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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 about 2,840 retail outlets in 43 countries outside the United States. The dataset provides information on output, input costs and labor costs at a weekly frequency over a 4-year period, 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 an increase in gross misallocation of labor ranging from 2 to 10 percent of total labor costs, for an increase in the index of labor regulation from the 25th to the 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.

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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 For example, a recent proposed relaxation of firing rules for younger workers in France had to be withdrawn in the face of mass demonstrations.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 amount of such 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 a 4-year period.

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 other 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 employment decisions 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]Anderson (1993), however, used weekly payroll data, and Hamermesh (1989) used monthly establishment-level data.

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

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 for three different types of commonly used adjustment cost specifications : (1) symmetric quadratic adjustment costs; (2) asymmetric linear adjustment costs; and (3) fixed (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 26.81 percent to 22.33 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 17.02 per cent to 26.58 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.

To test the robustness of our results to potential biases, we adopt two strategies. First, we run the same specification for materials cost. We find that, unlike for the labor cost specification, the interaction terms are statistically insignificant and have a very small economic magnitude in the materials cost specification. Second, we adopt an instrumental variables approach drawn from the literature (e.g., Arellano and Bond, 1991), using lags of endogenous variables as well as of materials costs as instruments. Our instrumental variables (IV) approach yields larger (and sharper) estimates of the coefficient on the interaction terms, suggesting that biases possibly attenuate the estimates in our baseline specification.[4]

may 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.

[4]The Global Competitiveness Survey was also undertaken in 2004. This provides us with some limited variation in the inflexibility index over time within countries. We find that for the quartile of countries where the index shows the largest increase between 2002 and 2004, the elasticity of labor with respect to revenue and lagged labor decrease and increase respectively, as predicted by our theory (see Appendix Table

We then use results from our baseline regressions to estimate the parameters of our underlying model, and the implied dampening of adjustments and 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 0.51 at the 75th percentile of the labor regulation index. Defining gross misallocation of labor as the absolute difference between the implied log optimal labor level and the actual log labor level and regressing this gross misallocation on the index of labor regulation, we find that gross misallocation of labor increases by 1.90 to 10.48 percent for an increase in the index of labor regulation from the 25th to the 75th percentile.

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.[5]

The rest of the paper is organized as follows. Section 2 describes briefly 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.

A.3, and discussion in Section 5.2).

[5] 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).

2 Theory and econometric specification

In this study, 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). In theory, if the national labor regulations/institutions captured by these indices have an impact on the day-to-day operations of firms, we expect the impact to be analogous to an increase in the adjustment costs for labor.

A standard test for the presence of labor adjustment costs in the literature is to examine 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.[6]

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.

Figure 2 presents a crude test of the latter prediction. This figure presents the correlation between week-to-week changes in labor cost and changes in revenue by country against the two indices of labor regulation. We find that the correlation is significantly lower in countries with more rigid labor laws. As a benchmark, we look at the correlation between changes in material cost and revenue. We find that this correlation, in contrast, is not reduced significantly for countries with high compared to low levels of labor regulation. Figure 2 thus suggests that labor laws indeed affect the labor choice decisions made by the Company's outlets.[7]

To develop an econometric framework to more carefully address the relationship between labor costs and output, and to formalize the intuitive predictions set forth above, 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).

[6]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 results in Section 2.2).

[7]Note that the fitted line is a GLS estimate, with weights equal to the square root of the number of observations in each country (to reflect differences in the precision of the estimated correlations across different countries).

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 its level of labor used, and M_t represents materials used. 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.[8]

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.[9] The outlet's profit function is given by:

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

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 (i.e., elasticity of supply is infinite), the exogenous variables in the model are the production function parameters (α and β), productivity (Θ_t), output demand elasticity (μ), demand shifters (Λ_t) and the input prices (W_t and S_t). First-order conditions yield optimal labor and materials input demand functions in terms of these exogenous variables as follows:

$$l_t^* = \frac{1}{1-\alpha^{'}-\beta^{'}}\left\{(1-\beta^{'})\log\alpha^{'} + \beta^{'}\log\beta^{'} + \phi_t - (1-\beta^{'})w_t - \beta^{'}s_t\right\} \tag{1}$$

$$m_t^* = \frac{1}{1-\alpha^{'}-\beta^{'}}\left\{\alpha^{'}\log\alpha^{'} + (1-\alpha^{'})\log\beta^{'} + \phi_t - \alpha^{'}w_t - (1-\alpha^{'})s_t\right\}, \tag{2}$$

where the small cap variables are the logarithms of the corresponding large cap variables (i.e., $l_t = \log L_t, m_t = \log M_t, w_t = \log W_t$, and $s_t = \log S_t$), $\phi_t = \log\left(\Lambda_t \Theta_t^{\left(1+\frac{1}{\mu}\right)}\right)$, $\alpha^{'} = \alpha(1+\frac{1}{\mu})$, and $\beta^{'} = \beta(1+\frac{1}{\mu})$. Equilibrium output is given by:

$$q_t^* = \frac{1}{1-\alpha^{'}-\beta^{'}}\left\{\alpha\log\alpha^{'} + \beta\log\beta^{'} + (\alpha+\beta)\lambda_t + \theta_t - \alpha w_t - \beta s_t\right\}, \tag{3}$$

[8] 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, $\Theta_t = \Theta_t^{'} K_t^{\gamma}$.

[9] 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 $q_t = \log Q_t$, $\theta_t = \log \Theta_t$, and $\lambda_t = \log \Lambda_t$.

The input demand equations 1 and 2 can be expressed conditional on output (sales revenue) and input prices as follows:

$$l_t^* = \log \alpha' + r_t - w_t \tag{4}$$
$$m_t^* = \log \beta' + r_t - s_t, \tag{5}$$

where $r_t = \log(P_t Q_t)$ represents sales revenue. Since input prices and quantities are not separately observable in our data (see discussion in 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:

$$b_t^* = \log \alpha' + r_t \tag{6}$$
$$f_t^* = \log \beta' + r_t. \tag{7}$$

Equations 6 and 7 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:[10]

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

where $\gamma_o > 0$. Thus this cost increases 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, there is a cost of adjustment that we also assume 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:

$$\begin{aligned} b_t &= \frac{\gamma_o}{\gamma_a^j + \gamma_o} b_t^* + \frac{\gamma_a^j}{\gamma_a^j + \gamma_o} b_{t-1} \\ &= (1 - \omega^j) b_t^* + \omega^j b_{t-1}, \end{aligned} \tag{8}$$

[10]This is a convenient simplifying assumption to make 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 6 and 8 yields:

$$\begin{aligned} b_t &= (1-\omega^j)\left\{\log\alpha' + r_t\right\} + \omega^j b_{t-1} \\ &= (1-\omega^j) r_t + \omega^j b_{t-1} + (1-\omega^j)\log\alpha'. \end{aligned} \tag{9}$$

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 9 yields the following econometric specification:

$$\begin{aligned} b_{it} &= (1 - a_0 - a_1\tau^j) r_{it} + (a_0 + a_1\tau^j) b_{i,t-1} + (1 - a_0 - a_1\tau^j)\log\alpha' \\ &= \beta r_{it} + \gamma b_{i,t-1} + \delta_r \tau^j r_{it} + \delta_b \tau^j b_{i,t-1} + \eta_{is} + \varepsilon_{it}, \end{aligned} \tag{10}$$

where b_{it} represents log labor cost, and r_{it} is log revenue, for outlet i in period t, and 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 $\delta_b = a_1 > 0$.[11] Thus our model predicts that if the 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 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.

[11] 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.

The details of the stochastic dynamic model and the simulation procedure are discussed in Appendix 1. We choose the three alternative adjustment cost specifications to address issues raised in the literature (see 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 as 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; (3) asymmetric, linear adjustment costs; and (4) non-convex (fixed or lump sum) adjustment costs. For each scenario, we choose 45 different adjustment cost regimes and simulate data for 75 firms over 104 periods (corresponding to two years of 52 weeks) in each regime, to match our data that has information on all relevant variables for about 45 countries, and a total sample size of about 350,000.[12] In all the scenarios, we assume the demand and productivity shock processes are iid across firms and over time. We then run a regression specification equivalent to equation 10 using the simulated data (see Appendix 2, Section D for details) for each of the four scenarios. The results are presented 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.[13] 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

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

[13] This result is of course unsurprising given the setup of the model and lack of adjustment costs in this scenario. The small discrepancy from one arises because the optimal labor choices are rounded to increments of 0.2 when we solve for the optimal policy function.

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 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 an international fast-food chain, which operates in over 43 countries around the world. 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 for the 4-year period 2000-2003.[14]

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. The different components that make up this index are detailed in Appendix 2. Since a common basis is used to evaluate the laws across all countries, this index has the advantage of being comparable across countries.

One potential disadvantage of this 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 practice some non-regulatory factors, such as the strength of labor unions, for example, could affect the flexibility in hiring and firing. For these reasons, we rely on data from the 2002 Global Competitiveness Survey to generate an alternative measure that captures the operational reality relating to the flexibility in hiring and firing faced by businesses.[15] This survey polls executives regarding business conditions around the world. One of the questions asked is whether the hiring and firing of workers is impeded

[14] Our data excludes the United States, where the Company is headquartered. The Company actually operated in over 55 countries during the period of the study. However, data availability constraints limit our sample to 43 to 48 countries for most of our analyses.

[15] The survey is used to prepare the *Global Competitiveness Report (GCR)*, which is 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 this data.

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.[16]

A scatter plot of our two measures of labor market regulation and flexibility 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.

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 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.[17]

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.[18]

[16]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.) A truly standardized and comparable index could be constructed if the executives surveyed were able to relatively rank all the countries in the sample. This, however, requires that all respondents have experience of all countries, which is unlikely to occur.

[17]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 thus goes up to 337,129.

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

4 Empirical results: Baseline specification

In our baseline regressions, we examine the specification in equation 10, using the index of labor regulation constructed by Botero et al. (2004). In all our specifications, because the variation in the regulatory index is at the country level, standard errors are clustered at the country level.

Results shown in Table 3 imply that the elasticity of labor demand with respect to revenue is significantly lower in countries with greater measured rigidity in labor regulation, as predicted by theory. Also consistent with the theory, we find evidence of greater hysteresis (a greater elasticity of labor demand in period t with respect to labor demand in period $t-1$) in countries with more regulated labor markets. All these effects are 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. Using results from column 1, 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), a one standard deviation 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 5.39 percentage points (a reduction from 24.70 percent to 19.31 percent) under the specification in column 2, which includes outlet-year fixed effects, and 4.48 percentage points (a reduction from 26.81 percent to 22.33 percent) using column 3 estimates which are obtained using outlet-year-season fixed effects.

As to the influence of lagged labor, estimates in column 1 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 2, the estimate is 12.50 percentage points (increased from 29.48 percent to 41.98 percent). Controlling for outlet-year-season fixed effects in column 3 yields an estimated effect of 9.56 percentage points (increased from 17.02 percent to 26.58 percent).

Thus in all the specifications, 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 an elasticity of 17.02 percent at the mean), but is also large for sales revenue (4.48 percent relative to 26.81 percent). We interpret the results as strong evidence that labor market rigidities, measured by the index of labor regulation, have real effects on labor decisions.

As mentioned in Section 3, 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 (see Appendix 2 for details). As we discussed earlier, this index has several advantages, most importantly the fact 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). Of course this index also suffers from some limitations. To address potential concerns with this measure, and in particular concerns associated with potential differences in enforcement levels across countries, we test the robustness of our results with an alternative measure, namely the index of hiring and firing inflexibility constructed from the 2002 Global Competitiveness Survey.

Results obtained with this alternative measure, shown in Table 4, are very consistent with those obtained with the Botero et al. (2004) index. 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, 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 6.64 percentage points (from 24.19 to 17.55 percent) when we include outlet fixed effects, by 6.49 percentage points (from 26.05 to 19.56 percent) when we include outlet-year effects, and by 5.84 percentage points (from 28.39 to 22.55 percent) when we include outlet-year-season fixed effects. The equivalent calculations for lagged labor imply increases of 10.95, 10.13, and 7.97 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 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

To understand the assumptions under which our estimates above correctly identify the parameters of interest, we turn our attention to the error term in equation 10. Defining the full error term as $e_{it} = \eta_{is} + \varepsilon_{it}$, equation 10 implies that:

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

where we again use j to index the country where outlet i is located. As stated, 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, the same outlet-period fixed effects also control for differences in the regulation index (τ^j) across countries.

Unanticipated demand (λ) or supply (productivity) shocks (θ), however, are another potential source of error whose effects we have not considered so far.[19] To understand the effects of such shocks, assume that labor, output price and materials for period t are chosen at some prior time $t-h$. Then the optimal labor cost in equation 9 is based on the expectation, formed at time $t-h$, of what will be optimal output at time t, namely $E_{t-h}[q_t]$. Assume that

$$q_{it} = E_{i,t-h}[q_t] + \epsilon^q_{it},$$

where the prediction error ϵ^q_{it} is orthogonal to the information available at time $t-h$. Then, the error term e_{it} in equation 10 includes the quantity prediction error term. Specifically, equation 9 is modified to:

$$b_{it} = (1-\omega^j)r_{it} + \omega^j b_{it-1} + (1-\omega^j)\log\alpha' - (1-\omega^j)\epsilon^q_{it}. \tag{11}$$

If, as mentioned above, price also is set at or before time $t-h$, then $cov(r_{it}, e_{it}) = cov(q_{it} + p_{it}, -(1-\omega^j)\epsilon^q_{it}) = -(1-\omega^j)Var(\epsilon^q)$. Thus, unexpected demand and productivity shocks would induce a negative correlation between the error term in equation 10 and the revenue variable, biasing the coefficient on the revenue variable downward.[20] 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. Since lagged labor costs, however, are set already by $t-h$, this variable is orthogonal to the prediction error term.

[19] An example of unanticipated demand shock is poor weather affecting traffic to the outlet. An example of unanticipated productivity shocks is an unexpected breakdown in equipment used at the outlet.

[20] Actual transacted quantity would be lower than expected quantity if there were a negative shock to either demand and/or productivity. However, for positive shocks, if we assume that price is fixed at the same time or prior to the choice of labor, the actual transacted quantity would be higher only if there were simultaneous positive shocks to productivity and demand. A positive demand (productivity) shock by itself will not induce a prediction error; the binding supply (demand) constraint will set the actual transacted quantity equal to the predicted quantity. Thus if there is a positive demand shock alone, some demand will go unmet as the firm would be unwilling to adjust inputs given the fixed prices. Similarly, if there is a productivity shock alone, the firm would be unable to utilize the additional capacity, as the demand would be low (given the set price).

The assumption that prices are set at the same time as (or before) the labor input choice implies that there is no prediction error for price in equation 6. If we also relax this assumption, then adjustments in prices (in response to unanticipated demand or productivity shocks) would induce another error term which would lead to a further downward bias for the coefficient on revenue in our regressions.[21]

The downward bias on the revenue term described above does not affect our coefficients of interest, δ_r and δ_b, in equation 10 so long as the prediction bias is not systematically larger in countries with more rigid regulations, for reasons unrelated to changes in labor regulation.[22] A priori, we have no reason to believe that the prediction bias would be larger in countries with a larger labor regulation index, so we believe our baseline results relating to the effects of labor regulation are unlikely to be biased due to prediction error on quantity or prices.[23]

Nonetheless, we check the robustness of our results to prediction errors and other potential mis-specification issues in two main ways. First, we use the information available in our data on the choice of material costs and run the same regression as in 10 for these costs (f_{it}):

$$f_{it} \quad = \quad \beta^f r_{it} + \gamma^f f_{i,t-1} + \delta_r^f \tau^j r_{it} + \delta_b^f \tau^j f_{i,t-1} + \eta_{is}^f + \varepsilon_{it}^f. \qquad (13)$$

If the estimates of δ_r and δ_b in our regression equation 10 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 $\gamma_f = 0$). If the prediction bias in quantity and/or price (and hence revenue) due to unanticipated demand or productivity shocks is systematically greater in countries with poor regulation, then the coefficient on revenue in-

[21]Let $p_{it} = E_{t-h}[p_{it}] + \epsilon_{it}^p$. Equation 11 then becomes:

$$b_{it} = (1-\omega^j) r_{it} + \omega^j b_{i,t-1} + (1-\omega^j) \log \alpha' - (1-\omega^j)(\epsilon_{it}^q + \epsilon_{it}^p), \qquad (12)$$

where j again indexes the country where outlet i is located. Thus the prediction error in the price variable would also induce a downward bias on the revenue coefficient. If the two prediction errors (on quantity and price) are positively correlated, then the error in quantity could add to the downward bias on the price variable and vice versa. This would be the case if the prediction error in the quantity variable were driven largely by unanticipated demand shocks; the two error terms would be negatively correlated if prediction error on the quantity variable is driven predominantly by unanticipated productivity shocks. This is because demand shocks drive quantity and prices in the same direction, while productivity shocks drive quantity and prices in opposite directions.

[22]For example, if firms are unable to adjust labor quickly in countries with a larger labor index, firms may invest less resources in predicting future demand in these countries. Any bias induced by this still reflects the effect of the regulation and in that sense is not really a bias.

[23]Similarly, unanticipated changes in wage rates could also affect equation 4 and hence equation 6, 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.

teracted with labor regulation would be downward biased in the material costs regressions also, so that we would expect to find $\delta_r^f < 0$.

Second, we adopt lagged revenue and suitable further lags for labor costs as instruments (following Arellano and Bond, 1991).[24] Lagged revenue and labor cost should be correlated with the current values of revenue and lagged labor costs, but uncorrelated with prediction errors or other errors induced by unexpected demand or productivity shocks. We also use lags of material costs as instruments for revenue; since lagged material costs are predetermined, we expect them to be uncorrelated with prediction errors and hence be valid instruments.

As discussed in Heckman and Pagés (2004), autocorrelation in the error term in equation 10 also 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 the outlet-period fixed effects that we include in our regressions, we do not expect the autocorrelation issue to be severe. Also, even if there is autocorrelation in the error term, this affects our parameters of interest only if the degree of persistence is systematically related to the rigidity of labor regulation. More specifically, our estimates are upward biased only if the error terms are systematically more strongly autocorrelated in countries with a larger index of labor regulation. We do not have any a priori reason to expect the persistence in the error term to be greater in countries with more rigid labor regulations.

However, if our model is mis-specified, there could be autocorrelation in the labor demand error term for other reasons, and the degree of persistence could somehow be correlated with the labor regulation index. The test described above, using the materials costs specification, addresses this source of bias as well. As in the case of the prediction error discussed above, we expect any error term autocorrelation to also affect the materials demand specification. Thus, if the larger hysteresis in labor demand is driven by a combination of specification error and greater persistence of demand and/or productivity shocks in countries with a larger labor regulation index, this should have a similar effect on the material costs specification, leading to an expectation of a positive δ_b^f coefficient in specification 13.[25]

[24] Arellano and Bond (1991) use lagged levels as instruments for first differences of endogenous variables. We control for fixed effects using outlet-year dummies, and use the lagged levels as instruments for the levels themselves.

[25] In unreported results, we examined labor demand specifications using the GMM approach proposed by Blundell and Bond, 1998. We find that specifications using 3 and 4 lags of the levels of endogenous variables as instruments for differences in the endogenous variables passed both the specification tests – the overidentification test for the instruments as well as the test for the assumption of no serial correlation in the (non-fixed part of the) residual – and yielded results strongly consistent with the findings in our baseline analyses. These findings reinforce our conclusion that the results in the baseline analyses are not driven by autocorrelation bias. In other difference and system GMM specifications, with different lag structures (even though one of the specification tests failed), the results remained qualitatively very robust.

5.1 Robustness check: Material costs specification

Since the labor regulations are expected to affect the adjustment costs mainly for labor, our model does not imply the same effects in the material costs equation 13.[26] As discussed above, one way to check whether our results in Tables 3 and 4 are driven by a correlation between unexpected demand and productivity shocks and the regulatory regime, or due to a correlation between persistence in demand/productivity shocks and regulation, is to examine whether material costs specifications yield similar results as the labor cost specifications.

The results from our analysis of material cost demand are presented in Table 5. We find that the impact of labor regulation on materials demand 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 -0.25, -0.01, and -0.82 percentage points respectively in our three specifications (with outlet, outlet-year and outlet-year-season fixed effects).

When we consider the impact of regulation on the response to changes in lagged materials choice, again the coefficients are insignificant and while the magnitude of the effects are slightly larger, they remain quite small – at 2.20, 1.73, and 0.84 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. The decreased hysteresis in materials could reflect a more careful optimization of material costs when labor flexibility is low; however, as noted above, these effects are not statistically significant.[27]

In summary, the results from the material costs specification suggest that the estimated effects of labor regulation on labor costs are not driven by spurious correlation between either 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.

5.2 Robustness check: IV specification

As discussed above, we also can address potential biases in our baseline estimates using an instrumental variables (IV) approach. In the IV analyses reported here, we use up to 5 lags

[26] With strong complementarity between the inputs, adjustment costs to one input could affect the demand for the other input. For example, for 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, there is no reason to expect such a strong complementarity in the production function of the Company, and hence we expect a lower or zero effect of labor regulation on the materials demand function.

[27] In Appendix 4, Table A.1, we present results from the same specification but 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.

of endogenous variables as well as lags of material costs as instruments. In all specifications, we control for outlet and time-specific effects using outlet-year fixed effects. Again, standard errors are clustered at the country level.

The results are shown in Table 6. In the first column, we consider only log revenue and its interaction with the index of regulation as endogenous (see notes below the table for the full list of instruments). In column 2, we instead take lagged labor cost and its interaction with regulation as endogenous. Finally, in column 3, we take all the right-hand side variables (i.e., log revenue and log lagged labor cost, as well as their interactions with the index of labor regulation) to be endogenous.

In these IV regressions, coefficients on both interaction terms are stronger than in our baseline analyses above. This suggests that potential endogeneity in our baseline regressions biases downward the estimates on the parameters of interest (coefficients on the interaction terms). Thus, we surmise that the results from our baseline analyses are conservative.

We carried out a number of tests to look for potential weaknesses in our IV approach. First, we find that the p value for the Hansen J-statistic (reported in the third to last row) is high enough that the null hypothesis – that the instruments are exogenous – cannot be rejected. Second, we check for weak instruments using the Cragg-Donald statistic, as suggested by Stock and Yogo (2002). We find that the statistic (reported in the second to last row) is far above the cutoffs for weak instruments suggested by Stock and Yogo (2002) (i.e., the instruments we use do not appear to be weak by this measure). This is also reflected in the Shea partial r-square (unreported) of the first stage regressions, which are in the range of 0.2 to 0.5 (across the different endogenous variables). We also report the p value from the Anderson canonical correlations likelihood-ratio test (see the last row) of whether the equation is identified; we find that the null hypothesis (that the equation is under-identified) is strongly rejected.

We conclude from these IV results that the estimates in our baseline specifications were not biased upwards by endogeneity. Thus, the elasticity of labor demand with respect to revenue is significantly reduced in countries with more rigid labor regulations. Also, hysteresis in labor demand (i.e., the elasticity of current labor with respect to last period's labor) is significantly higher in countries with more rigid labor regulation.[28]

Finally, we note that another possible robustness check would be to look at the effect of changes, if any, in relevant labor laws within a country, as country specific effects that may be correlated with cross-sectional variation in labor regulation would not bias within-country comparisons over time. Because the Botero et al. (2004) index has not been updated over time, we do not have any useful variation in this index. The Global Competitiveness Survey, however, was conducted again in 2004, and hence we can use these new data to

[28]We find similar results using the IV approach with the index of hiring/firing inflexibility obtained from the 2002 Global Competition Survey, as reported in Appendix 4, Table A.2. We also found our results robust to using different lag structures for the instruments.

look for changes within countries. But, not surprisingly, the data suggest that labor market inflexibility does not change much over a 2-year period, such that the index is in fact the same for almost all countries. We find a reported increase only for a small number of countries (see Appendix 4, Figure A.2). In Table A.3, in the same appendix, we report results from estimating labor demand for the quartile of countries that experienced the largest increase in the inflexibility index. Consistent with our theory, we find that the coefficient on lagged labor increased significantly in all specifications, while the coefficient on revenue decreased in all cases. (Since we focus on the 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.) The effect on revenue in the year 2003 is not significant, however, when we control for outlet-period fixed effects. The results were robust to focusing on just the top decile of countries showing the largest increases in the inflexibility index. However, directly using the change in inflexibility index did not yield statistically significant results. We interpret these findings as suggesting that the actual measured changes in the inflexibility index are somewhat noisy. Nevertheless, the changes measured for the group of countries with the largest shift in the inflexibility index could be informative. Hence we find the consistency of our results on the top quartile and decile of index changes with our baseline analyses reassuring. Overall, given the short time span of our data, the minimal changes in the survey measure for most countries, and the lack of corroborating information on changes in labor regulation, we are cautious in interpreting these results and hence relegate them to an appendix.

6 Estimated adjustment dampening and gross misallocation

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

From equation 8, we get the following relationship between the actual adjustment of labor and optimal adjustment of labor:

$$\frac{b_t - b_{t-1}}{b_t^* - b_{t-1}} = (1 - \omega^j). \tag{14}$$

Since b stands for the log of labor cost, 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 14 is a fraction between 0 than 1. Thus, our theory implies that regulatory rigidity dampens all observed adjustments to labor (both on the hiring as well as the firing margins).

The expression $(1 - \omega^j)$, which we term the "Dampening factor," provides a measure of the extent of dampening of labor adjustment induced by the labor regulations. Note that $\omega^j = a_0 + a_1.\tau^j$, where we can obtain estimates of a_0 and a_1 from the estimated coefficients on the different variables in our regressions. Thus, we can form estimates of the dampening factor using our results.

Table 7a presents alternative estimates of the dampening factor at different percentiles of labor regulation. In panel 1, we use coefficient estimates from column 3 of our baseline regression results in Table 3 to derive a_0, a_1, and then use these to estimate the values of 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 when we use 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 an increase in the labor regulation index from the 25th percentile (0.26) to the 75th percentile (0.57) changes the dampening factor from 0.67 to 0.51, a change of about 25 percent.

Panel 2 presents similar calculations based on results obtained with the GCS index of inflexibility in column 3 of Table 4. Again, the dampening factor estimates are the largest when we use the coefficients on the revenue variables. From row 3 of panel 2, we get that an increase in the inflexibility index from the 25th percentile (0.42) to the 75th percentile (0.66) changes the dampening factor from 0.69 to 0.53, or about 24 percent.[29]

The dampening factor gives us an indication of how much impact the labor regulation or inflexibility indices have on the labor adjustment process. Another relevant question is to consider how much misallocation of labor is caused by this dampening of the adjustment process. The tractability of our simple model in Section 2.1 allows us to answer this question. Specifically, equation 14 implies the following optimal labor choice for each outlet:

$$b_t^* = b_{t-1} + \frac{b_t - b_{t-1}}{1 - \omega^j}. \tag{15}$$

Note that, per our model, the optimal labor choice will be higher (lower) than actual if labor levels increased (decreased) relative to the prior period. That is, if $b_t > b_{t-1}$, then $b_t^* > b_t$ and vice versa. Accordingly, if the outlet faces a negative shock that leads it to lower its labor level from the previous period, the difference between optimal and actual labor levels, or "net misallocation," can be negative. 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.[30]

[29] These estimates of the dampening factor (and the following estimates of misallocation) are conservative, as the effects are significantly higher if we use coefficients from the IV regressions.

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

To capture the inefficiency of holding too little or too much labor, we define "gross labor misallocation" ρ as:

$$\rho \equiv |b_t^* - b_t| \tag{16}$$

This gross labor misallocation term indicates how much distortion there is between the optimal choice of labor and the actual labor level in each outlet each week. Since this is a difference between the log of two variables, the term can be thought of as the percentage difference between optimal labor choice and actual labor choice.[31]

To estimate how the magnitude of misallocation relates to changes in labor regulation, we regress the estimated gross misallocation on labor regulation. The results are presented in Table 7b. Columns 1, 2 and 3 use estimates of ω^j from rows 1, 2 and 3 respectively of panel 1 in Table 7a.

The positive sign on the regulation variable is not surprising, since we expect gross misallocation to be higher in countries with poorer regulation, where the dampening factor on adjustment is higher.[32] The magnitude of the coefficient on regulation is of greater interest; these results imply that an increase in the Botero et al. (2004) index from its 25th to 75th percentile value is associated with an increase in gross misallocation that represents approximately 3.97 (.128*(.57 - .26)), 10.48 and 5.89 percent of labor costs respectively.

The results are qualitatively similar, but smaller in magnitude, when we use the GCS index of hiring/firing inflexibility in columns 4, 5 and 6. Here, a change in the index from its 25th to its 75th percentile value increases misallocation by 1.90, 5.88 and 2.86 percent of labor costs respectively.[33]

We interpret our results on the dampening factor 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 about 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 the relatively small lower bound on the estimated gross misallocation of 1.9 to 3.97 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.

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

[32] Note that this need not necessarily be true; in particular, if shocks have a lower dispersion in countries with more rigid regulation, the measured gross misallocation could be lower in countries with more rigid labor markets.

[33] An alternative approach would be to measure the increase in gross misallocation resulting from a hypothetical increase in the labor regulation within a chosen country. We examined hypothetical increases in labor regulation to the 75th percentile for a sample of countries around the 25th percentile of the labor regulation distribution; the estimated increases in gross misallocation was of the same magnitude as we obtain here.

Thus the"misallocation" due to increase in regulation from the 25th to 75th percentile can be expected to be about 2.6 percent ([0.677-0.505]*0.15).

The magnitudes of the affects here are qualitatively similar to the findings in two related papers in the literature, 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 appears to be 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. Our estimates of the lower bounds of gross misallocation in the range of 1.9 to 3.97 percent, is in the ballpark of some of the effects calibrated by Hopenhayn and Rogerson (1993) for variables that could have a similar interpretation. 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 costs 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 15) 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. (Here a zero change to labor indicates that the actual labor level is also the optimal labor choice.) 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 expansion in markets where labor regulations are relatively rigid.

We test for such effects in Table 8. 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

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

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 variable of interest is either the time to entry into a country, in columns 1 and 2 of Table 8, or the number of outlets in each country in columns 3 and 4. Specifically, we define the time to entry in country j as the difference in years between the year when the Company first ventured outside its home market and the year the Company entered country j.

We analyze the entry decision of the firm using a Cox partial likelihood (proportional hazard) model, at a weekly frequency from the time of first entry to 2003. For this analysis, we include observations for all countries for which we have data on all the variables in the time to first entry to 2003 period, including countries where the Company has never established any operations. Since unobserved country-specific factors are likely to drive the error term, we adjust the standard errors for clustering at the country level.[36]

Consistent with the gravity model of trade, the results, in columns 1 and 2 of Table 8, imply that the Company was quicker to enter countries with larger markets, captured by higher 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.

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, measured using 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.

We find similar results 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 8). 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

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

[36] We have data on the opening date of each outlet. We back out the date of entry into each country from the date of opening of the oldest outlet in each country. 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 values as at the end of 2002.

[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.

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 country 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 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 is based on a survey on 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, moreover, should be interpreted with 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, as noted earlier, 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 restricting 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 found 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.

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

We argue that our within-firm establishment data presents several unique advantages for the type of analyses we carry out. 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 either 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 day-to-day operations and labor decisions of existing outlets within this firm, we find evidence that the Company has delayed entry and operates fewer outlets – conditional on the per capita income, population 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]

Our study focused on assessing the effect of labor regulation on the Company's operations. The 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 choices made by 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 our results do 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

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

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 somewhere between 2 to 10 percent of labor costs. 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 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).

[8] 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.

[9] 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.

[10] 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.

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

[12] 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.

[13] 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.

[14] 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.

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

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

[17] 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.

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

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

[20] 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.

[21] 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.

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

[23] 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.

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

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

[26] 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.

[27] 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:

$$Q_t = f(L_t) = \Theta L_t^{\alpha}, \tag{17}$$

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:

$$\max_{\{L_t\}_{t=1}^{t=\infty}} \left\{ \phi_1 L_1^{\alpha'} - W L_1 - g(\Delta L_1) + E_1 \left[\sum_{t=2}^{\infty} \beta^t \left(\phi_t L_t^{\alpha'} - W L_t - g(\Delta L_t) \right) \,|\phi_1 \right] \right\}, \tag{18}$$

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. The problem facing each outlet then is identical from period to period except for two (state) variables – the amount of labor from the last period and the current combined productivity and demand shock term (ϕ). Accordingly, equation 18 in the Bellman equation form is:

$$V(\phi, L) \quad = \quad \max_{\{L'\}} \left\{ \phi L'^{\alpha'} - W L' - g(\Delta L') + \beta E[V(\phi', L') \,|\phi] \right\}. \tag{19}$$

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 19 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 19:

- $\alpha' = 0.216$, 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 19 to be a contraction mapping hold. Additionally, 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} defines 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 (19) 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:

$$b_{it}^{j} = \beta r_{it}^{j} + \gamma b_{it-1}^{j} + \delta_r c^j r_{it}^{j} + \delta_b c^j b_{it-1}^{j} + \eta_{is}^{j} + \varepsilon_{it}^{j}, \tag{20}$$

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 2: 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.**

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.

Figure 2: Correlation between changes in input costs and revenue

This graph shows the correlation (by country) between changes in labor costs and changes in revenue, as well as the correlation between changes in material costs and revenue, against indices of labor regulation. The panel on the left uses the index of labor regulation from Botero et al. (2004). The panel on the right uses the index of hiring/firing inflexibility constructed using data from the 2002 Global Competitiveness Survey.

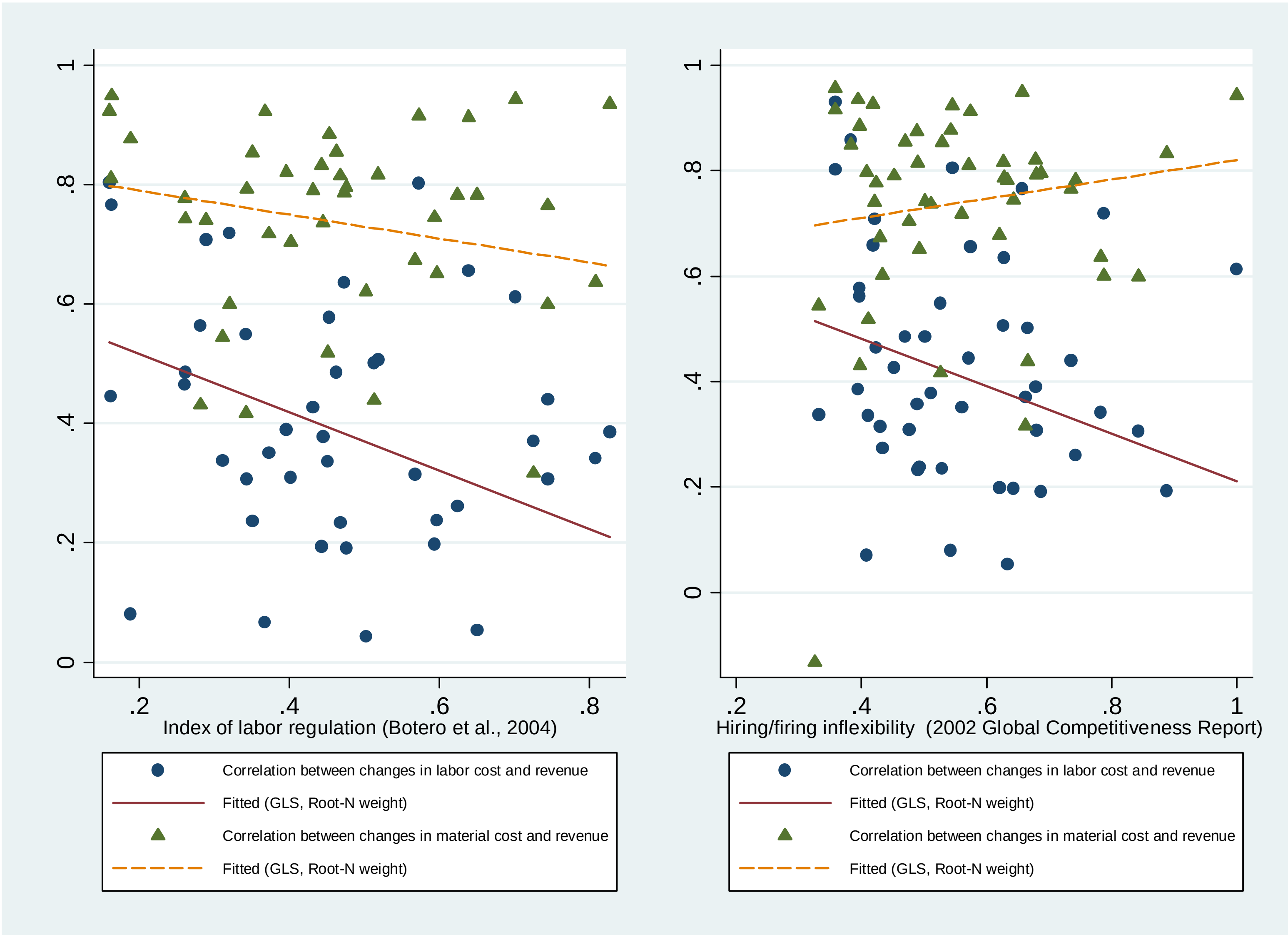


Table 1: Regression results from simulated data

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	78,958	1718	39
2001	85,111	1828	37
2002	74,201	2147	38
2003	82,305	1938	37
Total	320,575	2525	43

Panel B: Summary statistics (variables in logs)

Variable	N	Mean	SD	P25	Median	P75	Min	Max
Log (Lagged labor cost)	320,575	7.19	0.85	6.71	7.27	7.78	(5.05)	10.25
Log (Revenue)	320,575	8.84	0.69	8.46	8.90	9.32	2.85	11.50
Log (Lagged material cost)	317,300	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	320,575	1,796.76	1,385.12	819.81	1,434.39	2,391.44	0.01	28,219.16
Revenue	320,575	8,474.28	5,303.04	4,729.05	7,329.33	11,149.48	17.30	98,668.13
Material cost	317,300	2,703.76	1,622.16	1,590.15	2,393.32	3,478.27	0.01	56,580.45
Index of labor regulation	320,575	0.41	0.16	0.26	0.44	0.57	0.16	0.83
Index of hiring/firing inflexibility	318,129	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)
Log (Revenue)	0.573	0.558	0.555
	[0.071]**	[0.050]**	[0.050]**
Log (Lagged labor cost)	0.081	-0.030	-0.088
	[0.141]	[0.106]	[0.092]
Regulation X Log (Revenue)	**-0.569**	**-0.488**	**-0.406**
	[0.145]**	**[0.102]****	**[0.109]****
Regulation X Log (Lagged labor)	**1.021**	**0.919**	**0.703**
	[0.291]**	**[0.222]****	**[0.206]****
Constant	0.636	1.570	2.345
	[0.231]**	[0.315]**	[0.368]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
Observations	320,575	320,575	320,575
R-squared	0.950	0.950	0.960
Adjusted R-squared	0.945	0.952	0.959
Number of clusters	43	43	43

Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Regulation = mean (0.41)	23.44%	24.70%	26.81%
At Regulation = mean + sd (0.41+0.16=0.57)	17.16%	19.31%	22.33%
Impact of increase in Regulation	-6.28%	-5.39%	-4.48%
Effect of a one standard deviation (0.85) increase in Log (Lagged labor)			
At Regulation = mean (0.41)	42.47%	29.48%	17.02%
At Regulation = mean + sd (0.41+0.16=0.57)	56.35%	41.98%	26.58%
Impact of increase in Regulation	13.89%	12.50%	9.56%

Table 4: Labor regulation and labor demand hysteresis – 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	-0.182
	[0.225]	[0.185]	[0.152]
Inflexibility X Log (Revenue)	**-0.740**	**-0.724**	**-0.651**
	[0.219]**	**[0.215]****	**[0.260]***
Inflexibility X Log (Lagged labor)	**0.991**	**0.917**	**0.721**
	[0.333]**	**[0.294]****	**[0.243]****
Constant	0.251	1.151	1.941
	[0.240]	[0.317]**	[0.365]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
Observations	337,129	337,129	337,129
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)	24.19%	26.05%	28.39%
At Inflexibility = mean + sd (0.56+0.13=0.69)	17.55%	19.56%	22.55%
Impact of increase in Inflexibility	-6.64%	-6.49%	-5.84%
Effect of a one standard deviation (0.85) increase in Log (Lagged labor)			
At Inflexibility = mean (0.56)	45.47%	31.92%	18.85%
At Inflexibility = mean + sd (0.56+0.13=0.69)	56.42%	42.05%	26.82%
Impact of increase in Inflexibility	10.95%	10.13%	7.97%

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)
Log (Revenue)	0.861	0.901	0.974
	[0.072]**	[0.053]**	[0.021]**
Log (Lagged materials cost)	0.249	0.182	0.066
	[0.113]*	[0.114]	[0.069]
Regulation X Log (Revenue)	**-0.023**	**-0.001**	**-0.074**
	[0.137]	**[0.091]**	**[0.044]**
Regulation X Log (Lagged materials cost)	**-0.208**	**-0.164**	**-0.080**
	[0.202]	**[0.199]**	**[0.131]**
Constant	-1.033	-1.100	-0.848
	[0.086]**	[0.131]**	[0.139]**
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
Observations	361,249	361,249	361,249
R-squared	0.950	0.950	0.960
Adjusted R-squared	0.947	0.953	0.960
Number of clusters	43	43	43

Effect of a one standard deviation (0.69) increase in Log (Revenue)			
At Regulation = mean (0.41)	58.76%	62.14%	65.11%
At Regulation = mean + sd (0.41+0.16=0.57)	58.50%	62.13%	64.30%
Impact of increase in Regulation	-0.25%	-0.01%	-0.82%
Effect of a one standard deviation (0.66) increase in Log (Lagged materials cost)			
At Regulation = mean (0.41)	10.81%	7.57%	2.19%
At Regulation = mean + sd (0.41+0.16=0.57)	8.61%	5.84%	1.35%
Impact of increase in Regulation	-2.20%	-1.73%	-0.84%

Table 6: Labor regulation and labor demand hysteresis -- IV 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. All regressions include outlet-year fixed effects. Standard errors are clustered at country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)
Log (Revenue)	0.660	0.595	0.786
	[0.175]**	[0.045]**	[0.189]**
Log (Lagged labor cost)	-0.056	-0.197	-0.259
	[0.141]	[0.101]+	[0.165]
Regulation X Log (Revenue)	**-0.841**	**-0.674**	**-1.483**
	[0.335]*	**[0.106]****	**[0.377]****
Regulation X Log (Lagged labor)	**0.979**	**1.636**	**1.975**
	[0.288]**	**[0.211]****	**[0.323]****
Observations	258,662	258,662	258,662
Number of clusters	43	43	43
Hansen J p-value	0.281	0.464	0.317
Stock-Yogo Cragg-Donald Weak IV statistic	3352.08	4548.03	1909.91
Anderson under-identification test	0.000	0.000	0.000

Column 1: Instrumented -- Log (Revenue), Regulation X Log (Revenue)
Excluded instruments -- L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5).Regulation X Log (Revenue), L(1/5).Regulation X Log (Lagged labor), L(1/5).Log (Material cost)

Column 2: Instrumented -- Log (Lagged labor cost), Regulation X Log (Lagged labor)
Excluded instruments -- L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5).Regulation X Log (Revenue), L(1/5).Regulation X Log (Lagged labor), L(1/5).Log (Material cost)

Column 3: Instrumented -- Log (Lagged labor cost), Regulation X Log (Lagged labor), Log (Revenue), Regulation X Log (Revenue)
Excluded instruments -- L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5).Regulation X Log (Revenue), L(1/5).Regulation X Log (Lagged labor), L(1/5).Log (Material cost)

* Note: In all regressions, all right-hand side variables that are not considered endogenous (for example, Log (Lagged labor cost) and Inflexibility X Log (Lagged labor) in column 1) are included in the full set of instruments.

Table 7a: 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)	-0.088	Coefficient on Regulation X Lagged Labor	0.703	0.905	0.779	0.687
1 - Coefficient on Log (Revenue)	0.445	-(Coefficient on Regulation X Revenue)	0.406	0.449	0.376	0.324
Average of above	0.179	Average of above	0.555	0.677	0.578	0.505
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)	-0.182	Coefficient on Regulation X Lagged Labor	0.721	0.879	0.800	0.706
1 - Coefficient on Log (Revenue)	0.224	-(Coefficient on Regulation X Revenue)	0.651	0.503	0.431	0.346
Average of above	0.021	Average of above	0.686	0.691	0.615	0.526

Table 7b: Gross misallocation and regulation

The dependent variable is gross labor cost misallocation, which is defined as the absolute value of the difference between (the log of) optimal and actual labor cost. Optimal labor cost is estimated using coefficients in Table 7a. Columns 1, 2 and 3 use estimates in rows 1, 2 and 3 respectively of panel 1. Columns 4, 5 and 6 use rows 1, 2 and 3 of panel 2 respectively. 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. Standard errors are clustered at country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)	(4)	(5)	(6)
Index of labor regulation	0.128	0.338	0.190			
	[0.012]**	[0.052]**	[0.025]**			
Index of hiring/firing				0.079	0.245	0.119
inflexibility				[0.034]*	[0.136]+	[0.068]+
Constant	-0.025	0.026	-0.006	-0.016	0.007	0.001
	[0.004]**	[0.019]	[0.009]	[0.017]	[0.067]	[0.033]
Observations	356,311	356,311	356,311	372,867	372,867	372,867
R-squared	0.08	0.02	0.03	0.03	0.01	0.01
Number of clusters	43	43	43	48	48	48

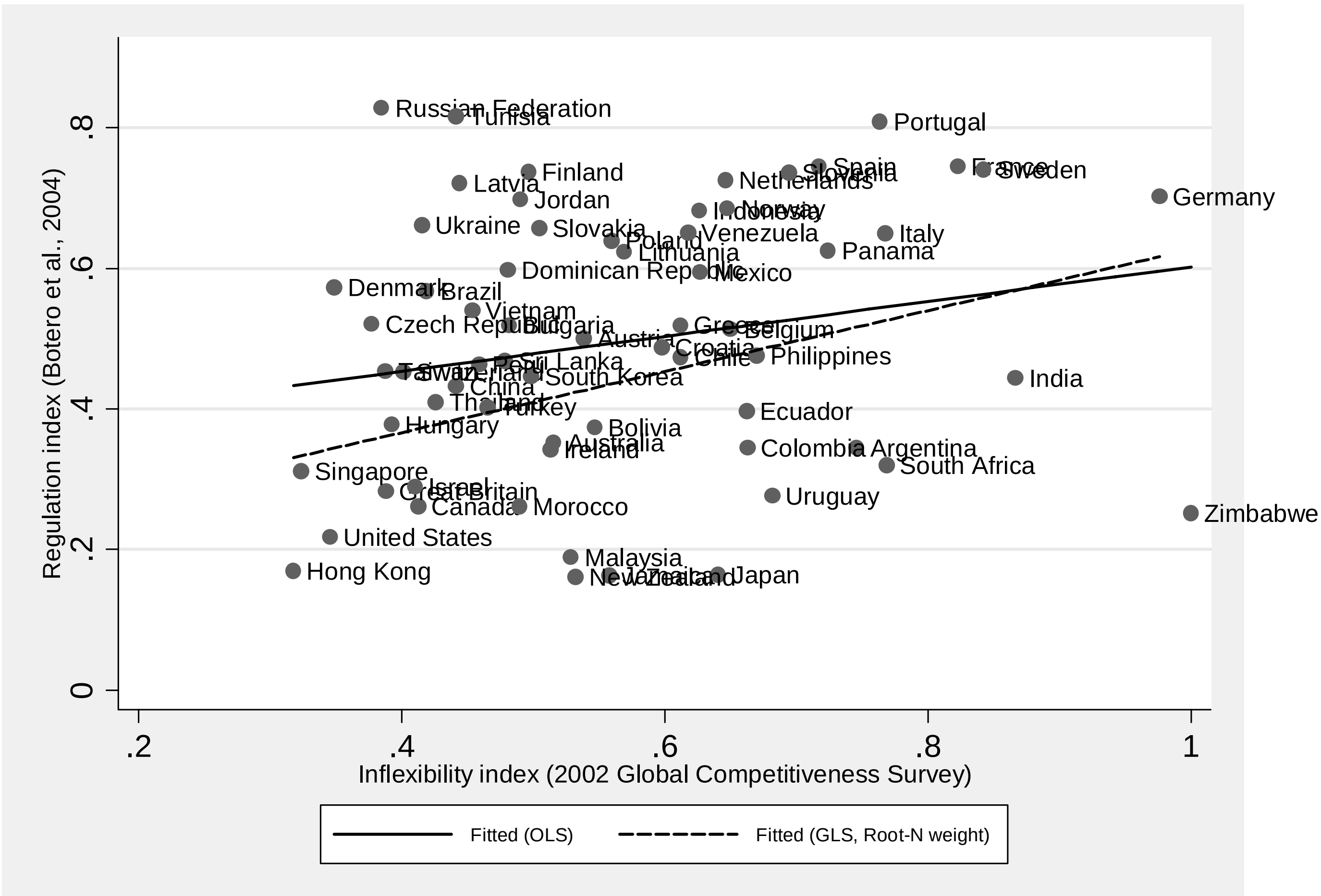
Table 8: Labor regulation and international expansion

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	0.938
	[0.117]**	[0.085]**	[0.050]**
Log (Lagged materials cost)	0.214	0.154	0.009
	[0.170]	[0.172]	[0.082]
Inflexibility X Log (Revenue)	0.000	0.051	0.014
	[0.171]	[0.122]	[0.076]
Inflexibility X Log (Lagged materials cost)	-0.092	-0.074	0.046
	[0.260]	[0.258]	[0.132]
Constant	-1.087	-1.131	-0.890
	[0.125]**	[0.164]**	[0.178]**
Observations	377,886	377,886	377,886
Fixed Effects	Outlet	Outlet-year	Outlet-year-season
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 (0.68) increase in Log (Revenue)			
At Inflexibility = mean (0.56)	59.06%	62.41%	65.26%
At Inflexibility = mean + sd (0.56+0.13=0.69)	59.06%	62.87%	65.39%
Impact of increase in Inflexibility	0.00%	0.46%	0.13%
Effect of a one standard deviation (0.66) increase in Log (Lagged materials cost)			
At Inflexibility = mean (0.56)	10.72%	7.43%	2.29%
At Inflexibility = mean + sd (0.56+0.13=0.69)	9.93%	6.79%	2.69%
Impact of increase in Inflexibility	-0.79%	-0.63%	0.39%

Appendix 4

Table A.2: Robustness check: Labor regulation and labor demand hysteresis -- IV specifications, alternative measure of labor regulation

The dependent variable is the log of labor cost per week for each store (outlet). "Inflexibility" is the index of hiring/firing inflexibility, constructed using data from the 2002 Global Competitiveness Survey. All regressions include outlet-year fixed effects. Standard errors are clustered at country level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)
Log (Revenue)	0.951	0.768	0.909
	[0.255]**	[0.132]**	[0.355]*
Log (Lagged labor cost)	-0.232	-0.447	-0.548
	[0.212]	[0.197]*	[0.320]+
Inflexibility X Log (Revenue)	-1.124	-0.765	-1.341
	[0.376]**	[0.211]**	[0.600]*
Inflexibility X Log (Lagged labor)	1.097	1.734	2.105
	[0.331]**	[0.361]**	[0.548]**
Observations	273,257	273,257	273,257
Number of clusters	48	48	48
Hansen J p-value	0.209	0.171	0.258
Stock-Yogo Cragg-Donald Weak IV statistic	3864.06	4851.31	1966.11
Anderson under-identification test	0.000	0.000	0.000

Column 1: Instrumented -- Log (Revenue), Inflexibility X Log (Revenue)
Excluded instruments -- L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5). Inflexibility X Log (Revenue), L(1/5). Inflexibility X Log (Lagged labor), L(1/5).Log (Material cost)

Column 2: Instrumented -- Log (Lagged labor cost), Inflexibility X Log (Lagged labor)
Excluded instruments – L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5). Inflexibility X Log (Revenue), L(1/5). Inflexibility X Log (Lagged labor), L(1/5).Log (Material cost)

Column 3: Instrumented -- Log (Lagged labor cost), Inflexibility X Log (Lagged labor), Log (Revenue), Inflexibility X Log (Revenue)
Excluded instruments -- L(1/5).Log (Revenue), L(1/5).Log (Lagged labor cost), L(1/5). Inflexibility X Log (Revenue), L(1/5). Inflexibility X Log (Lagged labor), L(1/5).Log (Material cost)

* Note: In all regressions, all right-hand side variables that are not considered endogenous (for example, Log (Lagged labor cost) and Inflexibility X Log (Lagged labor) in column 1) are included in the full set of instruments.

Appendix 4

Figure A.2: Changes to Index of Inflexibility between 2002 and 2004

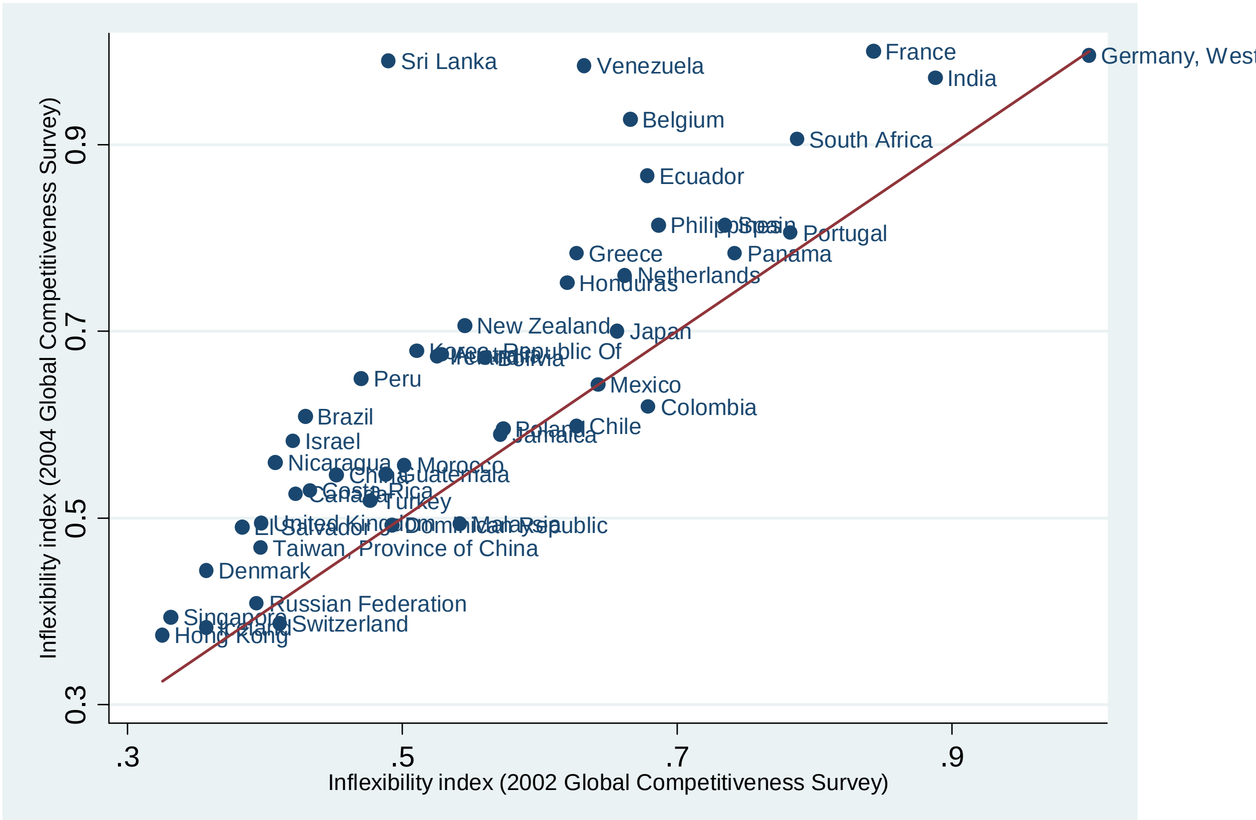


Table A.3: Robustness check: Using changes to Index of Inflexibility between 2002 and 2004

The sample here is all the observations in the top quartile of the change in index of hiring/firing inflexibility between the 2002 and 2004 Global Competitiveness Surveys. Standard errors are clustered at store level. + significant at 10 percent; * significant at 5 percent; ** significant at 1 percent.

	(1)	(2)	(3)
Log (Revenue)	0.427	0.454	0.487
	[0.017]**	[0.021]**	[0.024]**
Log (Lagged labor cost)	0.506	0.363	0.21
	[0.023]**	[0.021]**	[0.021]**
Year 2003 X Log (Revenue)	-0.043	-0.026	-0.004
	[0.014]**	[0.023]	[0.024]
Year 2003 X Log (Lagged labor cost)	0.053	0.051	0.073
	[0.016]**	[0.027]+	[0.025]**
Fixed effects	Outlet	Outlet-year	Outlet-year-season
Observations	64475	64475	64475
R-squared	0.93	0.94	0.94
Adjusted R-squared	0.927	0.936	0.945
Number of clusters	455	455	455