. 1997. *Myth and Measurement: The New Economics of the Minimum Wage*, Princeton University Press.

[13] Cooper, Russell and Jonathan L. Willis. 2004. "A Comment on the Economics of Labor Adjustment: Mind the Gap," *American Economic Review* 94, no. 4 (September): 1223-37.

[14] Foster, Lucia, John Haltiwanger and C.J. Krizan. 1998. "Aggregate Productivity Growth: Lessons from Microeconomic Evidence." NBER Working Paper No. W6803. National Bureau of Economic Research, Cambridge, MA.

[15] Griliches, Z., and J. A. Hausman. 1986. "Errors in variables in panel data," *Journal of Econometrics*, 31, 93-118.

[16] Haltiwanger, John, Stefano Scarpetta and Helena Schweiger. 2006. "Assessing Job Flows Across Countries: The Role of Industry, Size and Regulations." Policy Research Working Paper No. 4070. World Bank, New York.

[17] Hamermesh, Daniel S. 1989. "Labor Demand and the Structure of Adjustment Costs." *American Economic Review* 79, no. 4 (September): 674-89.

[18] Hamermesh, Daniel S. and Gerard A. Pfann. 1996. "Adjustment Costs in Factor Demand." *Journal of Economic Literature* 34, no. 3 (September): 1264-92.

[19] Heckman, James J. and Carmen Pagés. 2004. "Law and Employment: Lessons from Latin America and the Caribbean – An Introduction." *Law and Employment: Lessons from Latin America and the Caribbean.* Chicago: University of Chicago Press.

[20] Holt, Charles C., Franco Modigliani, John F. Muth and Herbert Simon. 1960. *Planning Production, Inventories,and Work Force.* Englewood Cliffs, NJ: Prentice-Hall.

[21] Hopenhayn, Hugo and Rogerson, R.. 1993. "Job Turnover and Policy Evaluation: A General Equilibrium Analysis." *The Journal of Political Economy*, 101(5): 915-38.

[22] Jaramillo, Fidel, Fabio Schiantarelli and Alessandro Sembenelli. 1993. "Are Adjustment Costs for Labor Asymmetric? An Econometric Test on Panel Data for Italy." *Review of Economics and Statistics*, 75, no. 4 (November): 640-48.

[23] Kim, S. 2005. "The Legal Regulation of Wrongful Dismissal in Korea." *Comparative Labor Law and Policy Journal*, Vol 25, no. 4: 535-60.

[24] Kim, Y.C. 1998. "Industrial Reform and Labor Backlash in South Korea: Genesis, Escalation, and Termination of the 1997 General Strike." *Asian Survey*, Vol 38, no. 12 (December): 1142-1160.

[25] Lafontaine, Francine and Jagadeesh Sivadasan. Forthcoming. "Within-firm Labor Productivity across Countries: A Case Study." In Richard Freeman and Kathryn L. Shaw, eds.,*International Differences in the Business Practices and Productivity of Multinational Firms: A Case-Based Approach.* Chicago: University of Chicago Press.

[26] Lazear, Edward. 1990. “Job Security Provisions and Employment.” *Quarterly Journal of Economics*, 105, no. 3 (August): 699-726.

[27] Nickell, S. 1981. “Biases in Dynamic-Models with Fixed Effects.” *Econometrica*, 49(6), pp. 1417-26.

[28] Petrin, Amil and Jagadeesh Sivadasan. 2006. “Job Security Does Affect Economic Efficiency: Theory, A New Statistic, and Evidence from Chile.” NBER Working Paper No. W12757. National Bureau of Economic Research, Cambridge, MA.

[29] Paola Rota. 2004. “Estimating Labor Demand with Fixed Costs.” *International Economic Review*, 45, no. 1 (February): 25-48.

[30] Pfann, Gerard A. and Franz C. Palm. 1993. “Asymmetric Adjustment Costs in Non-linear Labour Demand Models for the Netherlands and U.K. Manufacturing Sectors. *Review of Economic Studies*, 60, no. 203 (April): 397-412.

[31] Roodman, David. 2006. “How to do xtabond2: An Introduction to “Difference” and “System” GMM in Stata.” Working Paper No 103, Center for Global Development.

[32] Stock, James H. and Motohiro Yogo. 2002. “Testing for Weak Instruments in Linear IV Regression.” NBER Technical Working Paper No. T0284. National Bureau of Economic Research, Cambridge, MA.
http://www.nber.org/papers/T0284.

[33] Stokey, Nancy, Robert E. Lucas, Jr. and Edward Prescott. 1989. *Recursive Methods in Economic Dynamics* (Cambridge, MA: Harvard University Press).

Appendix 1: A stochastic dynamic programming model of adjustment costs

In this appendix, we present a stochastic dynamic programming model of labor adjustment in the presence of adjustment costs. We numerically solve the model for a set of parameter values, and then simulate data to assess the effect of increased adjustment costs on two properties of the optimal labor choice: (1) the observed elasticity of labor demand with respect to output, and (2) the elasticity of labor choice with respect to the previous period's labor choice.

A Model setup

The production function of the optimizing producer (here each outlet of the multinational firm) uses a single variable input, with the following form:

$$Q_t = f(L_t) = \Theta L_t^{\alpha}, \tag{14}$$

where Q is output, L is labor input, Θ is a productivity shock faced by the outlet, α is a production function parameter, and t the denotes time period. We assume that each outlet faces a downward sloping iso-elastic demand curve:

$$P = \Lambda_t \cdot Q_t^{\frac{1}{\mu}},$$

where Λ_t represents demand shocks in period t. Each outlet faces perfectly elastic labor supply at wage level W and a cost of adjusting labor from one period to the next, $g(\Delta L_t)$. Productivity (Θ) and demand (Λ) shocks are revealed to the outlet at the beginning of the period, and then the outlet chooses the labor level for that period. Thus the objective function of the outlet in period 1 is:

$$\max_{\{L_t\}_{t=1}^{t=\infty}} \left\{ \phi_1 L_1^{\alpha'} - WL_1 - g(\Delta L_1) + E_1 \left[\sum_{t=2}^{\infty} \beta^t \left(\phi_t L_t^{\alpha'} - WL_t - g(\Delta L_t) \right) |\phi_1 \right] \right\}, \tag{15}$$

where $\phi_t = \Lambda_t \Theta_t^{\left(1+\frac{1}{\mu}\right)}$ and $\alpha' = \alpha\left(1 + \frac{1}{\mu}\right)$.

The productivity and demand shocks (and therefore the combined productivity and demand shock parameter ϕ) follow a first-order Markov process. Then equation 15 in the Bellman equation form is:

$$V(\phi, L) \quad = \quad \max_{\{L'\}} \left\{ \phi L'^{\alpha'} - WL' - g(\Delta L') + \beta E[V(\phi', L') \; |\phi] \right\}. \tag{16}$$

The impact of labor regulations is modelled as affecting the adjustment costs. We model the labor regulations as imposing one of three types of adjustment costs:

1. Symmetric, quadratic adjustment costs: $g(\Delta L_t) = c_s \cdot (\Delta L_t)^2$, where $\Delta L_t = L_t - L_{t-1}$;

2. Asymmetric, linear adjustment costs: $g(\Delta L_t) = c_a \cdot (\Delta L_t) \cdot D_t$, where D_t is an indicator function for firing defined equal to 1 if $\Delta L_t < 0$ and 0 otherwise;

3. Fixed or lump sum adjustment costs: $g(\Delta L_t) = c_f \cdot D_t$, where D_t is an indicator function for any change in labor (hiring or firing), that is D_t is equal to 1 if $\Delta L_t \neq 0$ and 0 otherwise.

The assumption of quadratic symmetric adjustment costs is invoked in a number of early theoretical papers on labor adjustment costs. However, Jaramillo et al. (1993) and Pfann and Palm (1993) suggest that labor adjustment costs are asymmetric. Our specification of asymmetric firing costs is consistent with regimes with mandated severance payments. The fixed adjustment cost regime reflects the possible non-convexities in adjustment costs, as modelled in the literature (e.g., Caballero et al., 1997; Rota, 2004).

The sufficient condition for equation 16 to be a contraction mapping is that the objective function be concave, which is fulfilled if $\alpha' < 1$ (see Stokey, Lucas and Prescott, 1989). However, the equation does not yield closed form solutions for the value function $V(\phi, L)$ or the policy function $L'(\phi, L)$. To obtain numeric solutions, we need to make assumptions regarding parameter values, which we discuss in the next section.

B Selecting parameter values

We make the following parametric assumptions to derive a numeric solution to the dynamic programming problem in equation 16:

- $\alpha' = 0.216$, assuming $\alpha = 0.36$ and demand elasticity μ = -2.5.[40]
- $\phi \in [0, 1]$. (The evolution of ϕ over time is discussed below.)
- $\beta = \frac{1}{1.08}$, based on an 8 percent required rate of return for outlet owners.
- Wage W is set to 0.03552, to obtain an upper bound on labor of exactly 10.

With these assumptions, the per period labor choices are bounded between 1 and 10, since $L_{min} = \left[\frac{\alpha' \phi_{min}}{W}\right]^{\frac{1}{(1-\alpha')}} = 0$, and $L_{max} = \left[\frac{\alpha' \phi_{max}}{W}\right]^{\frac{1}{(1-\alpha')}} = 10$. Correspondingly, the output level and value functions are also bounded, which implies that the sufficient conditions for equation 16 to be a contraction mapping hold. We assume that ϕ follows a discrete Markov chain, with 10 states ($s_1 = 0.1, s_2 = 0.2, ..., s_{10} = 1.0$). We also assume that the shock process is iid. This is captured by setting $T_{ii} = T_{ij} = 0.1$, where T_{ij} is the probability of transition from state s_i to s_j.

C Solving the model and simulating data

Our simulations are intended to capture the effect of varying the cost of labor adjustment parameter (c_s, c_a, and c_f) on the relationship between labor demand, measured output (revenue) and lagged labor demand. We undertake the following 2-stage procedure:

[40] The production function parameter α and demand elasticity are backed out from an estimate of the production function and the observed material share of revenue. See Lafontaine and Sivadasan (forthcoming) for more details.

C.1 Stage 1: Obtaining optimal policy functions

In this stage, we solve and store the optimal policy function for 45 separate regimes. The adjustment cost parameter c_s varies from 0 to 1 in 44 equal increments in the quadratic case, while c_a and c_f vary from 0 to 8 period's (week) wage in 44 equal increments in the asymmetric and fixed cost cases. Standard errors are clustered at the regime (country) level.

Since standard regularity conditions hold, the Bellman equation (16) can be solved numerically. We find that the estimated optimal value function converges well in about 4 to 6 iterations. We obtain the optimal policy functions for four scenarios: (1) A benchmark case with zero adjustment costs; (2) Symmetric, quadratic adjustment costs; (3) Asymmetric, linear adjustment costs; and (4) Non-convex (fixed or lump sum) adjustment costs.

C.2 Stage 2: Simulating data

In the second stage, we simulate data for 75 outlets in each of the 45 adjustment cost regimes, for each of the four scenarios. For each outlet i, we draw period 0 labor levels (l_{i0}) from a uniform distribution over [0, 10], and period 0 combined demand/productivity shocks (ϕ_{i0}) from a uniform distribution over [0, 1]. Draws of ϕ for period t(ϕ_{it}) are based on the prior period shock and the transition probability matrix. Labor choice in period t is based on the optimal policy function (solved in stage 1 above).

First, we simulate the model for an initial 50 periods to allow the distribution of shocks and labor levels to reach steady state. We then simulate 104 periods (2 years of 52 weeks each) of data for each outlet, for each of the four scenarios.

D Regression analysis on simulated data

At the end of stage 2, we have four datasets, each containing data on $45 \cdot 75 = 3,375$ outlets for 104 weeks each ($3,375 * 104 = 351,000$ observations). To analyze the effect of changes in adjustment costs on the elasticity of labor demand to revenue and with respect to the previous period's labor demand, we run the following regression specification on the simulated data:

$$b_{it}^j = \beta r_{it}^j + \gamma b_{it-1}^j + \delta_r c^j r_{it}^j + \delta_b c^j b_{it-1}^j + \eta_{is}^j + \varepsilon_{it}^j, \qquad (17)$$

where i indexes outlets, j indexes the 45 different adjustment costs regimes, and t indexes weeks. The log labor cost $b_{it}^j = \log(L_{it} \cdot W_{it})$. Labor choice is made by each outlet based on the optimal policy function (and depends on prior period labor and current ϕ shock). Log revenue r_{it}^j is defined as log of the product of price and quantity, which in this model is log $(\phi_{it}.L_{it}^{\alpha'})$. Finally, c^j represents adjustment costs (and is therefore analogous to the labor regulation index in the data), and η_{is}^j captures outlet or outlet-season fixed effects.

The results from running the regression on the simulated data are presented in Table 1 and discussed in Section 2.2.

Appendix 2a: Definition of Employment Laws Index (from Botero et al., 2004)

Alternative employment contracts	Measures the existence and cost of alternatives to the standard employment contract, computed as the average of: (1) a dummy variable equal to one if part-time workers enjoy the mandatory benefits of full-time workers; (2) a dummy variable equal to one if terminating part-time workers is at least as costly as terminating full-time workers; (3) a dummy variable equal to one if fixed-term contracts are only allowed for fixed-term tasks; and (4) the normalized maximum duration of fixed-term contracts.
Cost of increasing hours worked	Measures the cost of increasing the number of hours worked. We start by calculating the maximum number of "normal" hours of work per year in each country (excluding overtime, vacations, holidays, etc.). Normal hours range from 1,758 in Denmark to 2,418 in Kenya. Then we assume that firms need to increase the hours worked by their employees from 1,758 to 2,418 hours during one year. A firm first increases the number of hours worked until it reaches the country's maximum normal hours of work, and then uses overtime. If existing employees are not allowed to increase the hours worked to 2,418 hours in a year, perhaps because overtime is capped, we assume the firm doubles its workforce and each worker is paid 1,758 hours, doubling the wage bill of the firm. The cost of increasing hours worked is computed as the ratio of the final wage bill to the initial one.
Cost of firing workers	Measures the cost of firing 20 percent of the firm's workers (10 percent are fired for redundancy and 10 percent without cause). The cost of firing a worker is calculated as the sum of the notice period, severance pay, and any mandatory penalties established by law or mandatory collective agreements for a worker with three years of tenure with the firm. If dismissal is illegal, we set the cost of firing equal to the annual wage. The new wage bill incorporates the normal wage of the remaining workers and the cost of firing workers. The cost of firing workers is computed as the ratio of the new wage bill to the old one.
Dismissal procedures	Measures worker protection granted by law or mandatory collective agreements against dismissal. It is the average of the following seven dummy variables which equal one: (1) if the employer must notify a third party before dismissing more than one worker; (2) if the employer needs the approval of a third party prior to dismissing more than one worker; (3) if the employer must notify a third party before dismissing one redundant worker; (4) if the employer needs the approval of a third party to dismiss one redundant worker; (5) if the employer must provide relocation or retraining alternatives for redundant employees prior to dismissal; (6) if there are priority rules applying to dismissal or layoffs; and (7) if there are priority rules applying to reemployment.
Employment laws index	**Measures the protection of labor and employment laws as the average of: (1) Alternative employment contracts; (2) Cost of increasing hours worked; (3) Cost of firing workers; and (4) Dismissal procedures.**

Appendix 2b: Key Changes to South Korean labor laws (1996-1998)

Source: Kim (1998), Table 3

Clause	Old labor laws	Laws enacted by NKP (December 1996)	Revised labor laws (March 1987)	New Labor Laws (February 1998)
Flexible work hours	Prohibited except in a few industries	Ban is lifted	No further change	No further change
Flexible layoffs	No clause; handled by court cases	Permitted flexible layoffs to cope with changing economic conditions, improve productivity, and adopt new technologies	Permitted only under corporate emergency; enforcement delayed for two years	Immediate implementation of the flexible layoffs
Hiring substitute workers during disputes	Prohibited	Allows employers to substitute striking workers and seek new sub-contractors	Allows employers to fill job slots vacated by striking workers with other striking workers in the same company but prohibits new sub-contractors	Allows hiring substitute workers for professional position for up to two pears, for manual positions for up to six months
No work, no pay	No clause	Employers are banned from paying workers who participate in strikes	Employers have no obligation to compensate the wage losses incurred by strikes	No further change
Multiple unions	Prohibited	Allows multiple unions from the year 2000 at the industry and national levels and from the year 2002 at the plant level	Allows multiple unions immediately at the industry and national levels	No further change
Third party intervention	Prohibited	Ban is lifted	No further change	No further change
Union's political activities	Prohibited	Ban is lifted, but restrictions by election laws exist	Practically no change	Practically no restrictions (election laws revised in April 1998)

Figure 1: Index of regulation of affecting labor hiring and firing flexibility.

This graph shows the index of labor regulation from Botero, Djankov, La Porta, Lopez-de-Silanes and Shleifer (2004). Larger values indicate less flexibility in hiring and firing regular and temporary workers.

Table 1: Regression results from simulated data

The dependent variable is log labor cost from simulated datasets. The adjustment cost parameter *c* varies from 0 to 1 in 44 equal increments in the quadratic case, and from 0 to 8 periods' (weeks) wage in 44 equal increments in the asymmetric case as well as the fixed cost case. Standard errors are clustered at the regime (country) level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	Zero adjustment costs		**Symmetric quadratic adjustment costs**		**Asymmetric linear adjustment costs**		**Fixed (lump-sum) adjustment costs**	
Log (Revenue)	0.984	0.984	0.473	0.472	0.403	0.402	0.764	0.763
	[0.000]**	[0.000]**	[0.075]**	[0.075]**	[0.110]**	[0.110]**	[0.075]**	[0.075]**
Log (Lagged labor)	0.000	0.000	0.116	0.105	-0.019	-0.039	-0.023	-0.028
	[0.000]	[0.000]	[0.053]*	[0.052]*	[0.008]*	[0.012]**	[0.010]*	[0.010]*
Adjustment cost X Log (Revenue)	0.000	0.000	-0.013	-0.013	-0.013	-0.013	-0.024	-0.024
	[0.000]	[0.000]	[0.003]**	[0.003]**	[0.004]**	[0.004]**	[0.003]**	[0.003]**
Adjustment cost X Log (Lagged labor)	0.000	0.000	0.023	0.024	0.075	0.077	0.021	0.019
	[0.000]	[0.000]	[0.003]**	[0.003]**	[0.005]**	[0.005]**	[0.002]**	[0.002]**
Constant	-1.529	-1.529	-0.623	-0.600	1.157	1.211	-0.951	-1.012
	[0.000]**	[0.000]**	[0.051]**	[0.058]**	[0.159]**	[0.164]**	[0.076]**	[0.074]**
Fixed Effects	Outlet	Outlet-year-season	Outlet	Outlet-year-season	Outlet	Outlet-year-season	Outlet	Outlet-year-season
Observations	351,000	351,000	351,000	351,000	351,000	351,000	351,000	351,000
R-squared	1.000	1.000	0.790	0.790	0.540	0.550	0.760	0.770
Adjusted R-squared	0.999	0.999	0.790	0.794	0.540	0.553	0.760	0.767
Number of clusters	45	45	45	45	45	45	45	45

Table 2: Summary statistics

For comparability, labor cost, material cost and revenue are expressed in rescaled U.S. dollars, where the U.S. dollars were obtained originally using the average of the weekly exchange rates (reported in the Company dataset) for the year. The index of labor regulation is from Botero et al. (2004). The index of hiring/firing inflexibility is constructed using data from the 2002 Global Competitiveness Survey. The summary statistics are reported for the subsample of the dataset that appears in our baseline analyses (i.e., observations for which we have data on labor costs, lagged labor costs, revenue and the Botero et al., 2004) index of labor regulation. In Panel A, column 2 of the last row reports the total number of distinct outlets and column 3 shows the total number of distinct countries appearing at some point in the dataset during the four years of our data.

Panel A: Panel data characteristics

Year	Number of observations	Number of outlets	Number of countries
2000	78,960	1,718	39
2001	85,109	1,828	37
2002	74,200	2,147	38
2003	82,305	1,938	37
Total	320,574	2,525	43

Panel B: Summary statistics (variables in logs)

Variable	N	Mean	SD	P25	Median	P75	Min	Max
Log (Labor cost)	320,574	7.19	0.85	6.71	7.27	7.78	-5.05	10.25
Log (Revenue)	320,574	8.84	0.69	8.46	8.90	9.32	2.85	11.50
Log (Material cost)	317,299	7.72	0.66	7.37	7.78	8.15	-4.87	10.94

Panel C: Summary statistics (variables in levels)

Variable	N	Mean	SD	P25	Median	P75	Min	Max
Labor cost	320,574	1796.77	1385.11	819.82	1434.39	2391.41	0.01	28219.16
Revenue	320,574	8474.32	5303.07	4728.97	7329.44	11149.54	17.30	98668.13
Material cost	317,299	2703.80	1622.21	1590.20	2393.39	3478.32	0.01	56580.45
Index of labor regulation	320,574	0.41	0.16	0.26	0.44	0.57	0.16	0.83
Index of hiring/firing inflexibility	318,128	0.56	0.13	0.42	0.53	0.66	0.33	1.00

Table 3: Labor regulation and labor demand hysteresis

The dependent variable is the log of labor cost per week for each outlet. "Regulation" is the Botero et al. (2004) index of labor regulation, a measure of the rigidity of the labor market. Standard errors are clustered at the country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)	(4)	(5)	(6)
Log (Revenue)	0.326	0.352	0.388	0.573	0.558	0.554
	[0.052]**	[0.047]**	[0.046]**	[0.071]**	[0.050]**	[0.050]**
Log (Lagged labor cost)	0.535	0.361	0.200	0.081	-0.030	-0.087
	[0.071]**	[0.070]**	[0.059]**	[0.141]	[0.106]	[0.092]
Regulation X Log (Revenue)				**-0.569**	**-0.487**	**-0.406**
				[0.145]**	**[0.102]****	**[0.109]****
Regulation X Log (Lagged labor)				**1.021**	**0.918**	**0.703**
				[0.291]**	**[0.222]****	**[0.206]****
Constant	0.463	1.483	2.318	0.635	1.569	2.344
	[0.251]+	[0.403]**	[0.469]**	[0.231]**	[0.315]**	[0.369]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season	Outlet	Outlet-year	Outlet-year-season
Observations	320,574	320,574	320,574	320,574	320,574	320,574
R-squared	0.940	0.950	0.960	0.950	0.950	0.960
Adjusted R-squared	0.943	0.950	0.958	0.945	0.952	0.959
Number of clusters	43	43	43	43	43	43

Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Regulation = mean (0.41)	23.44%	24.72%	26.74%
At Regulation = mean + sd (0.41+0.16=0.57)	17.16%	19.35%	22.26%
Impact of increase in Regulation	-6.28%	-5.38%	-4.48%
Effect of a one standard deviation (0.85) increase in Log (Lagged labor)			
At Regulation = mean (0.41)	42.47%	29.44%	17.10%
At Regulation = mean + sd (0.41+0.16=0.57)	56.35%	41.93%	26.67%
Impact of increase in Regulation	13.89%	12.48%	9.56%

Table 4: Robustness to alternative measure of labor market flexibility

The dependent variable is the log of labor cost per week for each outlet. "Inflexibility" is the index of hiring/firing inflexibility, a measure of the rigidity of the labor market constructed using data from the 2002 Global Competitiveness Survey. Standard errors are clustered at the country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)
Log (Revenue)	0.765	0.783	0.776
	[0.155]**	[0.141]**	[0.162]**
Log (Lagged labor cost)	-0.020	-0.138	-0.181
	[0.225]	[0.185]	[0.152]
Inflexibility X Log (Revenue)	**-0.739**	**-0.723**	**-0.650**
	[0.219]**	**[0.216]****	**[0.261]***
Inflexibility X Log (Lagged labor)	**0.991**	**0.917**	**0.720**
	[0.333]**	**[0.294]****	**[0.243]****
Constant	0.250	1.151	1.941
	[0.240]	[0.317]**	[0.365]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
Observations	337,128	337,128	337,128
R-squared	0.950	0.950	0.960
Adjusted R-squared	0.948	0.955	0.961
Number of clusters	48	48	48

Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Inflexibility = mean (0.56)	24.23%	26.09%	28.43%
At Inflexibility = mean + sd (0.56+0.13=0.69)	17.60%	19.60%	22.60%
Impact of increase in Inflexibility	-6.63%	-6.49%	-5.83%
Effect of a one standard deviation (0.85) increase in Log (Lagged labor)			
At Inflexibility = mean (0.56)	45.47%	31.92%	18.89%
At Inflexibility = mean + sd (0.56+0.13=0.69)	56.42%	42.05%	26.84%
Impact of increase in Inflexibility	10.95%	10.13%	7.96%

Table 5: Robustness check: Labor regulation and hysteresis in material inputs

The dependent variable is the log of material cost per week for each outlet. "Regulation" is the Botero et al. (2004) index of labor regulation, a measure of the rigidity of the labor market. Standard errors are clustered at the country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)	(4)	(5)	(6)
Log (Revenue)	0.846	0.899	0.942	0.861	0.901	0.973
	[0.030]**	[0.021]**	[0.009]**	[0.072]**	[0.053]**	[0.022]**
Log (Lagged materials cost)	0.164	0.115	0.034	0.249	0.182	0.067
	[0.043]**	[0.042]**	[0.022]	[0.113]*	[0.114]	[0.069]
Regulation X Log (Revenue)				**-0.022**	**0.000**	**-0.072**
				[0.138]	**[0.091]**	**[0.044]**
Regulation X Log (Lagged materials cost)				**-0.209**	**-0.165**	**-0.081**
				[0.202]	**[0.199]**	**[0.131]**
Constant	-1.015	-1.110	-0.856	-1.032	-1.100	-0.846
	[0.117]**	[0.166]**	[0.182]**	[0.086]**	[0.132]**	[0.139]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season	Outlet	Outlet-year	Outlet-year-season
Observations	361,246	361,246	361,246	361,246	361,246	361,246
R-squared	0.950	0.950	0.960	0.950	0.950	0.960
Adjusted R-squared	0.947	0.952	0.960	0.947	0.952	0.960
Number of clusters	43	43	43	43	43	43

	(4)	(5)	(6)
Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Regulation = mean (0.41)	58.79%	62.17%	65.10%
At Regulation = mean + sd (0.41+0.16=0.57)	58.54%	62.17%	64.31%
Impact of increase in Regulation	-0.24%	0.00%	-0.79%
Effect of a one standard deviation (0.66) increase in Log (Lagged materials cost)			
At Regulation = mean (0.41)	10.78%	7.55%	2.23%
At Regulation = mean + sd (0.41+0.16=0.57)	8.57%	5.80%	1.37%
Impact of increase in Regulation	-2.21%	-1.74%	-0.86%

Table 6: Robustness check: GMM (levels) results

The dependent variable is the log of labor cost per week for each outlet. "Regulation" is the Botero et al. (2004) index of labor regulation, a measure of the rigidity of the labor market. First differences of the instruments are used in the levels equations. Two-step, robust standard errors are reported in braces. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)
Log (Revenue)	0.969
	[0.135]**
Log (Lagged labor cost)	-0.233
	[0.186]
Regulation X Log (Revenue)	**-2.586**
	[0.666]**
Regulation X Log (Lagged labor)	**2.987**
	[0.828]**
Constant	0.998
	[0.843]
Observations	320,574
Hansen J p-value	0.1100
AR1 test	0.0000
AR7 test	0.4416
AR8 test	0.8911

<u>Instrumented</u> -- Log (Lagged labor cost), Regulation X Log (Lagged labor), Log (Revenue), Regulation X Log (Revenue)

<u>Instruments</u> (IV style) -– Lags 7 and 8 of Log (Lagged labor cost), Regulation X Log (Lagged labor), Log (Revenue), Regulation X Log (Revenue).

Table 7a: Robustness check: Difference-in-difference comparison of top and bottom deciles of the change in Index of Inflexibility between 2002 and 2004

The sample here is all the observations in the top decile and bottom decile of the change in index of hiring/firing inflexibility between the 2002 and 2004 Global Competitiveness Surveys. "Inf_p90 dummy " equals 1 for the countries that belonged to the top decile of the change in inflexibility index, i.e. the countries with the largest increases in inflexibility. The years are restricted to 2002 and 2003. Standard errors are clustered at store level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	LABOR		MATERIALS	
	(1)	(2)	(3)	(4)
Log (Revenue)	-0.008	0.198	0.879	0.922
	[0.035]	[0.051]**	[0.025]**	[0.022]**
Log (Lagged labor cost)	0.673	0.353	0.14	0.052
	[0.041]**	[0.045]**	[0.026]**	[0.020]*
Year 2003	-0.966		-0.415	
	[0.372]*		[0.179]*	
Year 2003 X Log (Revenue)	0.395	0.354	1.421	
	[0.045]**	[0.071]**	[0.275]**	
Year 2003 X Log (Lagged labor)	-0.349	-0.205	0.018	0.023
	[0.043]**	[0.049]**	[0.052]	[0.051]
Inf_p90 dummy X Year 2003	1.256		0.073	0.051
	[0.484]*		[0.052]	[0.046]
Inf_p90 dummy X Log (Revenue)	0.317	0.057	0.016	0.035
	[0.122]*	[0.122]	[0.031]	[0.023]
Inf_p90 dummy X Log (Lagged labor)	-0.151	-0.159	0.039	0.025
	[0.116]	[0.157]	[0.030]	[0.025]
Inf_p90 dummy X Year 2003 X Log (Revenue)	**-0.574**	**-0.413**	-0.19	-0.104
	[0.097]**	**[0.135]****	[0.065]**	[0.065]
Inf_p90 dummy X Year 2003 X Log (Lagged labor)	**0.508**	**0.378**	0.049	0.053
	[0.116]**	**[0.163]***	[0.064]	[0.052]
Constant	1.666	1.893	-1.226	-1.042
	[0.248]**	[0.261]**	[0.149]**	[0.094]**
Fixed effects	Outlet	Outlet-year-season	Outlet	Outlet-year-season
Observations	10,339	10,339	10407	10407
R-squared	0.800	0.840	0.97	0.98
Adjusted R-squared	0.799	0.839	0.974	0.981
Number of clusters	125	125	125	125

Table 7b: Robustness check: Case study of labor reform in South Korea (1996-98)

This table examines changes in South Korea following labor reforms that increased labor market flexibility. The sample includes the years 1994 and 1995 (pre-reform years) and years 1999 and 2000 (post-reform years). "POST_REFORM" is a dummy equal to one for the post reform years (1999 and 2000). D_KOREA is a dummy equal to 1 for South Korea. The sample in the before-after regressions includes only South Korea, while the difference-in-difference regressions sample includes other Asian countries in the Asia-Pacific region. Standard errors are clustered at store level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	BEFORE-AFTER				DIFFERENCE-IN-DIFFERENCES			
	LABOR		MATERIALS		LABOR		MATERIALS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log (Revenue)	0.205	0.16	0.719	0.822	0.462	0.551	0.951	0.961
	[0.034]**	[0.041]**	[0.034]**	[0.026]**	[0.013]**	[0.013]**	[0.010]**	[0.010]**
Log (Lagged input cost)	0.766	0.27	0.33	0.122	0.271	0.078	0.079	0.026
	[0.049]**	[0.058]**	[0.039]**	[0.024]**	[0.022]**	[0.017]**	[0.009]**	[0.008]**
POST_REFORM X Log (Revenue)	**0.335**	**0.574**	0.032	0.04	-0.17	-0.156	-0.04	0.003
	[0.043]**	**[0.049]****	[0.036]	[0.035]	[0.014]**	[0.014]**	[0.012]**	[0.013]
POST_REFORM X Log (Lagged input)	**-0.404**	**-0.128**	-0.023	-0.018	0.194	0.101	0.051	0.015
	[0.053]**	**[0.064]***	[0.043]	[0.029]	[0.016]**	[0.022]**	[0.014]**	[0.013]
D_KOREA X Log (Revenue)					-0.257	-0.391	-0.233	-0.139
					[0.037]**	[0.043]**	[0.035]**	[0.028]**
D_KOREA X Log (Lagged input)					0.495	0.192	0.251	0.097
					[0.054]**	[0.060]**	[0.040]**	[0.025]**
D_KOREA X POST_REFORM X Log (Revenue)					**0.505**	**0.73**	0.072	0.036
					[0.045]**	**[0.050]****	[0.038]+	[0.037]
D_KOREA X POST_REFORM X Log (Lagged input)					**-0.598**	**-0.229**	-0.075	-0.033
					[0.056]**	**[0.067]****	[0.046]	[0.031]
Constant	-0.128	0.512	-1.242	-0.713	1.145	2.157	-1.437	-1.125
	[0.096]	[0.145]**	[0.100]**	[0.137]**	[0.104]**	[0.085]**	[0.053]**	[0.056]**
	Outlet	Outlet-year-season	Outlet	Outlet-year-season	Outlet	Outlet-year-season	Outlet	Outlet-year-season
Observations	15,071	15,071	15,099	15,099	72,070	72,070	71,937	71,937
R-squared	0.850	0.890	0.940	0.960	0.980	0.980	0.97	0.980
Adjusted R-squared	0.854	0.894	0.944	0.963	0.977	0.984	0.97	0.978
Number of clusters	152	152	152	152	597	597	596	596

Table 8: Estimates of the dampening factor

The dampening factor is the ratio of actual changes in labor costs to the change that would have occurred in the absence of adjustment costs.

Estimate of a_0		Estimate of a_1		Dampening factor estimate Regulation Percentile		
Basis	Estimate	Basis	Estimate	P25	P50	P75
Panel 1: Using index of labor regulation (Botero et al., 2004) and results from Table 3, column 3						
Coefficient on Log (Lagged labor cost)	-0.087	Coefficient on Regulation X Lagged Labor	0.703	0.904	0.778	0.686
1 - Coefficient on Log (Revenue)	0.446	-(Coefficient on Regulation X Revenue)	0.406	0.448	0.375	0.323
Average of above	0.180	Average of above	0.555	0.676	0.577	0.504
Panel 2: Using index of inflexibility in hiring and firing (2002 GCS) and results from Table 4, column 3						
Coefficient on Log (Lagged labor cost)	-0.181	Coefficient on Regulation X Lagged Labor	0.720	0.879	0.799	0.706
1 - Coefficient on Log (Revenue)	0.224	-(Coefficient on Regulation X Revenue)	0.650	0.503	0.432	0.347
Average of above	0.0215	Average of above	0.685	0.691	0.615	0.526

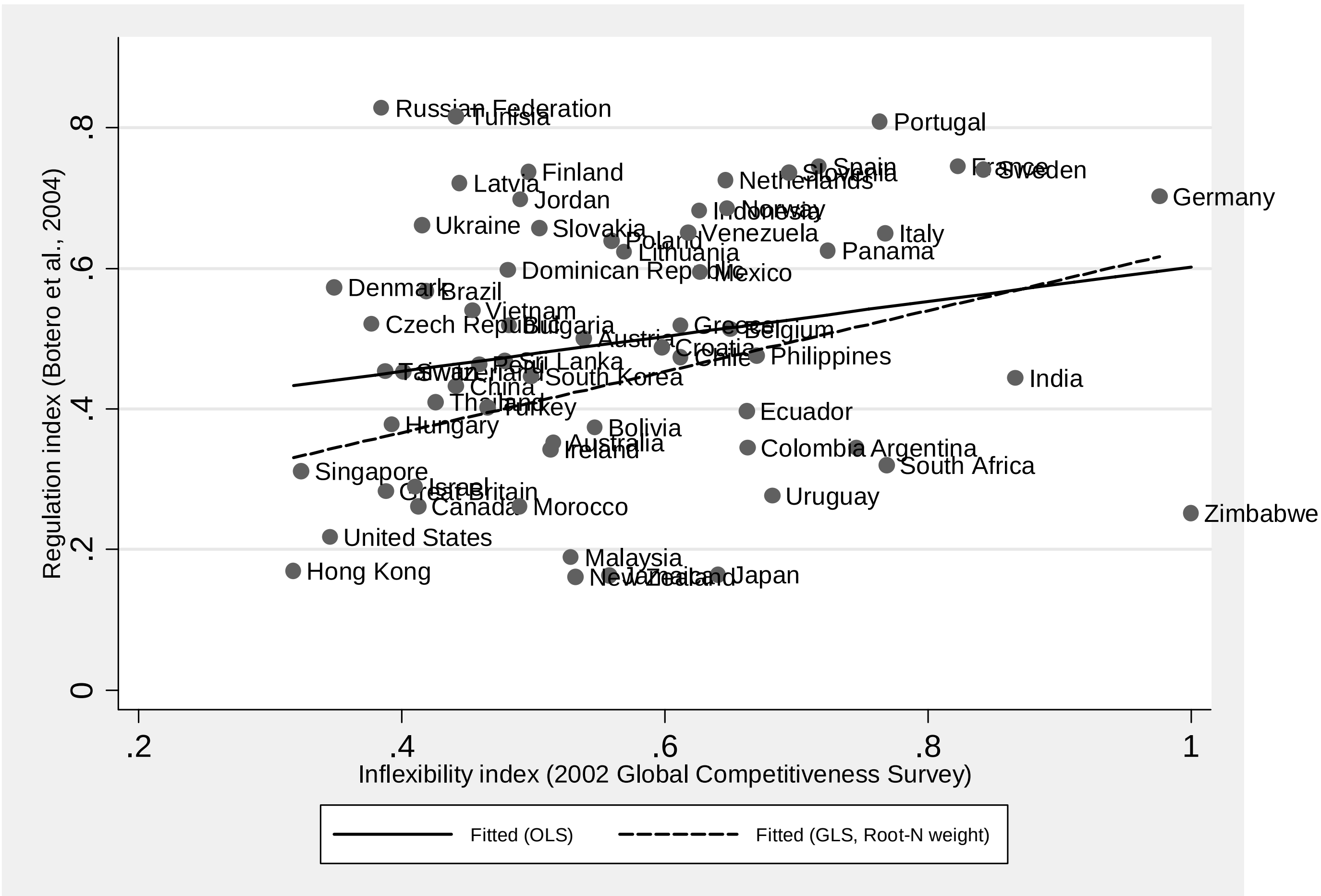
Table 9: Labor regulation and international expansion

Columns 1 and 2 report estimated coefficients (not exponentiated) from a Cox proportional hazard model where "failure" is defined as entry into a country. The sample for these columns is weekly observations for the period from the time of first entry in a foreign market to 2003 for all countries (including countries that the Company never entered) for which we have data on all the variables. Columns 3 and 4 report results from an OLS with year fixed effects model, where the dependent variable is the number of outlets in the country. The sample for these columns is weekly observations for countries that the firm has entered within our data period. The index of labor regulation is obtained from Botero et al. (2004). The index of hiring/firing inflexibility is constructed using data from the 2002 Global Competitiveness Survey. Standard errors are clustered at country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)	(4)
Dependent variable	Entry	Entry	Number of outlets	Number of outlets
Log (Real GDP per capita)	1.319	0.561	27.242	19.239
	[0.282]**	[0.281]*	[9.599]**	[8.056]*
Log (Population)	0.872	0.532	25.718	22.844
	[0.123]**	[0.107]**	[6.825]**	[6.632]**
Log (Distance to USA in kms)	-1.647	-1.543	-42.139	-39.841
	[0.356]**	[0.304]**	[12.915]**	[10.977]**
English language dummy	0.353	0.582	5.398	16.789
	[0.370]	[0.445]	[15.736]	[15.434]
Log (Time to start a business, 2003)	0.003	-0.268	-15.895	-17.576
	[0.337]	[0.279]	[7.803]*	[6.818]*
Index of labor regulation	-3.676		-81.816	
	[1.049]**		[38.145]*	
Index of hiring/firing inflexibility		0.007		-33.802
		[1.161]		[36.651]
Constant			-18.033	51.796
			[130.568]	[103.250]
Observations	48820	41844	20264	23411
Log likelihood	-135.027	-166.085		
Number of clusters	68	65	44	50
Adjusted R-squared			0.472	0.443

Appendix 3

Figure A.1: Index of labor regulation (Botero et al., 2004) versus index of hiring/firing inflexibility (2002 Global Competitiveness Survey)



Appendix 4

Table A.1: Robustness check: labor regulation and hysteresis in material inputs, alternative measure of labor regulation

The dependent variable is the log of material cost per week for each outlet. "Inflexibility" is the index of hiring/firing inflexibility, constructed using data from the 2002 Global Competitiveness Survey. Standard errors clustered at the country level. * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)
Log (Revenue)	0.856	0.876	0.937
	[0.117]**	[0.085]**	[0.050]**
Log (Lagged materials cost)	0.215	0.155	0.009
	[0.170]	[0.172]	[0.082]
Inflexibility X Log (Revenue)	**0.001**	**0.052**	**0.015**
	[0.171]	**[0.122]**	**[0.076]**
Inflexibility X Log (Lagged materials cost)	**-0.093**	**-0.075**	**0.046**
	[0.260]	**[0.258]**	**[0.132]**
Constant	-1.087	-1.130	-0.888
	[0.125]**	[0.164]**	[0.178]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
Observations	377,883	377,883	377,883
R-squared	0.950	0.960	0.960
Adjusted R-squared	0.952	0.957	0.964
Number of clusters	48	48	48

Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Inflexibility = mean (0.56)	59.10%	62.45%	65.23%
At Inflexibility = mean + sd (0.56+0.13=0.69)	59.11%	62.92%	65.37%
Impact of increase in Inflexibility	0.01%	0.47%	0.13%
Effect of a one standard deviation (0.66) increase in Log (Lagged materials cost)			
At Inflexibility = mean (0.56)	10.75%	7.46%	2.29%
At Inflexibility = mean + sd (0.56+0.13=0.69)	9.95%	6.81%	2.69%
Impact of increase in Inflexibility	-0.80%	-0.64%	0.39%

Appendix 4

Table A.2: Robustness check: GMM (levels), alternative measure of labor regulation

The dependent variable is the log of labor cost per week for each outlet. "Inflexibility" is the index of hiring/firing inflexibility, constructed using data from the 2002 Global Competitiveness Survey. First differences of the instruments are used in the levels equations. Two-step, robust standard errors are reported in braces. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)
Log (Revenue)	0.63
	[0.213]**
Log (Lagged labor cost)	0.085
	[0.241]
Inflexibility X Log (Revenue)	**-1.064**
	[0.343]**
Inflexibility X Log (Lagged labor)	**1.495**
	[0.420]**
Constant	0.28
	[0.483]
Observations	309,038
Hansen J p-value	0.6000
AR1 test	0.0000
AR7 test	0.2139
AR8 test	0.3497

Instrumented -- Log (Lagged labor cost), Regulation X Log (Lagged labor), Log (Revenue), Regulation X Log (Revenue)

Instruments – (GMM style) Lags 7 and 8 of Log (Lagged labor cost), [Inflexibility X Log (Lagged labor cost)], Log (Revenue), [Inflexibility X Log (Revenue)], Log (Material cost), [Inflexibility X Log (Material cost)] (12 instruments)

Appendix 4

Table A.3 Robustness check: Other GMM specifications

The dependent variable is the log of labor cost per week for each outlet. "Regulation" is the Botero et al. (2004) index of labor regulation, a measure of the rigidity of the labor market. Levels of the instruments are used in the difference equations, and first differences of the instruments are used in the levels equations. In system GMM both the difference and levels equations are used. Two-step, robust standard errors are reported in braces. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	Level GMM	System GMM	Difference GMM
	(3)	(1)	(2)
Log (Revenue)	0.697	0.681	2.328
	[0.159]**	[0.125]**	[0.389]**
Log (Lagged labor cost)	0.493	0.016	-0.608
	[0.209]*	[0.145]	[0.187]**
Regulation X Log (Revenue)	**-1.423**	**-1.092**	**-5.792**
	[0.403]**	**[0.290]****	**[1.196]****
Regulation X Log (Lagged labor)	**1.140**	**1.072**	**2.233**
	[0.480]*	**[0.328]****	**[0.615]****
Constant	-0.654	1.892	5.526
	[0.700]	[0.332]**	[1.540]**
Observations	320,574	320,574	320,574
Hansen J p-value	0.0000	0.0000	0.5100
AR1 test	0.0000	0.0000	0.0000
AR3 test	0.0269	0.0173	0.0001
AR4 test	0.0008	0.0003	0.0006

Instrumented -- Log (Lagged labor cost), Regulation X Log (Lagged labor), Log (Revenue), Regulation X Log (Revenue)

Instruments:

(GMM style) -- Lags 3 to 4 of Log (Lagged labor cost), [Regulation X Lagged labor], Log (Revenue), [Regulation X Log (Revenue)] (8 instruments)