This PDF is a selection from a published volume from the National Bureau of Economic Research

Volume Title: International Differences in the Business Practices and Productivity of Firms

Volume Author/Editor: Richard B. Freeman and Kathryn L. Shaw, editors

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-26194-8

Volume URL: http://www.nber.org/books/free07-1

Conference Date: January 2006

Publication Date: September 2009

Chapter Title: Within-firm Labor Productivity across Countries: A Case Study

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Chapter URL: http://www.nber.org/chapters/c0439

Chapter pages in book: (p. 137 - 172)

5 Within-firm Labor Productivity across Countries
A Case Study

Francine Lafontaine and Jagadeesh Sivadasan

5.1 Introduction

According to *Franchise Times,* the 200 largest U.S.-based franchise chains in 2004 operated 356,361 outlets and generated a total of 327,058 million U.S. dollars in sales worldwide. Of these, eighty-six were fast-food chains, operating a total of 180,772 outlets and generating sales of 162,409 million U.S. dollars. The largest franchise chain in the world in 2004 was McDonald's, with 30,220 outlets worldwide and total sales of 45,932 million U.S. dollars. The international fast-food industry is important, however, not only because of its sheer size, but because of the role it plays in the daily lives of consumers worldwide. Many fast-food brands are among the best recognized brands around the world, and fast food is a very visible part of the global economy. Another fact that make these chains particularly interesting is that they produce basically the same output using the same technology in all their outlets worldwide.[1] This homogeneity in output, coupled with variations

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1. Of course, they adapt their menus to local tastes to varying degrees. But their main menu items are served worldwide and they only introduce local menu items that are easily handled

in outlet characteristics and in regulatory environment across countries, provide a unique opportunity to investigate how business practices, outlet characteristics, and regulatory contexts affect productivity. Moreover, the fast-food industry is a fairly labor intensive, low margin industry, making it a setting where labor productivity is particularly important.

In this study, and in contrast to other contributions to this volume where authors emphasize the effect of changes in business practices over time within a firm, we use weekly data from outlets of an international retail food chain to analyze how labor productivity—defined as the number of items produced per worker-hour—varies across countries. Specifically, we consider how various outlet characteristics, such as outlet age, the experience level of workers, and the average order size, as well as the form of governance (which varies across outlets) affect productivity. In addition, given the important role of labor costs in determining profitability in this industry, we analyze how labor regulations related to hiring and firing—that is, those rules that affect the capacity of the outlet manager to schedule workers flexibly and add or subtract hours on the schedule, affect observed average labor productivity and outlet-level output. To maintain confidentiality restrictions on the data, throughout the chapter we refer to the multinational firm under study as "the Company" and the product sold in the retail outlets as "item(s)." Also for confidentiality reasons, we are unable to provide certain details on the operations of the Company. However, we rely heavily on our understanding of the industry and the firm, based on interviews with industry insiders, and on the trade press, in our modeling and interpretation of results.

To motivate our empirical analyses, we examine the optimization problem of individual outlets assuming a simple multi-input Cobb-Douglas production function. Outlet-level profit maximization leads to a linear specification for labor productivity, which should be increasing in labor wages and declining in output price.[2] If outlets have some local market power, then average labor productivity would also depend on the elasticity of demand, with those facing less elastic demand curves cutting back on production and thus exhibiting higher productivity levels on average.

In addition to considering the effect of input and output prices, we model how other factors can affect observed labor productivity through their influ-

within the constraints imposed by their production processes and facilities, using basically the same technologies.

2. Note that the equilibrium labor productivity is independent of the Hicks-neutral total factor productivity (TFP) term in the Cobb-Douglas production function. Specifically, ceteris paribus, outlets with higher levels of TFP would be larger than those with lower levels of TFP, but would move further down the marginal product curve so that the revenue marginal product of labor equals the prevailing wage rate. Under this condition, the Cobb-Douglas specification yields the same average labor productivity for high and low TFP outlets facing the same wages and output prices. This is because the marginal product of labor is a constant times the average labor productivity (i.e., $dQ/dL = \alpha Q/L$).

ence on what we refer to as overhead labor.[3] In other words, given what we know about what is expected of workers, we take for granted that some of the labor costs we observe for each outlet is dedicated to generating complementary services, which, per the firm's measurement process, we refer to as execution quality. Other aspects of quality, which the firm refers to under the heading of "compliance," do not require additional labor hours. Incorporating this fact into our analyses, we find that (a) execution quality has a negative effect on our measure of labor productivity, as expected, but compliance has no such effect; (b) outlet age beyond the first year of operation and increases in the number of experienced employees do not have a statistically significant effect on labor productivity; and (c) larger order sizes on average improve labor productivity. The effect of governance form is ambiguous, and the choice of governance form appears to be correlated with unobserved country fixed effects.

Next, we consider the effect of different labor regulations across countries on observed labor productivity. We expect labor market rigidities to increase the effective cost of employing workers above the prevailing wage rate. We find that indeed labor regulations that reduce flexibility in hiring and firing workers raise the equilibrium labor productivity levels, consistent with our expectation that the laws raise the effective cost of labor. Accordingly, we find that increases in the rigidity of labor regulations lowers labor demand conditional on input and output prices. Our estimates imply that increasing the index of labor regulations from the twenty-fifth to its seventy-fifth percentile level reduces conditional labor demand by about 12.4 percent.

Finally, we use the high frequency of our data to develop an empirical strategy that allows us to estimate the net impact of the labor law rigidity on output at the outlet level. Assuming optimizing behavior by outlets, three major factors influence the effect of labor regulations on output: the effect of regulations on the effective wage locally, the elasticity of output with respect to inputs (in the production function), and the own-price elasticity of demand. Using our most conservative approach to estimating demand elasticities, and a range of coefficient estimates for the other factors, we conclude that an increase in labor regulation from the p25 level (= 0.28) to p75 level (= 0.59) leads to a net reduction in outlet-level output (conditional on outlet level wages, output prices, capital, and demand shifters) of about 1.5 percent to 2.6 percent. These results are consistent with the negative effect of job security laws on employment found by Lazear (1990). Our conservative

3. The standard approach in productivity studies is to examine total factor productivity (TFP) using a production function specification. Here, we lack data on store level capital and hence would be unable to disentangle TFP from unobserved capital. Data constraints thus lead us to focus on labor productivity, as data on both output and labor input are available. However, as discussed previously, TFP does not affect observed average labor productivity. Hence we capture the influence of factors such as product quality and governance through their potential effect on overhead labor.

estimates also are close to the 2 percent effect on consumption calibrated by Hopenhayn and Rogerson (1993) for a job security tax equivalent to one year's wages for the United States.[4]

In the next section, we present a simple model that captures how key factors affect measured labor productivity, labor demand, and output. In section 5.3 we discuss the data and provide some details about the operations of the Company. We present results in section 5.4. Section 5.5 concludes.

5.2 Model and Empirical Specifications

In this section, we present a simple model of production and demand for a typical retail food outlet that allows us to analyze the effects of outlet characteristics such as experience, execution quality, compliance, and governance, as well as country-level labor regulations on outlet-level decisions. As we describe further below, we treat such characteristics as exogenous or predetermined at the time managers make input and output decisions given that our data are weekly. More generally, we use our theoretical framework to derive empirical specifications for labor productivity, labor demand, and output that highlight some industry facts and practices, per Company officials, and take into account the strengths and weaknesses of our data.

5.2.1 Basic Specification

We assume that food items (output) are produced in each outlet each period according to a simple three-input Cobb-Douglas production function, with materials M, capital K and labor L as the three inputs.

$$Q = \theta L^{\alpha} K^{\beta} M^{\gamma}, \tag{1}$$

where we assume that α, β, and γ are all greater than 0, and $\alpha + \gamma < 1$.[5] For simplicity, we omit outlet and time subscripts, keeping those implicit throughout our discussion of the model.

Initially, we take the output market as competitive; that is, we assume a horizontal demand curve. This assumption is not unreasonable in our context since there are many close substitutes for the output of any fast-food outlet, from outlets of other chains and from more local restaurant and food offerings. Still, we relax this assumption further below. For now, however, under this assumption, outlet-level profits are given by:

$$\Pi = P \cdot Q - wL - rK - sM. \tag{2}$$

4. Our research is related also to Card and Krueger (1997), as some of the studies in that book were concerned with the effect of changes in minimum wage laws on employment levels in fast-food chains. While they found no effect of such changes on employment, other studies (e.g., Deere, Murphy, and Welch 1995) have found negative effects of minimum wages on employment.

5. The latter ensures that second order conditions for interior solutions hold.

We assume that for each outlet, capital is semi-fixed. That is, when the outlet manager makes weekly decisions, she is not free to choose capital—the size of the store or the amount of equipment is taken as given—but she can vary labor and materials. In fact, from our discussions with industry insiders, one of the most important jobs of a store manager (or franchisee) in the fast-food industry is to keep labor and materials costs low. In particular, they use data from the same week last year, and information about how the last few weeks this year compared to their experience the previous year, along with any information they have about the timing of special events in their market to forecast demand at their outlet one or two weeks ahead. They then plan their labor and materials purchases for the next one or two weeks based on these forecasts.[6]

Since each outlet is a small business, and thus a small employer and buyer locally, we assume material and labor are supplied at constant price through competitive input markets. At the optimum, the first-order condition for labor and material choices are binding so that the marginal cost of labor (material) is equal to the marginal revenue product of labor (material).

$$P(\alpha\theta L^{\alpha-1}K^{\beta}M^{\gamma}) = w \tag{3}$$

$$P(\gamma\theta L^{\alpha}K^{\beta}M^{\gamma-1}) = s. \tag{4}$$

Substituting for output and rearranging terms, equation (3) yields the following specification for average labor productivity (Q/L):

$$\log\left(\frac{Q}{L}\right) = \log(w) - \log(P) - \log(\alpha) + e, \tag{5}$$

where e is a residual from measurement or represents optimization errors.[7]

Equation (5) implies that in a cross-country context such as ours, if one assumes that the technology used within each outlet is the same everywhere for this type of chain (or more precisely that the parameter α is the same

6. See, for example, Deery and Mahony (1994) on the importance of labor flexibility in retail generally, and Hueter and Swart (1998) for information on how Taco Bell uses operations research models to optimize its labor usage and minimize its labor costs. The authors estimate that the company saved $40M in labor costs between 1993 and 1996 through the labor management system it developed at the time.

7. In this specification, deviations from unit values in estimated parameters for wage and output price could be due to measurement error in prices and wages, or to a mis-specification of the production function. For example, it can be shown that the general Constant Elasticity of Substitution (CES) production function yields the same specification as we use here, except that the coefficient on price and wage would be the coefficient of substitution. That is, if we assume $Q = (\alpha L^{\varsigma} + \beta K^{\varsigma} + \gamma M^{\varsigma})^{1/\varsigma}$, then the specification in equation (5) is modified to $\log(Q/L) = \psi \log(w) - \psi \log(P) - \psi \log(\alpha) + e$, where $\psi = (\varsigma - 1)/\varsigma$. We maintain the Cobb-Douglas assumption in part because it fits the data reasonably well, as will be clear following, and because it allows us to evaluate the effect of labor regulations on output per the method outlined in section 5.2.4. The Cobb-Douglas functional form is not an unusual assumption in the literature examining firm performance (see, e.g., Olley and Pakes [1996], and Fabrizio, Rose, and Wolfram [2007]).

across countries), labor productivity would be higher in countries where the wage rate w is high and/or the price per item P is low. In other words, we should observe higher labor productivity where the cost of labor is high relative to the price of output.

As noted previously, each outlet in our data is a very small firm, and the Company itself is just one of many different companies offering different food options to customers, as was made clear in our discussions with Company managers. In some applications, an identification issue for equation (5) can arise from the endogeneity of wages. In our context, however, we view the assumption that each outlet faces a horizontal labor supply curve in its local labor market as highly plausible, given the size of these outlets relative to the total retail marketplace. Further, we focus our attention on wage differences across countries, which are even less likely to be affected by the amount of labor employed by individual outlets (or even by the total employment of the Company in any one country).[8]

5.2.2 Overhead Labor and Outlet Characteristics

Fast-food production, while relatively straightforward, nonetheless requires some coordination as well as the provision of various complementary services, such as clean areas to consume the food, clean restrooms, well-stocked condiment bars, and so on. The production of these complementary services also entails the use of labor. To allow for this, we modify the basic model above to add the assumption that part of observed labor represents overhead labor that does not directly contribute to producing output. This modeling approach draws on Aghion and Howitt (1994), and has been viewed as a fairly realistic representation of production processes in the context of the retail sector (see Foster, Haltiwanger, and Krizan 2002).

We assume that overhead labor is utilized in several different ways in the Company's outlets, and that this affects how some outlet characteristics should be factored into our production function framework. Let observed total labor at the outlet be $\hat{L}$ and the optimal labor level (net of overhead labor) be L. We assume that the number of overhead employees is a fraction ρ of the optimal labor level. Then, the specification for observed labor productivity, in (5), becomes:

$$\text{(6)} \qquad \log\left(\frac{Q}{\hat{L}}\right) = \log(w) - \log(P) - \log(\alpha) - \log\left(\frac{\hat{L}}{L}\right) + e$$
$$= \log(w) - \log(P) - \log(\alpha) - \log(1 + \rho) + e.$$

8. One approach to instrumenting for wages could be to use the average wage for the region (similar to the approach in Hausman [1996]). But since we use the predicted wage based on average wage for cities reported by the Economist's Intelligence Unit (EIU), our wage measure is already purged of any variation from outlet-specific factors.

The impact of various outlet characteristics on measured outlet-level average labor productivity thus depends on their effect on the fraction of overhead labor ρ. Factors that increase the fraction of overhead labor would reduce average labor productivity, and vice versa. In what follows, we discuss the expected effects of outlet-level variables such as output quality, experience of employees, governance, and so on.

(i) Quality (S_e, S_c): Outlets in a franchise chain all operate under a common brand whose value depends crucially on consistent operations and consistent, positive consumer experiences across outlets. As a result, outlets are required to maintain quality levels to the parent company's standards, and franchisors spend both time and resources monitoring the operations of each outlet. At the Company, outlets are audited on a periodical basis, and various individual scores are summarized under two major headings: (a) Execution (S_e), which measures how well the outlet meets product specifications (size, presentation, portion sizes), speed of customer service requirements, cleanliness of customer areas, and so on; and (b) Compliance (S_c), which captures the extent to which the outlet abides by policies concerning temperature and length of storage for food products, employee safety rules, employee grooming and attire, and so on.

Given what these scores represent, we view execution quality as a second output produced by workers at the outlet. Thus, we expect that increasing execution quality level would, all else equal, require more labor resources to be diverted from actual item production. For example, customer wait times might be improved by hiring extra staff to take orders or work behind the counter. Similarly, better scores on store and customer area cleanliness require more labor resources to be allocated to related tasks. Hence, we expect the fraction of what we call overhead labor ρ to increase with increases in execution quality levels, so that:

$$\frac{d\rho}{dS_e} > 0 \Rightarrow \frac{d \log \frac{Q}{L}}{dS_e} < 0.$$

We expect compliance, on the other hand, to be less labor intensive—no labor is required to comply with grooming and dress code policies, for example. In fact, for the latter, it is likely less time consuming to rely on the sources of inputs suggested or required by the Company than it would be for an outlet to find its own sources. In that sense, we believe compliance does not really involve the use of extra labor. At the same time, it should contribute to the value of the franchise (i.e., it should increase demand via the value of the brand, as franchisors all argue compliance does). In that context, compliance with company policies could reduce wastage in the long run, including potential waste in the use of labor. This, then, could be reflected in lower (total) labor. Thus, we expect compliance potentially to contribute positively to labor productivity; that is:

$$\frac{d\rho}{dS_c} \leq 0 \Rightarrow \frac{d \log \frac{Q}{L}}{dS_c} \geq 0.$$

(ii) Average order size (Ω): We expect less labor (overhead and crew) to be required in outlets where the average order size is larger. For example, larger orders should be associated with larger production batches and reduced handling. As mentioned by company managers, larger orders are also particularly suited to the chain-like production process in fast-food outlets. Thus, we expect:

$$\frac{d\rho}{d\Omega} < 0 \Rightarrow \frac{d \log \frac{Q}{L}}{d\Omega} > 0.$$

(iii) Governance structure (G): The ownership structure of the Company's outlets varies from country to country, and in many cases from outlet to outlet within a country. There are five major types of governance structures (the last part of the chain indicates the owner of the outlet): (1) Parent Company → Local Franchisee (about 4 percent of outlets in the data); (2) Parent Company → Master Franchisee (about 43 percent); (3) Parent Company → Master Franchisee → Local Franchisee (about 44 percent); (4) Parent Company → Area Developer (about 7 percent); and (5) Parent Company owns and operates the outlet (about 2 percent). Note that the vast majority of outlets operate under master franchise agreements, where a firm or individual pays a fee for the right to a territory (often a whole country). Within this territory, the master franchisee may operate outlets directly or sell outlets to franchisees who then operate them. Master Franchisees most often do both, and act as a franchisor to the franchisees whom they recruit, sharing the franchise fees and royalties paid by their franchisees with the Company. Area developers are also granted the right to a territory (for a fee) but they are not allowed to sell franchises within this territory. Instead, an area developer necessarily owns and operates all the outlets in his territory.

Given the distribution of governance structures in our data, and the fact that within-country variation in governance form in particular takes the form of franchisee-owned versus nonfranchisee owned outlets, in what follows we focus on this distinction only.

The expected effect of franchisee ownership on average labor productivity is somewhat ambiguous, however. In general, franchisees are expected to put forth a greater level of effort in running their outlets (including monitoring crew labor), and hence one should find greater efficiency in the use of overhead and other labor for outlets owned and operated by franchisees.[9] This, in turn, implies that we should find higher levels of observed labor productivity for franchised outlets. Denoting franchisee-owned outlets by the dummy $D_{f'ee}$, then, holding all other factors constant, we expect:

$$E(\rho \mid D_{f'ee} = 1) < E(\rho \mid D_{f'ee} = 0)$$

$$\Rightarrow E\left(\log\frac{Q}{L} \,\middle|\, D_{f'ee} = 1\right) > E\left(\log\frac{Q}{L} \,\middle|\, D_{f'ee} = 0\right).$$

Two sets of factors may affect this prediction, however. One relates to data and measurement issues, while the other has to do with how outlet governance itself is selected by the firm. In terms of data and measurement, as discussed later, we measure labor inputs as total labor costs at the outlet divided by a country-level measure of wages. This approach to measuring labor usage, which is dictated by data constraints, may affect our results in two ways. First, outlets owned by franchisees may have downward-biased labor cost figures as these costs may exclude the compensation or full opportunity cost of franchisees' time. Since the latter typically undertake activities performed by paid managers in other outlets, but may be compensated for their effort at least partly through profits, the data on labor costs may underestimate total labor cost. Once divided by the wage rate, they would yield an underestimate of hours of labor used, and thus give rise to an upward biased measure of average labor productivity. Such a bias, of course, would reinforce our previous prediction that we should expect higher labor productivity in franchised outlets. The issue then is that if we find such higher productivity in franchised outlets, it will not be possible to determine whether this result arises from a real difference in productivity, per our hypothesis, or from a labor cost measurement problem.

Second, it could be that franchisees are better able to identify and hire workers at lower wage rates and substitute for lower labor quality through closer monitoring. In this case, the effective wage paid to workers in franchisee-owned outlets would be lower than for nonfranchised outlets. The net impact of this is ambiguous. As reflected in equation (6), we would expect these outlets to have greater output on the margin, given the lower marginal cost of production, and thus lower average levels of labor productivity. However, if franchisee-owned firms do indeed use relatively lower paid workers, our measured employment levels for franchisee-owned outlets would be biased downward given our reliance on country-level wages to infer employment from labor costs, so that measured labor productivity for these could be upward biased.

The other problem with our predictions is that as stated, our hypothesis

9. See Shelton (1967) and Krueger (1991) for some evidence that costs may be lower in franchised outlets.

takes governance form as given. Yet while the effect of franchisee ownership on overhead labor may be efficiency enhancing, one expects the presence of different governance forms within and across countries to be an endogenous response to *unmodeled* incentive constraints, as well as regulatory and market conditions. Thus, in equilibrium, labor efficiency advantages of franchisee-owned outlets may be offset by other costs to the parent company, and different governance forms would be chosen in different countries/contexts depending on the relative benefits and costs of particular governance forms. Still, on this issue, it is important to recognize that governance forms are not changed frequently—franchise contracts typically last for ten to twenty years—and thus it is reasonable to treat them as fixed by the time weekly decisions about labor and materials are made.

(iv) Experience (E_{emp}, E_{store}): It is typical in studies of labor productivity to consider how learning and employee experience levels affect productivity. In our data, we have access to information about employee and outlet-level experience. The first, E_{emp}, is proxied by the number of workers with more than one year of experience at time t. The second type of measure, E_{store}, captures experience/learning embodied in the outlet itself and is proxied by the age of the outlet. It is standard to assume that greater experience levels for the employees should help eliminate unnecessary overhead and improve efficiency. Similarly, learning at the outlet level should reduce overhead labor.[10] Thus we have:

$$\frac{d\rho}{dE} < 0 \Rightarrow \frac{d \log \frac{Q}{L}}{dE} > 0.$$

Incorporating the above factors into equation (6) and adopting a linear approximation, we get the following log-linear specification for measured average labor productivity:

$$\text{(7)} \quad \log\left(\frac{Q}{L}\right) = \log(w) - \log(P) - \log(\alpha) + a_{\text{se}}S_{\text{e}} + a_{\text{sc}}S_{\text{c}} + a_{\Omega}\log(\Omega) + a_{\text{dfee}}D_{\text{f'ee}} + a_{\text{ee}}E_{\text{emp}} + a_{\text{es}}E_{\text{store}} + e.$$

As discussed, we expect:

$$a_{\text{se}} < 0, a_{\text{sc}} > 0, a_{\Omega} > 0, a_{\text{dfee}} > 0, a_{\text{ee}} > 0, a_{\text{es}} > 0.$$

5.2.3 Imperfectly Competitive Output Markets

The restaurant and fast-food industry are typically viewed as ones that fit the assumptions of monopolistic competition quite well. Here, indeed, the Company's outlets operate under a brand, and as such, the product

10. Another variable capturing store/country level experience is the number of years the company has been in the country, which we examine in some of our robustness regressions.

they sell is differentiated. Given this, our model should allow for imperfect competition in the output market, or a downward-sloping demand at the outlet level. Thus, we now let outlet-level demand be given by:

$$\mathrm{P} = \mathrm{A} \cdot \mathrm{Q}^{1/\mu}, \tag{8}$$

where μ is the elasticity of demand, which must be greater than one in absolute value.[11] With this demand curve, the first-order conditions in equations (3) and (4) are modified such that the labor productivity equation (5) becomes:

$$\log\left(\frac{Q}{L}\right) = \log(w) - \log(P) - \log\left(1 + \frac{1}{\mu}\right) - \log(\alpha) + e. \tag{9}$$

Our data (see section 5.3) include measures for all the variables in equation (9) except for demand elasticity. One way to control for this unobserved parameter in our productivity regressions would be to include location-time fixed effects that implicitly control for potential demand shifters. However, the inclusion of such fixed effects would limit our ability to study the effect of labor regulation, which is fixed at the country level, and other factors of interest such as quality, which is fixed for store-quarters; governance, which is fixed at the store level; and experience, which would have little meaningful variation within a store-quarter. An alternative approach, which we adopt, is to control for demand elasticity using data on materials choices. Rearranging the modified first-order condition for materials gives:

$$\left(1 + \frac{1}{\mu}\right) = \frac{sM}{\gamma PQ} = \frac{1}{\gamma}\left(\frac{\text{MaterialCost}}{\text{Revenue}}\right) = \frac{m_{\text{sh}}}{\gamma}. \tag{10}$$

Combining equations (5) and (10), we get a modified specification for observed labor productivity:

$$\log\left(\frac{Q}{L}\right) = \log(w) - \log(P) - \log(m_{\text{sh}}) + \log(\gamma) - \log(\alpha) + e. \tag{11}$$

Accordingly, equation (7) becomes:

$$\log\left(\frac{Q}{L}\right) = \log(w) - \log(P) - \log(m_{\text{sh}}) + \log\left(\frac{\gamma}{\alpha}\right) + a_{\text{se}}S_{\text{e}} + a_{\text{sc}}S_{\text{c}} + a_{\Omega}\log(\Omega) + a_{\text{dfee}}D_{\text{f'ee}} + a_{\text{ee}}E_{\text{emp}} + a_{\text{es}}E_{\text{store}} + e. \tag{12}$$

11. This condition must be satisfied in equilibrium for outlet profit maximization and for second-order conditions to yield interior solutions. Also, in the general case μ could depend on the level of price, so that elasticity would not be constant along the demand curve. We assume that demand is iso-elastic to make our model empirically tractable. Given that outlet level prices move within a narrow band, we do not believe that this assumption is very restrictive. In our empirical specifications for demand, moreover, we control for local and seasonal factors that could affect the elasticity of demand.

Estimating equation (12) with our cross-country data implicitly assumes that the production function parameters γ and α are either constant across countries, or are uncorrelated with other regressors. As noted earlier, given the nature of the business, which is replicated from one location to another with a strong desire for consistency and conformity by the Company, the notion that the different outlets function under similar technology, processes, and standards is consistent with Company policy and with various statements made by Company managers.

5.2.4 Impact of Labor Regulations

In addition to studying the effect of outlet characteristics (as described above) on measured labor productivity, another goal of this study is to examine the effect of laws that increase labor market rigidity on measured labor productivity, labor demand, and output. We emphasize the potential effect of labor regulation for the Company because labor costs are a large part of total costs at fast-food outlets, and, given the very low margins in this industry, firms—including the Company—expand significant effort on labor cost minimization. At Taco Bell, for example, labor costs were estimated to be about 30 percent of every dollar of sales at the time Hueter and Swart (1998) examined labor scheduling at this company. They were also described as among the "largest controllable costs" at that company. Moreover, despite chain efforts, business practices in labor management can vary tremendously across outlets, leading to important differences in costs and labor turnover rates.[12] Under these circumstances, regulations further affecting labor flexibility could have a large impact on both labor practices and costs. Our goal is to assess and quantify the latter effect.

We measure labor market rigidity using an index developed in Botero et al. (2004) (see appendix), which combines measures of the difficulty or cost of using part-time employment, increasing hours worked, and hiring and firing workers. Note that, in theory, the effect of labor laws could be offset by individual outlets through contracts and agreements on side payments with their workers (Lazear 1990). In the absence of offsetting agreements—whether this is because of bargaining inefficiencies or incomplete contracts—these laws could affect labor demand at the outlet level, and, consequently, measured labor productivity.

A rich literature in labor economics has examined both theoretically and empirically the link between labor market regulations and employment (see Heckman and Pagés [2003] for a review). Both the theoretical and empirical work is divided on the net impact of labor rigidities on employment. It is easy to see how firing costs, for example, may increase as well

12. See Berta (2007) reporting on research conducted by Prof. Jerry Newman.

as decrease employment. On the one hand, increased firing costs would provide an immediate incentive not to fire workers when there is a negative demand (or productivity) shock. On the other hand, firms anticipate future firing costs and therefore hire less workers than required when times are good (positive demand/productivity shocks). The overall effect on employment in a cross-section of firms depends on which of these effects predominates.

For our purposes, motivated by Lazear's (1990) findings of a negative employment effect of labor rigidities, we model the rigid labor laws as increasing the effective marginal cost (or the shadow cost) of labor as perceived by an individual outlet.[13] Thus, we have:

$$w_{\text{eff}} = w_{\text{obs}} \cdot \exp(\varphi \text{Reg}),$$

where we expect $\varphi > 0$. Since higher wages leading to lower labor levels increase the equilibrium marginal product of labor, greater rigidity in labor markets would lead to higher average equilibrium labor productivity. Thus, expanding the specification for labor productivity in equation (12) to include the effect of labor rigidity, we get:

$$\text{(13)} \quad \log\left(\frac{Q}{L}\right) = \log(w_{\text{obs}}) - \log(P) - \log(m_{\text{sh}}) + \log\left(\frac{\gamma}{\alpha}\right) + a_{\text{se}}S_{\text{e}} + a_{\text{sc}}S_{\text{c}} + a_{\Omega}\log(\Omega) + a_{\text{dfee}}D_{\text{f}'\text{ee}} + a_{\text{ee}}E_{\text{emp}} + a_{\text{es}}E_{\text{store}} + \varphi\text{Reg} + e.$$

While the effect of labor regulation is expected to increase the equilibrium average labor productivity, the rigidity in the labor markets caused by the regulation has detrimental effects that are best shown in the labor demand equation (conditional on output and prices). To see this, we rearrange equation (13) above to yield:

$$\text{(14)} \quad \log L = \log Q - \log(w_{\text{obs}}) + \log(P) + \log(m_{\text{sh}}) - \log\left(\frac{\gamma}{\alpha}\right) - a_{\text{se}}S_{\text{e}} - a_{\text{sc}}S_{\text{c}} - a_{\Omega}\log(\Omega) - a_{\text{dfee}}D_{\text{f}'\text{ee}} - a_{\text{ee}}E_{\text{emp}} - a_{\text{es}}E_{\text{store}} - \varphi\text{Reg} - e.$$

The ultimate effect of the regulation, however, is to decrease output at the outlet level. This can be seen by solving for output:

13. Given the nature of these laws, a careful examination of their impact would require analysis and calibration of a dynamic labor choice model (as in, e.g., Hopenhayn and Rogerson [1993]). Unfortunately, data limitations, especially with regard to outlet-level capital stock, prevent us from pursuing such analyses here.

$$(15)\quad \log Q = \frac{1}{1-\alpha'-\gamma'}$$

$$\cdot[\log(\theta) + \beta\log(K) - \alpha\log(w_{\text{eff}}) - \gamma\log(s) - (\alpha+\gamma)\log(A)]$$

$$= \frac{-\alpha\varphi}{1-\alpha'-\gamma'}(\text{Reg}) + \frac{1}{1-\alpha'-\gamma'}$$

$$\cdot[\log(\theta) + \beta\log(K) - \alpha\log(w_{\text{obs}}) - \gamma\log(s) - (\alpha+\gamma)\log(A)],$$

where $\alpha' = \alpha[1 + (1/\mu)]$, and $\gamma' = \gamma[1 + (1/\mu)]$.

The effect of labor regulation on output thus depends on four parameters: α, γ, φ, and μ. In particular, the negative effect of labor regulation on output becomes larger the larger α and γ are. In other words, the greater the elasticity of output with respect to the two variable factors, the greater is the distortion in output due to regulation. Also, the negative impact of the regulations is greater the larger the (absolute value of the) own-price elasticity of demand. This is because when demand is less elastic, the outlet can pass the increased labor costs on to the consumer without having to reduce its output level as much. Thus, the effect of the regulation on output will be felt the most in those cases where the own-price elasticity of demand is very high; that is, when output markets are very competitive, on account of the availability of close substitutes, or because of the preferences of the consumers.[14]

Given our goal of estimating the impact of the regulations on output, one approach would be to directly estimate equation (15). This is unfortunately not possible with our data since we do not observe store-level capital (K), nor store-specific materials price(s), nor store-level demand shifters (A). One plausible way to condition out these unobserved variables would be to include store-period fixed effects in our regressions, but then we would be unable to identify the coefficients on many of our variables of interest, including the index of labor regulation given that this index is the same for all outlets in a country and constant over the two years of data we have.

Given that the direct estimation of equation (15) is infeasible, we estimate the four parameters determining the net impact of labor regulations on output as follows:

(i) Parameter φ is recovered as the coefficient of the regulation index in

14. In general, Marshall's (1920) four laws summarizing the determinants of own-price elasticity of factor demand apply: (a) Substitutability of other factors for labor. This does not explicitly appear in our model because the Cobb-Douglas production function we use is a special case where the elasticity of substitution between factors is one; (b) Elasticity of demand for the final good. This effect shows up in our previous derivations; (c) The share of labor in total costs. This effect shows up in the denominator; that is, via $(1 - \alpha' - \gamma')$; (d) Supply elasticity of other factors. Here we assume that the other variable factor (materials) is supplied with infinite elasticity.

the labor demand specification described by equation (14) or the specification for labor productivity in equation (13).[15]

(ii) We recover the technology parameters α and γ by estimating the original Cobb-Douglas production function directly, namely:

$$(16) \qquad \log(Q) = \log(\theta) + \alpha \log(L) + \beta \log(K) + \gamma \log(M) + \varepsilon.$$

Here again, the challenge is that capital K is not observed. Also, we only observe the total cost of materials, or sM, not the quantity of such inputs directly. However, in this case we do not have any variable of interest that does not change by country or across time periods. We can therefore address these data issues by making use of the high frequency of our data and assuming that: (a) capital does not vary for any given store within a season or month, so that capital gets absorbed by store-year-season or store-year-month fixed effects; and (b) similarly, materials prices do not change for any given store within a season or month, so that variations in such costs after including store-year-season or store-year-month fixed effects reflect changes in material quantities only.

With these assumptions, we obtain γ as the coefficient on materials costs, and α as the coefficient on labor costs, in the production function specification in equation (16), after including store-year-season or store-year-month fixed effects.

(iii) Finally, for the elasticity of demand parameter, we estimate a simple iso-elastic demand function:

$$(17) \qquad \log(Q) = -\mu \log(A) + \mu \log(P) + \eta.$$

The identification issue here involves potential omitted variables, in particular unobserved demand shifters that might affect A. We address this issue in many ways. First, we eliminate store effects via first differences. Moreover, we rely again on the high frequency of our data, and include store-year-month or store-year-season fixed effects. In a first-difference equation, these will capture store-specific trends within months or seasons.[16] Alternatively, as detailed further below, we use (first-differenced) materials costs per unit of output, and average output price in all other stores in the country in the same month, as instruments for price in equation (17).[17]

15. As noted earlier, we believe it is reasonable to treat wages as exogenous in our context. Moreover, we maintain the assumption that the technology parameters are either constant across countries, or uncorrelated with the other variables of interest, most importantly the labor regulation index.

16. We have verified that our results are very similar when we do not use first differences, and/or when we include fewer fixed effects. However, we chose to present results where we use all these controls for unobserved effects given that our data allow us to do so.

17. Our average output price instrument is similar to the average price instrument used by Hausman (1996) and hence is vulnerable to Bresnahan's (1996) critique. The key element of the critique is that there is a reason why the price at one outlet may be correlated with the prices at other outlets, which is the basis on which these prices could serve as an instrument for price at outlet i. So suppose that each outlet chooses price—the presumption we are making when we

5.3 Data Description and Definition of Variables

The main source of data for this study is an internal data set from an international retail fast-food chain. We have weekly outlet-level financial data on inputs and output levels for every outlet in every foreign country for the years 2002 and 2003. In addition, we have information on both ownership and quality of operations (execution and compliance) from audits that the Company performs for each outlet on average once every three months.[18]

In our analyses, we want to ensure that we compare outcomes obtained under similar circumstances. For that reason, starting with all outlets, we eliminated all observations that pertained 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 observations that are within the first year of operation for an outlet, and those observations pertaining to the last year of an outlet's operations. We also removed outlets that changed ownership the year before or after our period of analysis, as such changes are often accompanied by various disruptions, including renovations and temporary outlet closure. Additionally, a number of outlets and countries do not have information on all the variables we rely on. We exclude these as well.

Summary statistics for key variables in our study are presented in table 5.1. In what follows, we define each of the variables and explain how it is measured. To analyze labor productivity, we require a measure of output and labor input at the outlet level. The data already include a measure of the number of items produced by each outlet every week. Of course, in reality, the outlets offer a menu of different products to their customers. The company, however, translates this into a single metric, which it refers to internally as "items." We therefore follow the company's internal processes and use "number of items" as our measure of outlet-level output each week. As for labor input, our data include information on total labor cost ($w \cdot L$) for each outlet. To transform this into a measure of labor input, we need a measure of average hourly wages paid by each outlet to their workers. Since we do not have access to outlet-level data on wages, we use labor cost per hour data for 2002 and 2003 from the CityData data set, which is maintained by

allow downward sloping demand curves that are acted upon in the model—but the Company sets national advertising level, which is not observed. This advertising level then will affect all local demands similarly, explaining why they move together. The prices at other outlets, however, will not be a good instrument for the price at outlet i under these circumstances, as the same omitted variable—unobserved advertising—affects both. Since material costs are more likely to be driven by shifts in input supply or by differences in output composition, our material costs instrument is less vulnerable to the Bresnahan critique.

18. The average number of days between two audits is 101 days; however, there is significant variation in this figure, probably because the parent firm keeps its audit process somewhat random (standard deviation of about eighty days).

Table 5.1 Summary statistics

Variable	N	Mean	SD	Median	Min	Max
Log(Quantity = Number of items sold per week)	225,487	6.764	0.744	6.724	0.693	10.238
Log(Labor hours: Uses wages imputed using EIU data)	154,526	5.188	0.719	5.129	–6.141	9.351
Log(Material cost in USD)	233,861	7.790	0.683	7.882	–4.174	13.177
Log(Items per hour: Uses wages imputed using EIU data)	140,070	1.577	0.968	1.402	–3.823	12.109
Log(Price = Sales/item in USD)	225,421	2.106	0.548	2.185	–1.472	8.349
Log(Wage: Imputed for whole country using EIU city data)	197,522	1.929	1.183	2.729	–0.598	3.401
Log(Material cost/sales)[a]	233,794	–1.114	0.205	–1.082	–1.628	–0.626
Total execution points/100: Interpolated	82,681	0.494	0.127	0.520	0.000	0.700
Total compliance points/100: Interpolated	82,681	0.226	0.042	0.232	0.000	0.300
Outlet age in days/10,000	190,738	0.243	0.159	0.210	–0.025	0.754
Number of experienced employees (1plus)/100: Interpolated[a]	82,681	0.050	0.049	0.040	0.000	0.210
Experience (years) in country	235,378	13.979	4.052	14.000	2.000	20.000
Log(Average order size = Number of items/transaction)	211,514	0.356	0.336	0.311	–5.358	5.201
Dummy (Franchisee-owned = 1)	82,681	0.496	0.500	0.000	0.000	1.000
Index of labor regulations (Botero et al 2004)	219,223	0.421	0.159	0.443	0.161	0.828
Log(Exchange rate)	242,031	2.350	2.650	2.200	–1.240	14.360

Note: SD = standard deviation.

[a]These variables are winsorized by 1 percent on the upper and lower limit of the distribution to minimize influence of outliers.

the Economist Intelligence Unit. This source contains country-level wage, and hence allows us to calculate employment for twenty-seven different countries in our sample.[19]

We obtain output price, P, by dividing the data on total sales value by the reported number of items sold.[20] The material cost per item(s) also is obtained by dividing total material costs by the number of items sold.[21] The material share of revenue is obtained by dividing material costs by sales revenue. To minimize the effect of outliers, we winsorize the log material share of revenue by 1 percent on the tails of the distribution.

The parent company performs audits of outlets and compiles scores on various measures of operational performance that can be interpreted as

19. As mentioned below, we checked the robustness of our results to our measure of wages using two alternative sources of labor cost data. Results were generally consistent with those reported below. See next section.

20. Since the product mix varies from outlet to outlet and from week to week, our output price measure captures differences in price levels but also some amount of variation in output mix.

21. Note that while the theory suggests using marginal wages and prices, data limitations lead us to use (proxies for) average wage and observed average output and materials prices.

quality measures. As mentioned earlier, these measures are translated into total scores on two dimensions: (a) Execution (which includes measures of item quality, speed of execution of orders, and cleanliness of outlet), and (b) Compliance (which includes compliance with product storage and handling requirements, grooming and uniforms, and employee security policies). We use the separate scores on execution and compliance as our measures of quality (S_e and S_c). As these audits are performed only every several months (while our other data are weekly), we assign the same score to the outlet as long as a new audit is not performed, and refer to the resulting variables as interpolated. Some audit data are available for about 68.3 percent of the outlets (1,842 out of 2,695). However, all outlets were not audited with high frequency, so that even after interpolation, audit data is available for only 34 percent of the observations (i.e., 82,681 out of 242,031 outlet-week observations).

Average Order Size, Ω, is defined as the number of items sold in the week divided by the total number of transactions. As for governance, as discussed earlier, we define a dummy variable ("d_franchisee") denoting outlets that are owned and operated by a local franchisee as opposed to being owned and operated directly by the Company, an area developer, or a master franchisee. As this variable is available through audit reports, it is defined only for the set of observations for which we also have quality data.

Our data include several measures of experience. Three variables capture the experience of the labor force: (a) tenure of manager at the outlet, (b) tenure of manager as an employee of the chain, and (c) the number of employees with greater than one year of tenure at the outlet. The data also include information on the opening date for every outlet. Thus, we have data on (d) the age of each outlet, as well as (e) years of experience of the Company in the country (inferred from the earliest opening data among outlets within a country). Unfortunately, we found large coding errors for the manager tenure variables. Consequently, in our analyses we focus on a single measure of employee experience, namely the number of employees with greater than one year of experience. We also rely on data on the age of the outlet as our measure outlet-level experience, as these data are richer than information on the number of years since the Company began operations in each country. To minimize the influence of outliers, we again winsorize the employee experience variable (number of experienced employees) by 1 percent on the tails of its distribution.

Finally, as discussed in section 5.2.4, we measure the intensity of labor regulation using an index constructed by Botero et al. (2004). The definitions of the different components of this index are detailed in the appendix. Unfortunately, while the Company had operations in about fifty-nine countries around the world during the period of our study (2002 to 2003), audit data is available for only forty-five countries. Of these forty-five countries, data on labor regulation is available for twenty-nine countries, of which data on wages is available for twenty-seven. Thus, data limitations restrict the sample used in most of our analysis to twenty-seven or less countries.[22]

5.4 Empirical Results

In this section, we first examine the effects of quality, average order size, experience, and the choice of organizational or governance form, on labor productivity. We then discuss our results concerning the effects of labor regulations on labor productivity. Finally, we estimate the effect of labor regulation on output, following the procedure outlined in section 5.2.4.

5.4.1 Effect of Quality, Average Order Size, Governance, and Experience

We show the effects of various outlet characteristics on observed labor productivity in table 5.2. We include various subsets of our variables of interest in the different columns in part because our sample sizes are much reduced in some cases, so we want to show that our results are robust across specifications. Moreover, in the first seven columns our regressions include country-month fixed effects to control for country-specific characteristics along with potential seasonal effects.[23] In columns (8) and (9), we control for region-season fixed effects to provide comparisons to the specifications in tables 5.3 and 5.4.[24]

In all the specifications, we find a significant positive effect for wages and negative effect of output prices, as predicted by theory. In fact, our simple model implies a coefficient of 1 and –1 on wage and price, respectively. The coefficients for these variables in table 5.2 are remarkably close to unity, suggesting that the Cobb-Douglas specification provides a reasonable approximation in our context.[25]

The materials cost to sales ratio introduced to capture imperfect output

22. As requested by one of the referees, for the key dependent variables in our analysis, we undertook a test for stationarity using the methodology proposed by Im, Pesaran, and Shin (2003), which rejected the null of nonstationarity for all the variables. These results are in an appendix available on request from the authors. The Im, Pesaran, and Shin (2003) test allows for heteroscedasticity, serial correlation, and nonnormality. Because the period fixed effects we use vary across specifications, we tested with and without allowing for such effects. The null was rejected in all cases at p values less than 1 percent.

23. A regression of labor productivity on country fixed effects by itself shows that across-country differences account for about 83 percent of the variation, and country-month effects about 85 percent. Thus, the R-squareds in table 5.2 should be interpreted accordingly. Note that in these regressions, the wage effect is identified off of variation in wages across the two years in our data, as our fixed effects are defined as country-month or country-season, not country-year-month or country-year-season. If we use the latter, we get similar results for other variables, but in this case the wage coefficient is not identified in the first seven columns.

24. The variables of interest here—quality, order size, governance, and experience—vary at the outlet level, so we are able to include country-month fixed effects. In the next section, we will be examining labor regulations, which are constant within country; in those regressions we can include only region-season fixed effects.

25. See footnote 7, supra, for more on this.

Table 5.2 Labor productivity: Effect of quality, experience, and governance

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Wage in USD)	0.993***	1.073***	1.142***	0.926***	1.125***	0.960***	0.976***	0.687***	0.685***
	(0.14)	(0.14)	(0.14)	(0.14)	(0.13)	(0.22)	(0.21)	(0.06)	(0.06)
Log(Price in USD)	–0.943***	–0.932***	–0.941***	–0.911***	–0.939***	–0.737***	–0.752***	–0.823***	–0.828***
	(0.03)	(0.05)	(0.05)	(0.06)	(0.05)	(0.07)	(0.07)	(0.10)	(0.10)
Log(Materials cost/sales)							–0.108*		–0.035
							(0.06)		(0.10)
Total execution points		–0.189*				–0.203**	–0.207**	–0.108	–0.117
		(0.10)				(0.10)	(0.10)	(0.13)	(0.12)
Total compliance points		0.062				–0.002	–0.015	0.489	0.489
		(0.20)				(0.19)	(0.19)	(0.31)	(0.30)
Outlet age (days/10,000)			0.079			0.057	0.056	–0.054	–0.050
			(0.07)			(0.07)	(0.07)	(0.07)	(0.07)
No. of experienced employees			0.105			0.122	0.111	0.354	0.347
			(0.09)			(0.09)	(0.09)	(0.25)	(0.24)
Log(Average order size)				0.129*		0.294***	0.289***	0.429***	0.430***
				(0.07)		(0.07)	(0.06)	(0.15)	(0.15)
Franchisee-owned					0.014	0.015	0.013	0.160***	0.164***
					(0.07)	(0.06)	(0.06)	(0.05)	(0.05)
Constant	1.499***	1.310***	1.064***	1.531***	1.121***	1.018*	0.896	1.592***	1.569***
	(0.27)	(0.32)	(0.33)	(0.27)	(0.33)	(0.56)	(0.55)	(0.13)	(0.14)
Fixed effects	Country-Month	Country-Month	Country-Month	Country-Month	Country-Month	Country-Month	Country-Month	Region-Season	Region-Season
Observations	140,015	49,013	49,013	136,152	49,013	48,560	48,069	48,560	48,069
R^2	0.90	0.92	0.92	0.90	0.92	0.92	0.92	0.89	0.89
Number of clusters	27	26	26	26	26	24	24	24	24

Notes: Dependent variable is log labor productivity = log (items per hour of labor). Labor hours are obtained by dividing labor cost by hourly wages. Hourly wages are imputed for the countries using data for certain cities obtained from the EIU. Robust standard errors in parentheses (clustered at country level). Column (7) includes region-season fixed effects, with two regions (North and South) and four seasons.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

markets (see section 5.2.3) is only marginally significant, and becomes insignificant in particular in regressions where we control only for region-season effects. If we interpreted this to mean the coefficient is indeed zero, it would suggest that our more basic model, based on the notion that the market is perfectly competitive, may be appropriate for these data.

As for outlet characteristics, we find some evidence that higher execution quality scores are associated with lower labor productivity, which is consistent with our expectation that improving execution quality may require extra overhead labor (columns [2], [6], and [7]). Using the coefficients from column (7), which is our most complete specification for labor productivity, a one standard deviation (0.13) increase in execution points decreases log labor productivity by about 2.7 percent (-0.21×0.13). Compliance, on the other hand, does not seem to have any statistically significant effect on labor productivity.

We also find no statistically significant effect of either of our measures of experience on labor productivity in any of the regressions. Note that here, we focus on steady-state effects as we have excluded from the data those outlets that had not been operating for at least one year. The lack of significance of outlet age suggests that there is not much overhead-saving learning within outlets over time, at least beyond the first year of operation for these types of retail outlets. Our results do not inform us on, nor preclude the existence of, significant efficiency improvements in the first few weeks or months after an outlet is established.

We find that order size is positively correlated with labor productivity, in line with our expectation that less overhead labor is required to produce a given quantity of items when the average order size is larger. The effect here is statistically and economically significant; a one standard deviation increase in the log order size (0.34) increases labor productivity by about 9.9 percent (using the coefficient estimate of 0.29 from column [7] again).

Finally, the coefficient on the dummy variable for franchisee-ownership of an outlet is not statistically significant in the specifications that include country fixed effects. In columns (8) and (9), where we include only region (North and South) and season (winter, spring, summer, and fall) fixed effects, we find a positive and significant effect for franchisee ownership. While the latter result is consistent with the idea that there are better incentives for controlling overhead labor in franchisee owned outlets, we are cautious about this interpretation given that the effect disappears when we control for country fixed effects. It appears that omitted country-specific factors may be determining the choice of the franchisee ownership governance form, and that these same country characteristics may also be correlated with higher average labor productivity level (even after controlling for wages, prices, and other variables).

Overall, we conclude that (a) execution quality has a negative effect on labor productivity—this is as expected as the production of what the Company refers to as execution quality involves extra labor costs; (b) outlet age beyond the first year of operation and increases in the number of experienced employees do not have a statistically significant effect on labor productivity; and (c) larger order sizes improve labor productivity. The effect of governance form is ambiguous, and the choice of governance form appears to be correlated with unobserved country fixed effects.

5.4.2 Effect of Labor Regulation on Labor Productivity

As discussed in section 5.2.4, we expect labor regulations to increase the effective wage rate faced by the outlets of the Company, and accordingly, we expect labor productivity to be higher for outlets located in countries with more rigid labor regulations. We present results from investigating the impact of labor law regulations on measured labor productivity (equation [13]) in table 5.3. Since labor regulations are constant at the country level, unlike in table 5.2, we are unable to control for local factors using country fixed effects in these regressions, and rely instead on region/season fixed effects.

The results in table 5.3 are consistent with our expectations.[26] In all the specifications, we find that the coefficient on the index of labor regulations is positive and significant. The magnitude of the effects drops as we add more controls, especially when we add a control for governance type. Nevertheless, the effect is statistically very significant, and is also economically important. A one standard deviation increase in the labor regulation index (0.16) increases labor productivity by 6.1 percent (0.16×0.38), using the most conservative estimate for the effect of labor regulations (from column [6]).

In columns (6) and (8), we include two additional control variables: the log weekly exchange rate and log per capita GDP. Under the various labor productivity specifications (e.g., equation [13]), the units in which wages and prices are measured do not affect the equation; any scaling factor applied to wages is offset if the same factor is applied to output price. Thus, if our specifications are valid, our results should be unaffected by whether prices and wages are measured in local currency units or in U.S. dollars. However, if our regressions are misspecified, the units of measurement may bias our results. This is because local outlet-level decisions may be based on prices and wages perceived in local currency units. Because the price and wage variables enter the specification in logarithmic form, one way to control for possible biases introduced by fluctuations in the weekly exchange rates is to include the log of the exchange rate among the regressors, as we do in columns [6] and [8]. The log per capita GDP variable moreover controls for omitted variables that might be correlated with the income of local consum-

26. A simple table of productivity means across different quartiles of the regulation index (available on request from the authors) reveals an increasing pattern over the first three quartiles and then a decrease. These unconditional means are likely to be confounded by omitted wage and output prices, hence we focus here on the conditional effects.

Table 5.3 Labor productivity: Effect of labor regulations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index of labor regulation	0.713**	0.611**	0.626**	0.699**	0.449**	0.383***	0.420**	0.387**
	(0.28)	(0.27)	(0.29)	(0.26)	(0.21)	(0.14)	(0.17)	(0.14)
Log(Wage in USD)	0.829***	0.809***	0.803***	0.784***	0.785***	0.599***	0.702***	0.572***
	(0.03)	(0.04)	(0.04)	(0.03)	(0.04)	(0.08)	(0.05)	(0.08)
Log(Price in USD)	–1.053***	–1.046***	–1.046***	–0.944***	–1.045***	–0.886***	–0.838***	–0.928***
	(0.04)	(0.05)	(0.05)	(0.04)	(0.05)	(0.08)	(0.09)	(0.083)
Log(Material cost/sales)							–0.123*	–0.149*
							(0.07)	(0.08)
Total execution points		0.049				–0.101	–0.028	–0.118
		(0.13)				(0.14)	(0.12)	(0.13)
Total compliance points		0.397				0.463	0.393	0.449
		(0.29)				(0.29)	(0.31)	(0.29)
Outlet age (days/10,000)			0.099			0.04	0.077	0.062
			(0.11)			(0.08)	(0.08)	(0.08)
No. of experienced employees			0.277			–0.073	0.063	–0.134
			(0.29)			(0.15)	(0.19)	(0.14)
Log(Average order size)				0.230***		0.305***	0.423***	0.284***
				(0.07)		(0.10)	(0.13)	(0.10)
Franchisee-owned					0.128**	0.11**	0.152***	0.131**
					(0.05)	(0.05)	(0.05)	(0.06)
Log(Exchange rate)						–0.014		–0.012
						(0.01)		(0.01)
Log(GDP per capita in USD)						0.129		0.152*
						(0.08)		(0.08)
Constant	1.80***	1.78***	1.86***	1.60***	1.93***	3.42***	1.26***	3.68***
	(0.14)	(0.19)	(0.16)	(0.12)	(0.13)	(1.20)	(0.11)	(1.12)
Observations	138,871	48,367	48,367	135,008	48,367	47,914	47,423	47,423
R^2	0.87	0.89	0.89	0.87	0.89	0.9	0.9	0.9
Number of clusters	26	25	25	25	25	23	23	23

Notes: Dependent variable is log labor productivity = log (items per hour of labor). Labor hours are obtained by dividing labor cost by hourly wages. Hourly wages are imputed for the countries using data for certain cities obtained from the EIU. Robust standard errors in parentheses (clustered at country level). The sample is divided into two regions (North and South) and four seasons, and all specifications include region-season fixed effects. The index of labor regulation is taken from Botero et al. (2004).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

ers and that could affect labor productivity and yet also be correlated with labor regulations. For example, countries with lower GDP per capita may have bad public infrastructure that impacts labor productivity.

The results in columns (6) and (8) indicate that controlling for variations in exchange rate and for differences across countries in per capita income does not significantly affect the coefficient on the labor regulation measure (or other variables of interest).[27] This in turn suggests that our more basic specifications and results capture the main effects of interest in the data.

5.4.3 Impact of Labor Regulations on Labor Demand

The results in table 5.3 confirm our expectation that labor regulations raise the effective cost of labor. As discussed in section 5.2.4, this effect should also be visible in the demand for labor (i.e., in equation [14]). The results from examining the labor demand specification, shown in table 5.4, are very consistent with those in table 5.3. Conditional on output, outlets in countries with more rigid labor laws hire less labor. As expected from our simple model, the magnitude of the coefficients also is similar between the two tables. Using the most conservative estimate of φ in table 5.4 (0.40), and given the interquartile range in the labor regulation (0.31), we find that an increase in the index of labor regulations from the twenty-fifth to the seventy-fifth percentile is associated with a reduction in conditional labor demand of about 12.4 percent.

5.4.4 Impact of Labor Regulations on Output

As discussed in section 5.2.4, to evaluate the effect on output, in addition to the coefficient on the labor regulation index φ in table 5.3 (or table 5.4), we need to obtain production function parameters α (output elasticity with respect to labor input) and γ (output elasticity with respect to materials), as well as an estimate of the elasticity of demand (μ).

The results from estimating the production function parameters following the specification in equation (16) are shown in table 5.5. As mentioned earlier, given our data limitations, we control for the amount of capital and also for the prices of materials by including store-year-month fixed effects in all specifications. The one exception is column (6), where we include store-year-season fixed effects to check the robustness of our coefficient estimates. Since store-year-month effects would be better controls for store-level capital and material prices, in what follows we focus on the results from columns (1) to (5).

We find a range of estimates for α, from 0.123 to 0.205, depending on the set of control variables we include. We find a much narrower range of values for the γ parameter, from 0.505 to 0.608. In other words, the γ parameter

27. The lack of significance of per capita GDP and its lack of impact on other coefficients is not surprising given that the wage variable is already a close proxy for local income levels.

Table 5.4 Labor demand—conditional on output

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Index of labor regulation	–0.693***	–0.585***	–0.609***	–0.682***	–0.415**	–0.405**	–0.413**	–0.400**
	(0.21)	(0.19)	(0.21)	(0.21)	(0.16)	(0.16)	(0.17)	(0.16)
Log(Quantity)	0.754***	0.771***	0.765***	0.763***	0.766***	0.789***	0.777***	0.785***
	(0.03)	(0.04)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Log(Wage in USD)	–0.751***	–0.754***	–0.756***	–0.742***	–0.725***	–0.678***	–0.707***	–0.685***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.06)	(0.03)	(0.06)
Log(Price in USD)	0.866***	0.878***	0.878***	0.852***	0.870***	0.814***	0.797***	0.804***
	(0.04)	(0.06)	(0.06)	(0.04)	(0.03)	(0.06)	(0.06)	(0.07)
Log(Material cost/sales)							–0.035	–0.037
							(0.10)	(0.10)
Total execution points		0.000				0.048	–0.004	0.045
		(0.09)				(0.14)	(0.11)	(0.14)
Total compliance points		0.053				–0.041	0.002	–0.032
		(0.35)				(0.30)	(0.32)	(0.30)
Outlet age (days/10,000)			–0.036			–0.008	–0.005	–0.001
			(0.09)			(0.04)	(0.05)	(0.05)
No. of experienced employees			0.352*			0.391**	0.326	0.373**
			(0.19)			(0.18)	(0.19)	(0.17)

(*continued*)

Table 5.4 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Average order size)				–0.039		–0.132	–0.153	–0.134
				(0.07)		(0.10)	(0.10)	(0.10)
Franchisee-owned					–0.142***	–0.128*	–0.137***	–0.124**
					(0.05)	(0.05)	(0.05)	(0.05)
Log(Exchange rate)						0.008		0.008
						(0.01)		(0.01)
Log(GDP per capita in USD)						–0.028		–0.021
						(0.07)		(0.07)
Constant	0.084	–0.093	–0.035	0.045	–0.073	–0.560	–0.035	–0.465
	(0.26)	(0.39)	(0.42)	(0.26)	(0.27)	(1.09)	(0.25)	(1.06)
Observations	138,871	48,367	48,367	135,008	48,367	47,914	47,423	47,423
R^2	0.81	0.85	0.85	0.81	0.86	0.86	0.86	0.86
Number of clusters	26	25	25	25	25	23	23	23

Notes: Dependent variable is log labor hours. Labor hours are obtained by dividing labor cost by hourly wages. Hourly wages are imputed for the countries using data for certain cities obtained from the EIU. Robust standard errors in parentheses (clustered at country level). The sample is divided into two regions (North and South) and four seasons, and all specifications include region-season fixed effects.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

Table 5.5 Production function estimates

	(1)	(2)	(3)	(4)	(5)	(6)
Log(Labor hours)	0.123**	0.204**	0.205**	0.125**	0.198**	0.172**
	(0.05)	(0.08)	(0.08)	(0.05)	(0.08)	(0.07)
Log(Materials cost in USD)	0.608***	0.563***	0.563***	0.541***	0.505***	0.535***
	(0.07)	(0.10)	(0.10)	(0.07)	(0.10)	(0.10)
Total execution points		–0.017			0.043	0.018
		(0.04)			(0.03)	(0.02)
Total compliance points		–0.007			0.027	–0.046
		(0.11)			(0.12)	(0.05)
Outlet age (days/10,000)			–2.331**		–3.044**	–0.224
			(1.00)		(1.10)	(0.49)
No. of experienced employees			–0.037		0.038	–0.009
			(0.05)		(0.06)	(0.06)
Log(Average order size)				0.708***	0.721***	0.735***
				(0.05)	(0.08)	(0.09)
Log(Exchange rate)					0.486**	0.464***
					(0.20)	(0.10)
Log(GDP per capita in USD)					–0.059	0.311*
					(0.04)	(0.16)
Constant	1.423***	1.329*	1.985***	1.701***	0.437	3.945
	(0.47)	(0.65)	(0.65)	(0.49)	(1.49)	(2.41)
Fixed effects	Store-year-month	Store-year-month	Store-year-month	Store-year-month	Store-year-month	Store-year-season
Observations	138,274	48,523	48,523	134,469	48,070	48,070
R^2	0.98	0.98	0.98	0.99	0.99	0.98
Number of clusters	27	26	26	26	24	24

Notes: Dependent variable is log output. Output is measured as number of items sold per week, per Company's internal definition and records. Labor hours are obtained by dividing labor cost by hourly wages. Hourly wages are imputed for the countries using data for certain cities obtained from the EIU. Store-month fixed effects in all specifications except column (6), which, for comparison purposes, contains region-season fixed effects. Robust standard errors in parentheses (clustered at country level).

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

estimate is not very sensitive to the inclusion or not of various controls. Also, results in columns (5) and (6) are similar, indicating that estimates are not sensitive to whether we control for store level year-month or year-season effects. The α and γ parameters appear to be reasonable, compared to Cobb-Douglas parameter estimates in the production function literature.[28]

Our production function specification could potentially be affected by endogeneity of input choice, an issue lucidly reviewed in Griliches and Mairesse (1997). The availability of very high frequency data allows us to control for potential unobserved shocks using very detailed outlet-period fixed effects. So long as the remaining residual is unanticipated by the firm, the inclusion of detailed fixed effects would address the endogeneity issue (Griliches and Mairesse 1997). Because we lack data on capital and investment, implementing the Olley-Pakes approach is impractical. The need for outlet-period fixed effects to control for outlet specific capital further makes implementing the Levinsohn-Petrin, or the more recently proposed Ackerberg-Caves-Frazer approach, problematic as well. Accordingly, to check the robustness of our estimates, we adopt the Blundell and Bond (2000) Generalized Method of Moments (GMM) approach that uses suitably lagged input variables (levels for differenced equations and differences for equations in levels) as instruments. The models that passed specification tests (level specifications with 2 to 3 and 2 to 4 lags of differenced dependent variables as instruments) yielded labor coefficient estimates of 0.181 and 0.179, which are within the range obtained with our other specifications. (The GMM results are available on request from the authors.)

Next we turn to estimating the elasticity of demand in table 5.6. Here, the coefficient on the price variable is the elasticity of demand (μ). A key issue in demand estimation is omitted-variable bias arising from unobserved demand shifters that are correlated with both price and quantity. We address this first by eliminating store-specific effects via differencing, and then given the high-frequency of our data, we further control for potential demand shifters that could induce store-specific trends over time within months or seasons through store-year-season or store-year-month fixed effects. In columns (3) and (4), moreover, we restrict our sample to periods such that the change in price is more than 5 percent. We do this because, as noted earlier, we do not observe output price directly, but instead measure it by dividing weekly sales revenue by items sold. Since the latter measure is noisy, in the sense that output mix changes are not reflected in the "items" variable, some of the variation we see in our price data reflects changes in output mix at the store level instead of real price changes. We assume that our restricted samples in columns (3) and (4) are more likely to correctly capture actual variation in price and quantity rather than changes in output mix, and in that sense the results should yield more valid estimates of μ. Finally, as

28. See, for example, Levinsohn and Petrin (2003).

Table 5.6 Demand elasticity estimates

	OLS, FE				IV, FE	
	(1)	(2)	(3)	(4)	(5)	(6)
Log price (first difference)	–1.002***	–1.011***	–1.022***	–1.033***	–1.078***	–1.080***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Constant	0.001***	0.001***	0.000***	0.000***		
	(0.00)	(0.00)	(0.00)	(0.00)		
Fixed effects	Store-year-season	Store-year-month	Store-year-season	Store-year-month	Store-year-month	Store-year-month
Observations	176,338	176,338	56,046	56,046	169,200	169,200
R^2	0.42	0.49	0.65	0.74		
Number of clusters	26	26	26	26	26	26
Shea's first stage partial R^2					0.40	0.41
First stage *F* statistic (joint significance of instruments)					110.42	60.3
Hansen's *J* statistic						0.86
p-value for Hansen's *J* statistic						0.35

Notes: Dependent variable is first difference of log output. Output is measured as number of items sold per week, per Company's internal definition and records. Columns (5) and (6) are instrumental variables regressions. Columns (3) and (4) restrict the sample to periods in which the magnitude of the change in price is above 5 percent. One instrument is used in column (5), namely materials cost per item for outlet *i* (first difference). The same instrument is also used in column (6), along with mean output price (first difference) for the same country-year-week (excluding outlet *i*). Robust standard errors in parentheses (clustered at country level). FE = Fixed Effects Estimation; IV = Instrumental Variable Estimation.

***Significant at the 1 percent level.

**Significant at the 5 percent level.

*Significant at the 10 percent level.

discussed briefly in section 5.2.4, an alternative approach to identifying the demand elasticity parameter is to use an instrumental variables approach. In column (5), we use the average cost of materials per item in outlet *i* as an instrument for price per item at a given store. Note that this instrument has the added advantage that it varies with output mix. In column (6), we add the average price per item in all other stores in the country-month cell as a second instrument. Here we look at the Hansen's J overidentification test and cannot reject the null of the validity of the instruments. Note that for both columns (5) and (6), the joint significance of the instruments in the first stage is high, as is the first-stage Shea's partial R-square, suggesting that our instruments are not weak. Finally, the results imply that material costs per item is a more important instrument than price at other outlets. This is reassuring given that, as argued previously, our material cost instrument is not so subject to the Bresnahan (1996) critique.

Our specifications yield demand elasticity estimates for the entire sample ranging from –1.00 to –1.08.[29] Contrary to the expected effect from omitted demand shifters, however, we find that using instruments here increases the magnitude of the estimated elasticity.

Given our estimates of the four key parameters, table 5.7 summarizes the range of estimates for the coefficient of labor law regulation per equation (15), and accordingly the expected effect of a change in the labor regulation index on outlet-level output. In sum, we find that an increase in labor regulation from the p25 level (= 0.28) to p75 level (= 0.59) leads to a net reduction in outlet level output (conditional on outlet level wages, input prices, capital and demand shifters) of 1.53 percent to 2.65 percent if we use our demand elasticity estimates, and by up to 5 to 8 percent if we assume that demand for the items is infinitely elastic. Note that our lower range of estimates is close to the 2 percent effect on consumption calibrated by Hopenhayn and Rogerson (1993) for a job security tax equivalent to one year's wages for the United States.

5.4.5 Robustness

Our results were obtained using different sets of controls and fixed effects, and in some cases, different instruments. We found that our results were quite robust to these differences. In this section we explore two remaining issues explicitly.

First, as discussed previously, we relied on wage data not only as a regressor in some of our regressions, but also to generate a measure of labor hours per outlet per week from our labor cost data. To verify that our results are robust

29. Note that our estimates of the (short-run) demand elasticity suggest that outlets are operating in the elastic portion of their demand curve, as firms with market power are expected to do. This finding, however, is different from results obtained in Chintagunta, Dubé, and Singh (2003) for supermarkets, and from those of Levitt (2006), which he obtained in the context of a bagel shop.

Table 5.7 Calibrated effect of labor regulation on output

	Low	High
Parameter φ	–0.383	–0.400
Parameter α	0.123	0.205
Parameter γ	0.608	0.505
Interquartile range (p75–p25) in index of labor regulation	0.310	0.310
Assuming competitive output market (infinite demand elasticity)		
Parameter $\frac{1}{\mu}$	0.000	0.000
Coefficient on index of labor regulation in equation (15)	–0.175	–0.283
Effect of p25 to p75 change in index of labor regulation on output	–5.28%	–8.39%
Estimating demand elasticity using equation (10)		
Parameter $\frac{1}{\mu}$	–0.426	–0.384
Coefficient on index of labor regulation in equation (15)	–0.081	–0.146
Effect of p25 to p75 change in index of labor regulation on output	–2.48%	–4.42%
Using estimated demand elasticity (table 5.6)		
Parameter $\frac{1}{\mu}$	–0.926	–0.926
Coefficient on index of labor regulation in equation (15)	–0.050	–0.087
Effect of p25 to p75 change in index of labor regulation on output	–1.53%	–2.65%

to different measures of wages, we reproduced our analyses in tables 5.2, 5.3, and 5.4 using two alternative measures of wages. The first was obtained from Ashenfelter and Jurajda (2001), which provided data for seventeen countries in our sample. We extended this measure to the other countries in our data using GDP per capita data from the UN World Development Indicators. More precisely, we used a simple model to predict wages based on GDP per capita for the remaining countries in our sample.[30] The second measure of wages we used are minimum wages, from the International Labour Organization (ILO). For this measure to be valid for our purposes, we must assume that wages paid at the outlets are the same as the minimum wage (or equivalently, a common multiple of the minimum wage across outlets and countries). We found that the signs and magnitudes of our results were broadly robust to using these alternative wage data sources, though the statistical significance varied across some specifications. In particular, the estimates obtained with these variables were much noisier. For this reason, and because we believe that the actual wage data we obtained from our main source were more appropriate for our purposes, we chose to focus on the previous results.

30. Regressing wages on GDP per capita yields a very good fit—an R-square of about 85 percent.

Second, we examined the effect of another measure of labor market regulation—a cross-country index measuring the extent to which minimum wage laws impact the operations of business—obtained from the Heritage Foundation's *Index of Economic Freedom* database. Since we measure wages at the country level, however, using data on average labor cost or a model based on GDP, our measure of wages paid by outlets (and hence amount of labor) could be systematically downward (upward) biased in countries with relatively higher minimum wage standards given that such standards likely apply in fast food. Thus, we expect the minimum wage regulation index to be positively correlated with measurement error in wages, and hence to be positively correlated with equilibrium labor productivity. Our results were in line with these expectations—we found that countries with more severe minimum wage standards had higher labor productivity levels. Thus, strong minimum wage standards appear to have a similar qualitative impact on retail food outlets as laws constraining the hiring and firing of workers.[31]

5.5 Conclusion

In this study, we used weekly data from the outlets of an international retail food chain to analyze how labor productivity—defined as the number of items produced per worker-hour—varies with outlet characteristics and organizational factors such as experience levels of the workers, average order size, governance, execution, and compliance differences, and a cross-country index of the severity of labor regulations.

We found that (a) execution quality has a negative effect on labor productivity, as expected; (b) outlet age beyond the first year of operation and increases in the number of experienced employees do not have a statistically significant effect on labor productivity; and (c) larger order sizes improve labor productivity. The effect of governance form is ambiguous, and the choice of governance form appears to be correlated with unobserved country fixed effects.

Consistent with Company managers' statements about the importance of controlling labor costs in this industry, we also found that labor laws have a significant and economically important positive effect on outlet-level labor productivity in this international fast-food chain, an effect we showed is due

31. We also redid all our analyses using a measure of the inflexibility in hiring and firing workers obtained from the Global Competitiveness Report (GCR) published by the World Economic Forum (WEF) in collaboration with the Center for International Development (CID) at Harvard University and the Institute for Strategy and Competitiveness, Harvard Business School. This measure is obtained by surveying managers of multinational firms and hence is constructed differently from the Botero et al. (2004) index that we use (which is based on tabulating labor laws and regulations across countries). The GCR measure is not highly correlated with the index of labor regulation from Botero et al. (2004), and there was no statistically significant effect of labor inflexibility on outlet level output and labor demand using this measure.

to the resulting decision of outlets to reduce the amount of labor they use in outlets located in countries with more rigid laws. We found that increasing the index of labor regulations from the twenty-fifth percentile (= 0.28) to its seventy-fifth percentile level (= 0.59) reduces conditional labor demand by about 12.4 percent.

Our data set has unusually high frequency (weekly) data on output and costs that would not be available in most contexts. We exploit this to address some potentially restrictive limitations in the data. The key limitations include the lack of direct data on labor (hours), quantity of materials, the amount of capital, rental rates, and profits at the outlet level. We also lack information on competition/market structure at the local (outlet) level. In particular, our empirical strategy to estimate the effect of labor law rigidity on outlet-level output utilizes outlet-year-season or outlet-year-month fixed effects to condition out unobserved heterogeneity induced by missing data. With this approach, we found that an increase in labor regulation from its twenty-fifth percentile value (= 0.28) to its seventy-fifth percentile level (= 0.59) leads to a net reduction in outlet-level output (conditional on outlet level wages, input prices, capital, and demand shifters) of about 1.5 percent to 2.6 percent (using the lowest estimates of demand elasticity, which yield the most conservative estimates of the effect on output).

Consistent with these findings of a negative impact of labor market rigidities on employment and output, in a companion paper we document that these rigidities lead to hysteresis in labor costs for the outlets of this Company, and specifically reduce the responsiveness of labor costs to changes in both output and output price in economically important ways (see Lafontaine and Sivadasan 2009). Though we cannot rule out the possibility that other factors, including other forms of regulation that might be present in markets with high labor regulation, might be affecting the firm's operations, our work nevertheless suggests that policies that increase labor market rigidities lead to substitution away from labor and cause a net reduction in output levels. These effects, moreover, are documented using data from existing outlets. If labor regulations affect the profitability of the Company's operations, they also likely affect decisions on another margin, namely entry and expansion decisions. Discussion with Company officials and preliminary analyses suggest that indeed the firm has been slower to enter and has established fewer stores in countries with more rigid labor regulations. We conclude that the easing of labor market rigidities would likely yield some increase in employment and boost output in this industry.

Appendix

Definition of Employment Laws Index

This index taken 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 lay-offs; 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.

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