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Roberto Álvarez
Rodrigo Fuentes*

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*rodrigo.fuentes@uc.cl

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Labor Market Regulations and Productivity: Evidence from Chilean Manufacturing Plants*

Roberto Álvarez

Universidad de Chile

robalvar@fen.uchile.cl

Rodrigo Fuentes

Pontificia Universidad Católica de Chile

rfuentes@faceapuc.cl

Abstract

This paper analyzes the effect of minimum wage and labor market regulations on productivity. The main hypothesis to be tested is that an increase in the relative minimum wage could have a negative effect on total factor productivity (TFP) if there are important costs of adjustment like firing costs. Using data for the Chilean manufacturing industry for the period 1992-2005, we find that the effect of relative minimum wage is negative and significant. The quantitative effect on cumulative TFP for an industry in the 25th percentile of relative minimum wage increase was a decline of 5.3% for the period 1998-2005, but for an industry in the 75th percentile of relative minimum wage increase, the cumulative reduction in TFP was 10.2%, over the same period. We also find that the continuous reduction in unilateral trade restrictions and through free trade agreements has been productivity enhancing. This is especially true for those sectors with larger exposure to international trade.

Keywords: TFP, minimum wage, firing costs, slowdown

JEL Codes: O17, J30

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1. Introduction

Since the Asian and the Russian crisis, Latin America has struggled to recover its long term productivity growth. Only in the last few years, mainly due to the high terms of trade, Latin American economies have been growing at a faster pace. Chile has not escaped to this trend. After being a successful example of growth over 1986-1997 (TFP grew at 3%), the aggregate productivity growth rate has dramatically declined over the last 10 years (TFP grew at 0.4%) (Figure 1). The profession has not come out with an undisputable answer to explain this productivity slowdown. Most of studies regarding total factor productivity have emphasized the macroeconomic environment and economic reforms to explain aggregate productivity growth[1]. However, Chile has been an example of good macroeconomic management today and in the recent past (Fuentes and Mies, 2005). In contrast, causal evidence suggests that there are some microeconomic aspects, for example labor and entry regulations, where the Chilean economy shows severe deficiencies (World Economic Forum, 2008)[2]. Then, the effect of microeconomic regulations may be a potential answer to this phenomenon.

The main objective of this project is to explore - using plant and industry data - how changes in regulations have affected productivity, with a special motivation due to the TFP slowdown observed in the Chilean economy starting the new century. One of the challenges to conduct an empirical study on the effect of microeconomic policies on productivity is that most of the policies in Chile are neutral. In contrast to some

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[1] For instance, see Easterly and Levine (2002), Loayza et al. (2005), Easterly (2005). See Fuentes, Larraín and Schmidt-Hebbel (2006) and the references therein for the case of Chile.
[2] The Global Competitiveness Report 2008-2009 ranks Chile in the 14th place over 134 economies in terms of macroeconomic stability, but only in the 56th place regarding innovation.

other countries, there is not regional variation in regulations as those that have been useful to identify their effects in countries like the U.S. and India[3].

We aim to identify the effect of labor regulations on productivity considering exogenous plant and industry characteristics that may have shaped this impact. We exploit changes overtime in employment protection derived from labor reforms and changes in minimum wages during 1992-2005 period. To make us sure that we are not capturing the effect of other regulations, we control also for the differential effect of other reforms like tariff reductions and those implemented in the financial system.

Despite the neutrality of Chilean policies in general, it is possible to observe changes in policies over time (labor's law, minimum wages, and import tariff cuts due to free trade agreements) that would have different effects on the performance of individual plants and sectors[4]. For instance, it can be argued that changes in the labor's law or minimum wage will differently affect plants depending on their unskilled labor intensity[5]. Our identification strategy then is based on the idea that the effect of regulations depends on the exposure of plants to these regulation. In the specific case of minimum wages, we identify its differential effect on plants and industry exposure to an increase in the cost of unskilled labor. What matters, however, is not the increase in wages per se. It can be argued that this change in relative prices could be absorbed by optimal variation in inputs demand. However, in the presence of relevant firing

[3] See, for example, Autor et al. (2007) analyzing the effect of employment protection on productivity in the U.S., and Aghion et a. (2008) studying the interaction effects of entry regulation and labor markets in India. In both cases, the authors exploit the fact that regulations change at different path in the U.S. and Indian states.

[4] Caballero, Engel and Micco (2004) argue that microeconomic inflexibility trough adjustment costs may have explained observed lower productivity for the Chilean economy during the last years.

[5] Montenegro and Pagés (2005) show evidence on how minimum wages and job security provisions affect differently unemployment rate of young versus old workers, skilled versus unskilled workers and men versus women.

cost, such as high severance payments, firms may be unable to adjust employment because is too costly. They may forced by regulation to keep undesired less skilled workers affecting plant's productivity.

Many of these regulations existed in Chile before 1998. The natural question become why did not they affect productivity earlier than that? A hypothesis considered in this work is that labor market constraints did not become binding until the economy experienced a negative shock. This idea is consistent with Blanchard and Wolfers (1999), who present evidence for OECD countries suggesting that observed increases in unemployment rates over time and also across country were the result of the interaction between shocks and labor institutions. Related to our paper is the work by Petrin and Sivadasan (2006), who construct a dynamic model to illustrate how job security affects economic efficiency. The transmission channel suggested by these authors is through the gap between the marginal revenue product and the marginal cost of hiring an additional unit of labor generated by the job security system. They present evidence in favor of their model using Chilean data. Then, these works are consistent with our hypothesis that, in the presence of labor adjustment costs, negative shocks can have significant effects on productivity[6].

One potential shortcoming of using Chilean data to analyze these issues is that this country was an early reformer and, it can be argued, most of the most important policy changes were already implemented.[7] Nevertheless, Chilean labor market tends to be less regulated than other Latin American labor markets; but the economy is well

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[6] Appendix 2 presents a very stylized model to show how the combination of labor adjustment cost and a minimum wage shock may reduce TFP. Moreover, this effect depends on how unskilled labor intensive the firm is.

[7] More important, as suggested by Bergoeing et al (2006) it could be assumed that the effects of most of the early reforms were already in place.

behind the best practices though (See Fuentes and Mies, 2005). In Table 1 we show some comparative labor-market statistics, where Chile ranked above the average of Latin American (LA) economies, but below OECD average and USA, and way below the best practices in the world.

Our results show that the long-term elasticity of TFP respect to relative minimum wage is -0.32. The quantitative effect on cumulative TFP for an industry in the 25th percentile of relative minimum wage increase (341 Paper) was -5.3% for the period 1998-2005, but for an industry in the 75th percentile of relative minimum wage increase (381 Metal Products), the cumulative reduction in TFP was 10.2%, over the same period. This evidence suggests that the large increase in the minimum wage at the end of the nineties exacerbated the negative shock faced by the Chilean economy in 1999 and 2001. We also find that tariff reductions have been TFP enhancing specially for those sectors more exposed to international competition.

The paper continues as follows. Section 2 makes a brief review of the literature that connects productivity and labor institutions. Section 3 revises the main policy changes in the Chilean economy. Section 4 explains the methodology to identify the effect of these regulations on productivity. Section 5 describes the data set. Section 7 analyzes the regression results for the effect of regulations on TFP. Section 8 concludes.

2. Labor Market Regulation and Productivity

There are several aspects about labor market regulation that are similarly considered in the literature: mandatory benefits, job security regulations, minimum wage, among others. Most of these regulations aim to protect workers in case of accident, health problem or to diminish the cost of being laid-off or to balance the bargaining power of workers when negotiating with firm's owners. Benefits for employed workers also have a negative counterpart, for example less protection for unemployed people (Freeman, 1993). Despite the fact that evidence is clear about the impact of most of these regulations on employment (Botero et al., 2004) it is far from clear that labor market reforms may have a negative effect on economic performance (Nickell and Layard, 2000; Besley and Burgess, 2004).

Much of the literature considers employment protection as equivalent to mandated employment benefits. If so, then by raising the cost of employing workers, labor demand will tend to contract accordingly. But, if workers value the mandated benefit at its marginal cost of provision then, by the Coase theorem, the labor supply will shift outward offsetting demand's contraction. No change in the workforce level may occur, but wages decline will cover exactly the cost of the dismissal benefit.

Nevertheless, if workers value the protection less than its marginal cost due to, for example, a third party payment – lawyers, then a deadweight loss emerges. In this situation, both the worker and the firm will find optimal to continue the relationship so long as the present value of the productivity shortfall is less than the deadweight loss. Some unproductive workers will be retained by the firm. However, productivity should be negatively affected.

By offsetting this effect, firms may screen new hires more stringently, leading to a favorable compositional shift in the productivity of the employed force (Autor et al, 2007). Moreover, inefficient dismissal protection may incentive firms to substitute labor with other factors of production. Either a capital deepening process may be observed and/or an improvement on its own R&D effort especially for those close to the technological frontier (Aghion et al, 2006). Therefore, the net impact on technical efficiency, as opposed to allocative efficiency, is far from clear.

The answer provided by the empirical literature on the relationship between productivity and labor regulations, is also ambiguous. One of the main reasons for this ambiguity, as noted by Forteza and Rama (2006), is the difference between what the regulations aims for - *de jure* and what the compliance is - *de facto*. Squire and Suthiwart-Narueput (1997) capture these effects in a parsimonious theoretical model grouping firms in those that evade regulation, complying with the regulations and those avoiding regulations. In their model, the effect on efficiency of labor regulations depends on demand for labor elasticity and the size of the distortion (whether it is binding or not). Facing a new regulation some firms will comply with it or switch to the group of avoiders or evaders, depending of their productivity. Therefore, the aggregate productivity may increase, decrease or remain constant accordingly.

Forteza and Rama (2006) relate labor market rigidity with the success of economic reforms in other areas. Specifically they conclude that reforms on public sectors, openness and financial regulations are more profitable than re-writing a new labor code. The difference between what is written in the law and the practice could explain this result. However, they do not analyze the case of minimum wage and mandatory benefits, which could be more distortive according to them. Following similar lines Calderon, et al. (2007), by using a panel of countries, found that enforceable labor rigidities do negatively affect growth while non-enforceable labor regulations do not.

Other studies look at the impact of labor regulation on the unemployment rate and labor productivity. Heckman and Pagés (2000) present evidence on the negative effect on efficiency and employment of job security regulations in Latin America. Forth and O'Mahony (2003) and Metcalf (2002) argue that the impact of national minimum wage may increase labor productivity through several ways that firms use to adjust to this institution. However the evidence for the UK is inconclusive.

Using data for the Chilean manufacturing industry, Petrin and Sivadasan (2006) investigate the impact of firing cost on efficiency, based in a model of dynamic demand for labor. They find that severance payment creates a wedge between the marginal revenue product and the wage paid to blue and white collar workers, but it not affect the relationship in other input markets. This gap increases when the severance payment increased from zero months to a maximum of five months. Moreover, that increase was even higher when the labor law changed in 1992, increasing severance payment from five months to a maximum of eleven months.

In sum, theoretically and empirically, this literature suggests that the impact of labor institutions on productivity is ambiguous. The following sections provide new evidence on this matter.

3. Economic Policy Changes

As previously discussed, most of the Chilean economic policies has been neutral. Among them, labor market regulations. Nevertheless, we assume that this and other sort of policy reforms may have differentially affected productive sectors depending on for example, their input intensity. In what follows we describe reforms to labor markets that could have impacted firms' inputs allocation starting with the minimum wage.

Minimum wage has been, maybe, the main tool for labor market regulation in Chile. Figure 2 shows the evolution of the real minimum wage, deflated by CPI, and the minimum wage as a fraction of unskilled wages calculated by Beyer (2008). The real minimum wage has increased significantly during the period 1992-2005. The total growth was 72%. It is interesting to note that, compared to the average wage received by unskilled labor, this increase in 27% over the same period. However, as in can be appreciated in Figure %, during the first part of the period the increase was close to zero. The sharper increase in the minimum wage took place between 1998 and 2000, when the Minister of Finance, at that time, negotiated a real increase over three years period with the unions.[8]

This evidence suggests that since 1998, the increase in minimum wage could be turned binding in those plants that use unskilled workers more intensively. It is important to note that on 1998, we observe a structural break in TFP coincident with the Asian crisis that heavily affected the terms of trade for Chile.

A second aspect of labor regulations is related with unemployment insurances and the like. In this work, we use information relative to changes in social contribution payments over the sample period. According to Lora (2001) the social contributions drop from 25 to 21 per cent in 1994. But during 2002 the social contributions raised in 3% due mainly to the effect of a law that establishes an unemployment insurance mechanism that passed on 2001. The Figure 3 presents the evolution of social contributions during the period 1992-2005.

We complement social contributions with a "job security" index developed by Heckman and Pagés (2000) and updated for Chile by Pagés and Montenegro (2007), which combines information on notice periods, compensation for dismissal, the likelihood that firm' difficulties be considered as justified cause of dismissal, and the severance pay that is due in that event.

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[8] There has been a huge discussion in Chile on how these increments would have affected unemployment, which remained very high until about the year 2005. However, there is not much empirical evidence on this issue. Some exception is the work by Cowan et al. (2005).

The following index, described in detail by Pagés and Montenegro (2007), measures the expected cost of dismisses a worker in monthly wages, as follows:

$$\text{Index}_t = \sum_{i=1}^{T} \beta^i \delta^{i-1} (1-\delta)(b + a\,SP_{t+i}^{jc} + (1-a)\,SP_{t+i}^{uc}$$

Where $\boldsymbol{\beta}$ is the discount factor, $\boldsymbol{\delta}$ is the probability to keep the job ***(1-δ)*** is the probability of loosing a job, $\boldsymbol{\delta^{i-1}(1-\delta)}$ is the probability of a worker loose a job after ***i*** periods in the same job, ***b*** is the advance notice cost, ***a*** is the probability that a court will declare the dismissal was by justified causes, $\boldsymbol{SP^{jc}}$ is the tenured related to severance payment under justified cause for dismissal, $\boldsymbol{SP^{uc}}$ is the tenured related to severance payment under no justified cause for dismissal.

Pagés and Montenegro (2007) only present information of this index up to 1998. However, in the Chilean case, there was a change in regulation that took place on December 1st of 2001, when the cost of worker dismissal increased due to a raise in the penalty paid by firms in case a court declares that the cause for dismissing a worker is unjustified. The fine increased from 20% to a minimum of 30% and a maximum of 100% of the severance payment, depending of the fault. Also the courts make more difficult to prove justification for worker dismissal. To update this index, we use the same parameters than Pagés and Montenegro (2007), but taking the maximum value of the fine incorporated in the 2001 legislation. The evolution of this index is presented in Figure 4, and it shows specifically the increase in the cost of labor after the year 2001.

We compute an overall labor regulation index using both indicators. To do that, we standardize these indicators for taking the value 0 when regulation is less severe (the minimum value) and 1 when is more severe (the maximum) value[9]. Then, the labor regulation index is the simple average of both standardized indicators. The index that we include then in the estimations is shown in Figure 5.

Before moving to the empirical analysis it is worth noting that we need to control for other policy reforms that may have affected the evolution of the TFP. As previously suggested by Bergoeing et al. (2006) for the Chilean case, trade barriers and financial reforms may have played an important role.

Since 1979 Chilean import tariffs are uniform across sectors with few exceptions like price bands for some crops and additional taxes on some luxury goods and alcoholic beverages. However, this neutral policy changed over the nineties as a result of free trade agreements signed by Chile with other economies. Therefore, the ***effective*** average import tariff has decreased sharply over this period as shown in Figure 6.[10]

To control of the potential effect of financial development, we consider the variable private credit by deposit money banks to GDP (Beck, et al. 2000). Figure 7 shows the evolution of these measures over our sample period. It can be appreciated that credit to private sector expanded continuously since 1992, but there is a contraction at the end of the sample period.

4. Empirical Methodology

As explained in the introduction, the neutrality of most policies in Chile allows for time series variation of policies rather than cross-industry variation. Thus, the identification strategy proposed in this study closely follows Rajan and Zingales (1998),

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[9] We use the typical standardization $y^{s} = (y - {}^{min})/(y^{max} - y^{min})$.

[10] Becerra (2006) estimated the effective average tariff for the period 2000-2006, and for 1992-2000 the estimation by Bergoeing et al. (2006) is available. Figure 3.5 merges both time series.

in the sense that sectors and plant exposure to each specific regulation are identified *ex-ante* the implementation of the policy.

The general specification for plant-level estimation for looking at the differential effect of regulations on firm productivity is given by:

$$y_{it} = \alpha_i + \alpha_t + \beta x_{it} + \lambda \, \mathrm{Reg}_t * Z_i + \varepsilon_{ijrt}$$

Where y_{it} is total factor productivity (in logs), ***i*** denotes a plant, and ***t*** a year. x_{it} is a vector of plant characteristics, Reg is a measure of regulations, and Z is a vector of plant or industry characteristics that captures differences in exposure to regulations.

When using labor regulations and financial development Reg varies over time; while tariffs vary across industries and over time. In both cases Z_i may vary across industries and plants depending on the type of regulation. This methodology does not allow identify the overall effect of regulations, but it is useful for identifying differential effects on plants and industries that differ ex-ante in their exposure to specific regulations.

The effect of minimum wage is captured by a time and industry varying variable calculated as the ratio between minimum wage and the median wage of unskilled (blue-collar) workers. We check the robustness of our results by using the minimum wage relative to first quartile of unskilled workers. Both variables are measured in logs. The evolution of these two variables averaged across industries is shown in Figure 4.1.

We also exploit the identification strategy followed by Micco and Pagés (2006), who use information for the U.S. industries exposure to volatility in demand or supply shocks. In such a case, we test the hypothesis that the effect of employment regulations will be higher for industries more exposed to volatility in demand or supply shocks.

It should be noted that, similar to most of the recent empirical works using the methodology proposed by Rajan and Zingales (1998), this specification allows to identify the differential effect across industries, and not the overall impact of regulations.

5. Data Description

Our analysis is mainly based on information for Chilean manufacturing plants covering the period 1992-2005. This is the most recent information provided by the Encuesta Nacional Industrial Annual (the Annual National Manufacturing Survey, ENIA) collected by the Instituto Nacional de Estadisticas (National Institute of Statistics, INE). Currently, we have information for the period 1992-2005.[11]

The panel for the ENIA collects information for more than 5,000 plants and contains information on several variables such as sales, output, employment, wages, exports, foreign ownership, and other plant characteristics for each manufacturing plant with at least 10 employees. All monetary variables were converted to constant pesos using 3-digit ISIC level price deflators. In addition, plants are classified according to the International Standard Industrial Classification (ISIC) rev 2.

Table 2 shows the number of plants by year. There are approximately 6,000 plants at the beginning of the period, but about 5,300 plants in 2005. Table 3 presents the

[11] The INE changed the plant identification number in 2000. We have been working in matching plant identification number to construct the entire time series 1979-2005, but the results have been unsatisfactory in terms of plant coverage. There is a significant number of plant for which the matching is imperfect.

distribution of plant by industry for the year 2005.[12] More than on third of the plants corresponds to the food sector (311, according to ISIC), followed in importance by fabricated metals (381) and wood (331) with 9 percent and 6.7 percent of the total of manufacturing plants.

The information provided by the ENIA allow us to estimate total factor productivity at firm-level data using the methodology developed by Olley and Pakes (1996) and extended by Levinsohn and Petrin (2003), as it has been made previously for the Chilean manufacturing industry by Bergoeing et al (2006) and Alvarez and López (2005).

Figure 8 shows the evolution of manufacturing industry TFP during this period. To have a better understanding of the evolution of this variable, we present three indicators of industry average TFP using the unweighted average and the weighted averages using both shares of employment and value added. We find that the evolution of manufacturing TFP, in general, reproduces a similar pattern to aggregate TFP shown in Figure 1. As it can be observed, there is also a change in the trend of this variable after the year 2000, which is little later than the 1998-break experienced by aggregate TFP.

6. Econometric Results

In Table 4 we present the first set of regressions to explain TFP using plant level data. Before moving to labor related variables, results show that there exists some persistence on the TFP series, the coefficient of the lag TFP is around 0.23. Although important, in the sense that there are differences between short and long run impacts,

[12] Given that the number of plants in some 4-digit industries is very low, we work with plants grouped at 3-digit level industries.

the absolute value of this coefficient discards any serious consistency problem in the estimated parameters.[13]

As observed in the Table 4 the coefficient of the minimum wage, whether it is deflated by the median or by the first quartile of blue collars' wages, has always a negative sign. From this we obtain a TFP elasticity respect to this variable of -0.25 in the short run and -0.32 in the long run. Considering the median of the rise in minimum wage respect to unskilled wage across sector was 25% between 1998 and 2005, the cumulative effect on TFP for the median sector was a reduction in 8% for that period.

However, we find that the change in the labor regulation implemented in 2001 has no effect on total factor productivity in any of our regressions. This labor regulation change may have been marginal respect to the previous law. In fact, the 1991 change in labor law was tougher since it increases the maximum severance payment from 5 to 11 months and it modifies the causes to justify firing.

The coefficient of the interaction between tariff and the degree of tradability (measured as import plus export over output for 1992) is negative. This result is expected in the sense that tariff reduction will have a positive effect on TFP and that this effect should be larger for those sectors that are more exposed to international competition.

Given that the estimation includes time effect, we are unable to capture the overall effect of capital market development on productivity. But the negative coefficient of the interaction between exposure to external financing and credit market deepening

[13] Specialized literature suggests that in the presence of highly persistent series and with short panels, GMM techniques are needed instead (Bond 2002), but we have a relatively long panel with a moderate persistence in the dependent variable. Then, we use standard panel data with fixed effects.

suggests, unexpectedly, that as credit market develops firms in industries with higher exposure to external financing have smaller effect on TFP[14]. Nevertheless, the effect of credit market development on TFP is less clear that this effect on growth. In fact, the seminal paper by Rajan and Zingales (1998) found a positive effect on industry growth, but they did not analyze the effect on TFP. In addition, by using external finance dependence using the U.S. data, we may misidentify actual differences across Chilean industries.

As a robustness exercise, we include two additional regressors in the estimation. To control in part for the fact that we are only including surviving plants and TFP could behave differently in plants that are leaving the market compared with incumbents, we include a dummy variable for exiting firms[15]. We also extend our previous results by analyzing whether the increase in minimum wage has a different effect on larger plants. To do that, we include and interaction between relative minimum wage and plant size (measured as the lagged value of log of employment).

Table 5 exhibits these results with these two additional explanatory variables. We find no major change in the rest of the parameters once this variable was introduced. As expected, the parameter value for exit of about 7%, means that exiting plants have on average 7% lower TFP than incumbents. The interaction between size and relative minimum wage is positive, indicating that larger plants are less likely to be reduced their productivity when facing increasing in labor costs.

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[14] Bergoeing *et al* (2006) found a positive effect for both the measure of openness and capital market development, on TFP of the manufacturing industry but for a different time period. However, they do not include all variables simultaneously, but one at the time in different regressions, and they do not control for lagged TFP.

[15] The sample selection sample is not completely solved by this procedure. We also show below estimations using average productivity by industries and our main results hold.

One potential shortcoming of these results is the potential endogeneity of the relative minimum wage variables. In fact, any unobserved shock affecting productivity may also have an effect on wages driving the negative relationship that we have obtained. It is not easy to find an instrumental variable for industry specific unskilled wages. We have tried with several instruments (such as unskilled wages in other industries, investment ratios, and cost of imported materials), but the results reveal a problem of weak instruments. However, we can follow the identification strategy used for the rest of regulations or policy variables. In fact, we may identify ex-ante manufacturing sectors that could be more affected by a minimum wage increase. Then, by interacting minimum wage with this industry characteristic, we may infer the differential effects of this regulation. We measure the exposure to minimum wage regulation by the unskilled to skilled ratio of industries at the beginning of the period.[16].

We show the results of this estimation for our basic regression in Table 6. The results are very similar to those of Table 4. In fact, the significance and sign of the lagged value of TFP and the differential effect of trade barriers and financial development are robust to the inclusion of this new variable. The coefficient of the interaction between minimum wage and the unskilled ratio is negative, suggesting that the TFP reducing effect is larger in plants producing in industries with a larger ratio of unskilled to skilled workers.

We are aware that a more convincing strategy should include some IV estimation, but in absence of good instruments we think that these last results show additional

[16] Both variables are measured in logs.

evidence of a negative relationship between minimum wages and productivity. Note that the variables are defined in different ways and the results still hold[17].

We address the quantitative importance of minimum wages regulations for TFP using the basic results obtained in Table 4. Note that in those regressions we are capturing the differential effect of minimum wages on industries differing in exposure to these regulations. Thus for an industry in the 25th percentile of relative minimum wage increase (341 Paper), the cumulative reduction in TFP was 5.3% for the period 1998-2005, but for an industry in the 75th percentile of relative minimum wage increase (381 Metal Products), the cumulative reduction in TFP was 10.2%, over the same period.

Finally, we show our estimations using average productivity. This estimation allows to have an idea of the quantitative importance of the changes in minimum wages and also to deal with sample selection problems in our previous regressions. As shown, the only robust variable that explains TFP at the aggregate level (besides its own lag) is the ratio of minimum wage to the median (or the first quartile). All the other explanatory variables have a non-statistically significant coefficient. Then, our results al industry-level tend to be consistent with plant-level data. It seems that minimum wages increases have tended to reduce productivity in Chilean plants and that this effect is robust to alternative specifications.

[17] As and additional robustness check, in the appendix 1 we show the results excluding all manufacturing plants in sectors 371 and 372 because this sector show a notable increase in value added share in the last years (see Figure 7.1). The results are very similar to those shown in Tables 8.1, 8.2 and 8.3.

8. Conclusions

The effect of labor market institutions on total factor productivity is at best ambiguous. This paper provides empirical evidence that high minimum wage relative to unskilled worker wage reduces productivity in the presence of cost of adjustment like firing cost. Nevertheless, the unique change to labor laws that passed during the period shows no statistically significant effect on TFP. The reason for this is the lower variability of labor institutions during the period and the fact that main rigidities to labor contracts, like firing cost, were introduced back in 1991.

Results also show that the continuous reduction in trade restrictions unilateral or through free trade agreements has been productivity enhancing. This is especially true for those sectors with larger exposure to international trade. On the other hand, although we were unable to identify the total effect of credit market development on TFP, the marginal impact for those plants with larger external financial dependence was negative. More work is needed to solve this interesting result.

Despite these interesting results there exits a significant decline on TFP evolution starting this century for which we do not have a clear explanation. Nevertheless, the evidence presented here suggests that the large increase in the minimum wage at the end of the nineties could exacerbate the negative shock faced by the Chilean economy during the financial crisis of the end of the past decade.

References

Aghion, P., Burgess, R., Redding, S. J and F. Zilibotti (2008). "The Unequal Effects of Liberalization: Evidence from Dismantling the License Raj in India, *American Economic Review*, 98(4): 1397–1412

Aghion, P., Blundell, R., Griffith, R., Howitt, P. and S. Prantl (2006) "The Effect of Entry on Incumbent Innovation and Productivity". Manuscript. Institute for Fiscal Studies (IFS), London.

Albagli, E., P. García and J. E. Restrepo (2005). "Assessing the Flexibility of the Labor Market in Chile: An international Perspective", in Restrepo and Tokman (Eds.) *Labor Market and Institutions*, Central Bank of Chile, Santiago, Chile.

Álvarez, Roberto (2004), "Sources of Export Success in Small and Medium-Sized Enterprises: The Impact of Public Programs", *International Business Review* 13, 383-400.

Álvarez, R., and R. A. López (2005). Exporting and Performance: Evidence from Chilean Plants. *Canadian Journal of Economics* 38 (4): 1384-1400.

Alvarez, R. and R. Fuentes (2003): "Reforma Comercial y Productividad en Chile: Una mirada 15 años más tarde", *Trimestre Económico*, 70 (277): 21-41.

Alvarez, R. and H. Görg (2007). "Multinationals as Stabilizers?: Economic Crisis and Plant Employment Growth", *Working Paper* No. 412, Central Bank of Chile.

Autor, D. H., W. Kerr and A. D. Kluger. (2007). "Does Employment Protection Reduce Productivity? Evidence from US States", *The Economic Journal*, 117(521):189-217

Becerra, G. (2006). "Arancel Efectivo de las Importaciones Chilenas: 2000-2005", Estudios Económicos Estadísticos, No. 50, Central Bank of Chile. February.

Beck, T., A. Demigurc-Kunt and R. Levine (2000). "A New Database on Financial Development and Structure," *World Bank Economic Review* 14: 597-605.

Benavente J. M., Crespi G. and Maffioli A. (2007), "Public Support to Firm Innovation: The Chilean FONTEC Experience" OVE Working Papers 0407, Inter-American Development Bank, Office of Evaluation and Oversight (OVE).

Bergoeing, R. and F. Morandé (2003). "Labor Market Distortions, Emplyment and Growth: The Recent Chilean Experience", *Working Paper* 251, Central Bank of Chile.

Bergoeing, R. Hernando, A. and A. Repetto (2006). "Market Reforms and Efficiency Gains in Chile," *Working Paper* No. 372, Central Bank of Chile

Bertrand, M. and F. Kramarz (2002). "Does Entry Regulation Hinder Job Creation? Evidence from the French Retail Industry", *The Quarterly Journal of Economics*, 117(4): 1369-1413.

Besley, T. and R. Burgess (2004). "Can Labor Regulation Hinder Economic Performance? Evidence form India", *The Quarterly Journal of Economics*, 119(1): 91-134.

Beyer, H. (2008). "Mercado del Trabajo y Salario Mínimo," Puntos de Referencia No. 93, Centro de Estudios Públicos.

Blanchard, O. and J. Wolfers (1999). "The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence", *NBER Working Papers* 7282

Bond, S. (2002). "Dynamic Panel Data Models: A Guide to Microdata Methods and Practice", *Portuguese Economic Journal*, 1: 141-162.

Botero, J., Djankov, S., La Porta, R., Lopez-de_Silanes F. and A. Schleifer (2004) "The Regulation of Labor". *The Quarterly Journal of Economics*, 119 (4): 1339-1382.

Caballero, R., Engel, E. and A. Micco (2004). "Flexibilidad Microeconómica en América Latina". *Revista Economía Chilena*, 7(2):5-26.

Calderón, C. and J. R. Fuentes (2007) "Characterizing the Business Cycles of Emerging Economies." Mimeo, Central Bank of Chile.

Calderon, C., Chong, A. and G. Leon (2007). "Institutional Enforcement, Labor-Market Rigidities, and Economic Performance," *Emerging Markets Review* 8(1): 38-49.

Cowan, K., Micco, A., Mizala, A., Pagés-Serra, C. and P. Romaguera (2005). *Un Diagnóstico del Desempleo en Chile*, University of Chile and Inter-American Development Bank.

Easterly, W. (2005). "National Policies and Economic growth: A Reappraisal", in Aghion and Durlauf (eds), *Handbook of Economic Growth,* Volume 1A, North Holland: Amsterdam, 1015-1059.

Easterly, W. and R. Levine (2002) "It's not Factor Accumulation: Stylized Facts and Growth Models". *World Bank Economic Review* 15(2):177-220.

Forteza, A. and M. Rama (2006). "Labor Market "Rigidity" and the Success of Economic Reforms across more than 100 Countries", The Journal of Policy Reform, 9(1) 75-105.

Forth, J. and M. O'Mahony (2003). "The Impact of the National Minimum Wage on Labor Productivity and Unit Labor Cost", Research Report, National Institute of Economic and Social Research.

Foster, L., J.C. Haltiwanger, and C.J. Krizan, (1998). "Aggregate Productivity Growth: Lessons from Microeconomic Evidence." NBER Working Paper 6803.

Freeman, R. B. (1993). "Labor Market Institutions and Policies: Help or Hindrance to Economic Development?" Proceedings of the World Bank Annual Conference on Development Economics, Washington D.C.: World Bank.

Fuentes, J. R. and V. Mies (2005). "Una Mirada al Desarrollo Económico de Chile desde una Perspectiva Internacional", *Revista Economía Chilena*, 8(1): 7-33

Fuentes, J. R., Larraín M. and K. Schmidt-Hebbel (2006) "Measuring and Explaining Total Factor Productivity in Chile." *Cuadernos de Economía*, 43(May): 113-142.

Fuentes, J. R., Gredig, F. y M. Larraín 82008). "La brecha de producto en Chile: Medición y evaluación", *Revista Economía Chilena* 11(2):7-30, Banco Central de Chile

Heckman, J. and C. Pagés (2000): "The Cost of Job Security Regulation: Evidence from Latin American Labor Markets," Economia 1.1: 109-144

Levinsohn, J. and A. Petrin, (2003). "Estimating Production Functions Using Inputs to Control for Unobservables." *Review of Economic Studies* 70, 317-41.

Loayza, N., Fajnzylber P. and C. Calderon (2005). *Economic Growth in Latin America and the Caribbean: Stylized Facts, Explanations, and Forecasts*. The World Bank, Washington D.C.

Lora, E. A. (2001). "Structural Reforms in Latin America: What Has Been Reformed and How to Measure it," Inter-American Development Bank (IADB), Working Paper No. 466.

Metcalf, D. (2002). "The National Minimum Wage: Coverage, Impact and Future", *Oxford Bulletin of Economics and Statistics*, 64, Supplement: 567-582.

Micco, A. and C. Pagés (2006). "The Economic Effects on Employment Protection: Evidence from International Industry-Level Data", *IZA Discussion Paper* N° 2433.

Montenegro, C. and C. Pagés (2005). "Who benefits from Labor Market Regulations? Chile 1960-1998", in Restrepo and Tokman (Eds.) Labor Market and Institutions, Central Bank of Chile, Santiago, Chile.

Nickell, S. and R. Layard (2000) "Labor Market Institutions and Economic Performance" in Ashenfelter, O. and D. Card (eds) Handbook of Labor Economics. Amsterdam : North-Holland.

Olley, S. and A. Pakes, (1996). "The Dynamics of Productivity in the Telecommunication Equipment Industry." *Econometrica* 64: 1263-98.

Pagés, C. y C. Montenegro (2007): "Job Security and the Age-Composition of Employment: Evidence from Chile, *Estudios de Economía*. 34 (2): 109-139.

Parente and Prescott (2002)

Pavcnik, N. (2002). "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants "*Review of Economic Studies* 69 (1): 245–276.

Petrin A. and J. Sivadasan (2006). "Job Security Does Affect Economic Efficiency: Theory, A new Statistic, and Evidence from Chile" *NBER Working Papers* 12757.

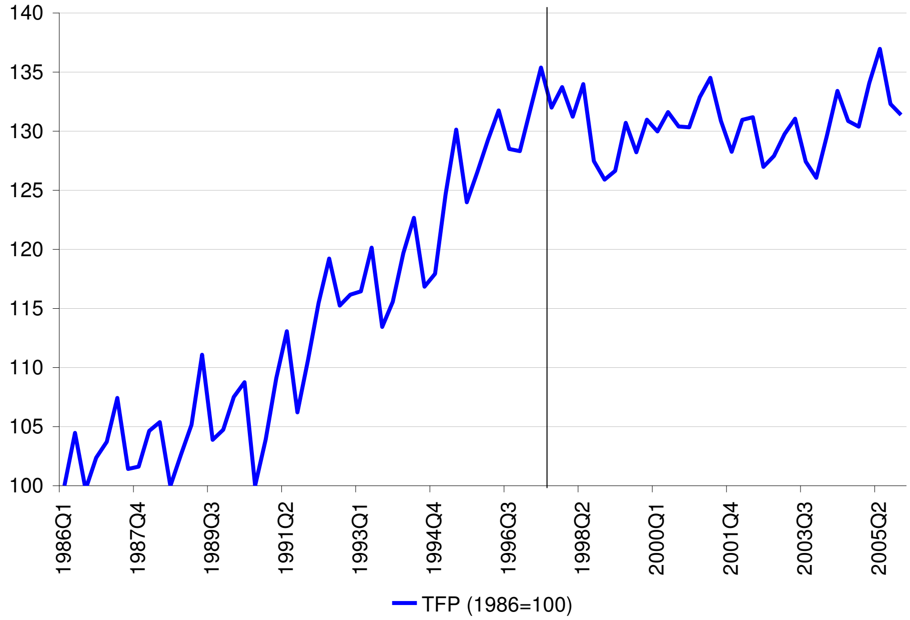
Rajan, R. and L. Zingales (1998). "Financial Dependence and Growth", *American Economic Review*, 88(3): 559-586.

Squire, L. and S. Suthiwart-Narueput (1997). "The Impact of Labor Market Regulations", *The World Bank Economic Review* 11(1):119-143.

World Economic Forum (2008). "The Global Competitiveness Report 2008-2009".

Figure 1

Total Factor Productivity Index

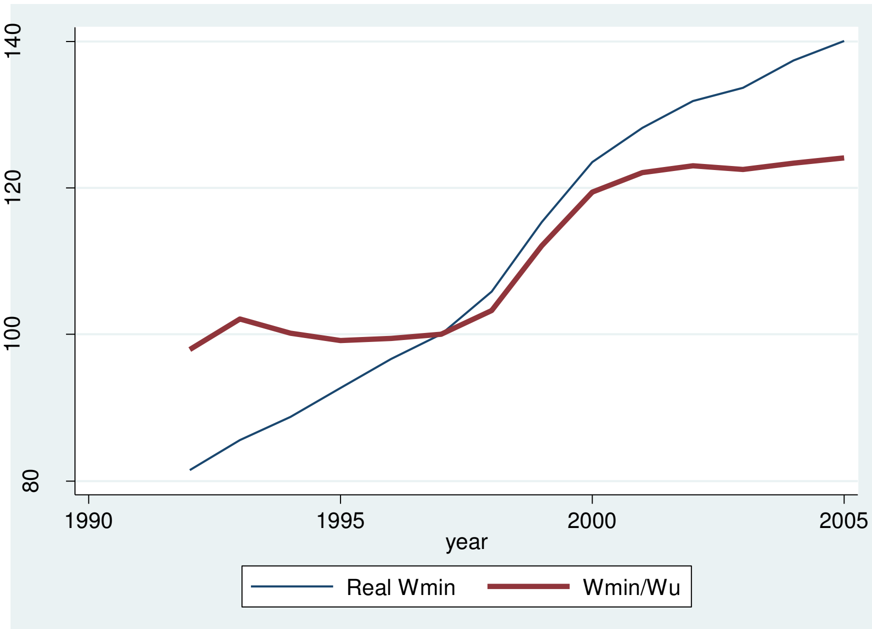


Source: Fuentes, Gredig and Larrain (2007)

Figure 2

Evolution of Real Minimum Wage (Wmin) and

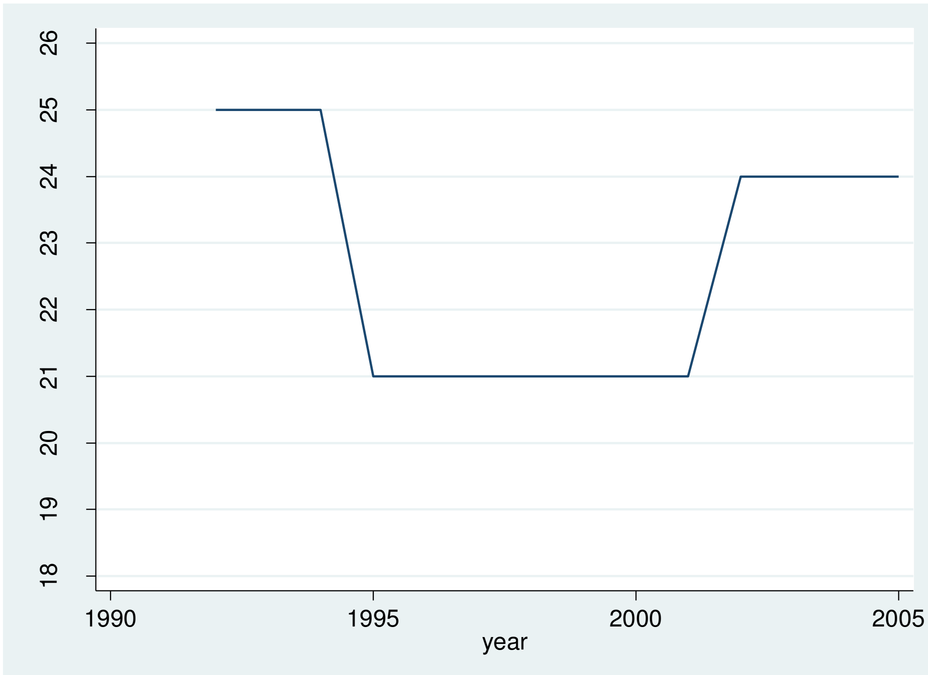
Relative to Unskilled Wage (Wmin/Wu)



Source: Beyer (2008)

Figure 3

Social Contributions in Chile: 1992-2005



Source : Own calculations based on Lora(2001)

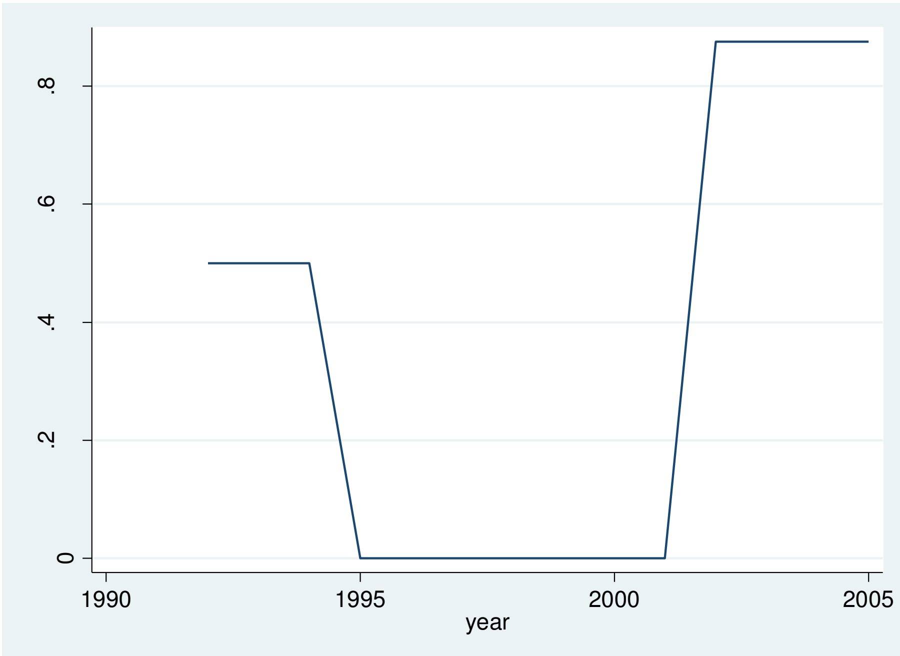
Figure 4

Index of Employment Protection

Source: Pagés and Montenegro (2007) and own´s calculations.

Figure 5

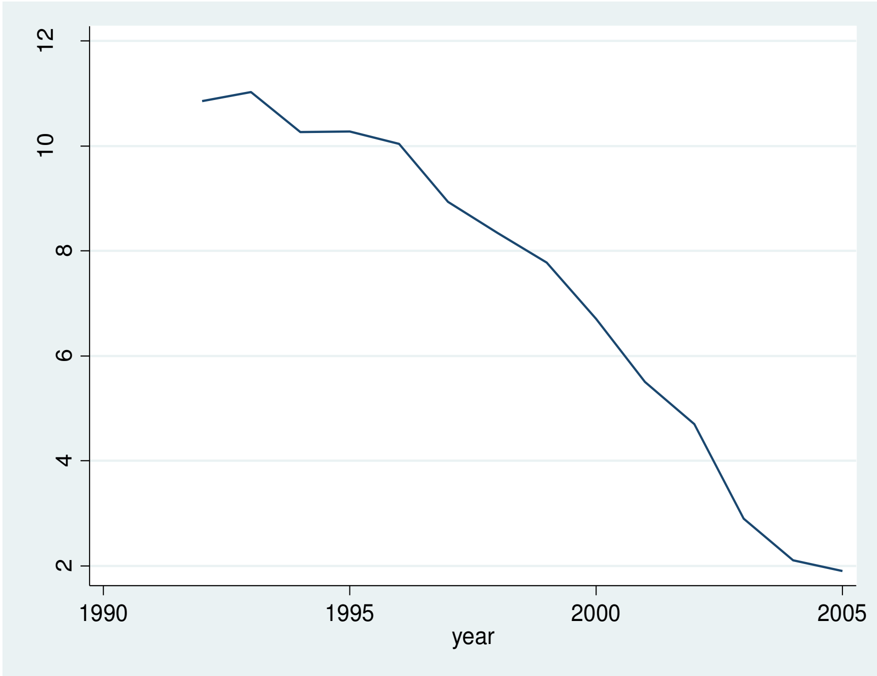
Labor Regulation Index



Source : Own calculations

Figure 6

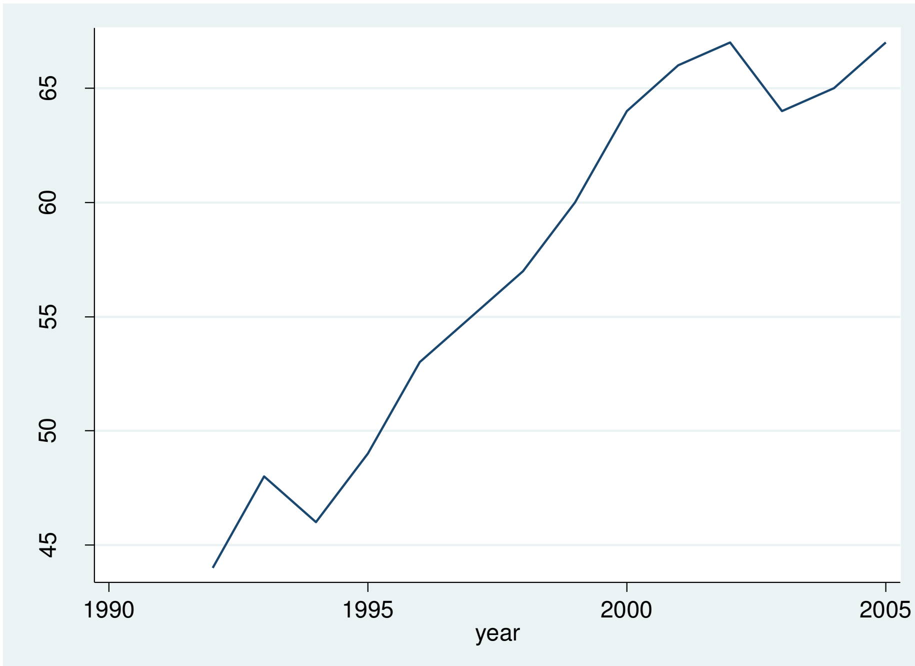
Effective Average Tariff Rate



Source : Own calculations based on Becerra (2006) and Bergoeing et al (2006)

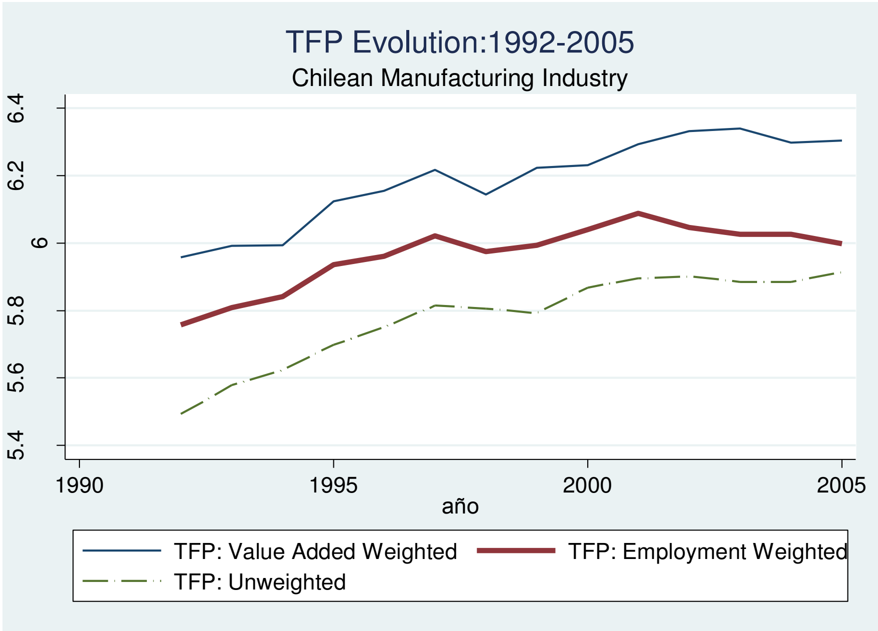
Figure 7

Financial Development



Source : Own calculations based on Beck et al. (2000).

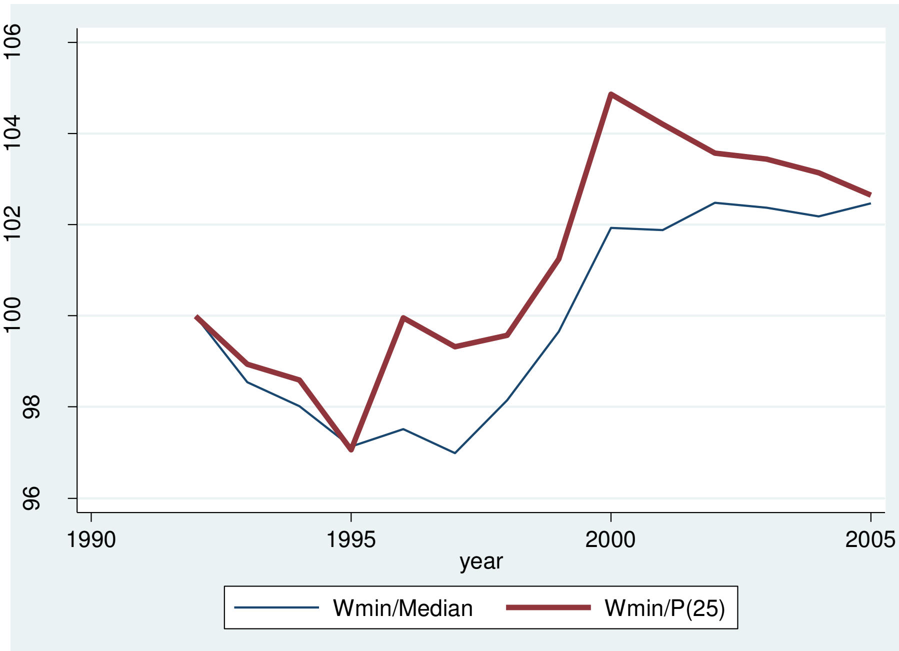
Figure 8



TFP Evolution:1992-2005
Chilean Manufacturing Industry
5.4
5.6
5.8
6
6.2
6.4
1990
1995
2000
2005
año
TFP: Value Added Weighted
TFP: Employment Weighted
TFP: Unweighted

Figure 9

Relative Minimum Wage: Manufacturing Industry



Source: Own calculation based on ENIA.

Table 1

Labor Market Flexibility Condition

(0 means more flexible)

	Chile	LA	OECD	Brazil	Mexico	USA	Best practice
Hiring flexibility	**56**	56	49	78	81	33	17
Market labor conditions	**65**	79	58	89	81	29	22
Firing flexibility	**29**	48	28	68	70	5	1
Labor regulation	**50**	61	45	78	77	22	20

Sources: Fuentes and Mies (2005) using data from Doing Business (2004), World Bank.

Table 2

ENIA and Number of Plants

Year	*Plants*
1992	5937
1993	5935
1994	6256
1995	5111
1996	5465
1997	5317
1998	4862
1999	4800
2000	4632
2001	4790
2002	5171
2003	5155
2004	5447
2005	5326

Source : ENIA

Table 3

Distribution of Plants by Industries, 2005

Industry	*Description*	*Plants*	*Percentage*
311	Food	1,499	28.0
313	Beverages	196	3.7
314	Tobacco	5	0.1
321	Textiles	275	5.2
322	Wearing	198	3.7
323	Leather	36	0.7
324	Footwear	78	1.5
331	Wood	356	6.7
332	Furniture	122	2.3
341	Paper	127	2.4
342	Printing & Pub.	284	5.3
351	Industrial chemicals	93	1.8
352	Other chemicals	208	3.9
353	Petroleum refineries	9	0.2
354	Petroleum & coal	14	0.3
355	Rubber	53	1.0
356	Plastic	292	5.5
361	Pottery	7	0.1
362	Glass	30	0.6
369	Other non-metallic	214	4.0
371	Iron & steel	70	1.3
372	Non-ferrous	98	1.8
381	Fabricated metal	477	9.0
382	Machinery	307	5.8
383	Machinery elec.	89	1.7
384	Transport equ.	88	1.7
385	Prof. & scientific eq	33	0.6
390	Other manuf.	68	1.3

Source : ENIA

Table 4

Productivity and Regulations

	(1)	(2)	(3)	(4)	(5)
log TFP(-1)	0.234	0.234	0.235	0.235	0.232
	(11.99)**	(11.94)**	(12.00)**	(12.05)**	(11.70)**
Log(MinWage/Median)	-0.243	-0.247	-0.245	-0.246	
	(3.05)**	(2.99)**	(3.08)**	(2.97)**	
Log(MinWage/P(25))					-0.195
					(2.75)*
Tariff*Trade	-0.004	-0.004	-0.004	-0.004	-0.004
	(2.32)*	(2.35)*	(2.30)*	(2.33)*	(2.07)*
Labor Reg. *Volatility	0.051			-0.137	-0.024
	(0.09)			(0.23)	(0.04)
Labor Reg.* Unskilled Ratio		0.022		0.021	
		(0.55)		(0.59)	
Labor Reg. *KL			-0.010	-0.008	
			(0.52)	(0.49)	
Finance*Financial Dependence	-0.186	-0.181	-0.188	-0.182	-0.190
	(2.13)*	(2.15)*	(2.23)*	(2.10)*	(2.18)*
Constant	4.536	4.540	4.589	4.581	4.416
	(12.62)**	(12.33)**	(11.71)**	(11.96)**	(12.69)**
Observations	38801	38801	38801	38801	38801
Plants	6775	6775	6775	6775	6775
R-squared	0.39	0.39	0.39	0.39	0.39

Robust t statistics in parentheses. Standard errors clustered at 3-digit industries. It includes 3-digit industry dummy variables and year fixed effects. Median is the median unskilled wage of the industry. P(25) is 25th percentile unskilled wage of the industry. Trade is exports plus imports over output of the industry in 1992, Volatility is a measure of industry excess job reallocation from Micco and Pagés (2006), Unskilled ratio is the industry median in 1992 of unskilled to skilled workers, K/L is the industry median of capital per worker (in logs) in 1992, Finance is a measure of financial development (Private credit by deposit money banks to GDP) and Financial dependence is a measure of industry external finance dependence form Rajan and Zingales (1998). All explanatory variables are one-year lagged. * significant at 5%; ** significant at 1%

Table 5

Productivity and Regulations: Additional Regressors

	(1)	(2)	(3)	(4)	(5)
Log TFP (-1)	0.235	0.235	0.235	0.235	0.233
	(11.94)**	(11.89)**	(11.96)**	(12.00)**	(11.64)**
Log(MinWage/Median)	-0.274	-0.278	-0.276	-0.277	
	(3.51)**	(3.43)**	(3.53)**	(3.41)**	
Log(MinWage/Median)*Size	0.008	0.008	0.008	0.008	
	(2.25)*	(2.25)*	(2.25)*	(2.25)*	
Log(MinWage/P(25))					-0.226
					(3.18)**
Log(MinWage/P(25))*Size					0.007
					(2.27)*
Tariff*Trade	-0.004	-0.004	-0.004	-0.004	-0.004
	(2.34)*	(2.36)*	(2.32)*	(2.35)*	(2.09)*
Labor Reg.* Volatility	0.043			-0.143	-0.031
	(0.08)			(0.24)	(0.06)
Labor Reg.* Unskilled Ratio		0.021		0.020	
		(0.53)		(0.56)	
Labor Reg.* K/L			-0.010	-0.008	
			(0.51)	(0.50)	
Finance*Financial Dependence	-0.191	-0.187	-0.194	-0.187	-0.195
	(2.17)*	(2.20)*	(2.27)*	(2.15)*	(2.22)*
Exit	-0.068	-0.067	-0.068	-0.068	-0.068
	(6.05)**	(6.01)**	(6.02)**	(6.03)**	(6.05)**
Constant	4.537	4.542	4.591	4.584	4.423
	(12.60)**	(12.30)**	(11.63)**	(11.89)**	(12.66)**
Observations	38801	38801	38801	38801	38801
Plants	6775	6775	6775	6775	6775
R-squared	0.39	0.39	0.39	0.39	0.39

Robust t statistics in parentheses. Standard errors clustered at 3-digit industries. It includes 3-digit industry dummy variables and year fixed effects.. Median is the median unskilled wage of the industry. P(25) is 25th percentile unskilled wage of the industry. Trade is exports plus imports over output of the industry in 1992, Volatility is a measure of industry excess job reallocation from Micco and Pagés (2006), Unskilled ratio is the industry median in 1992 of unskilled to skilled workers, K/L is the industry median of capital per worker (in logs) in 1992, Finance is a measure of financial development (Private credit by deposit money banks to GDP) and Financial dependence is a measure of industry external finance dependence from Rajan and Zinagales (1998). All explanatory variables are one-year lagged. Size (-1) is the lagged value of employment (in logs). Exit is dummy variable for plant exit. * significant at 5%; ** significant at 1%

Table 6

Productivity and Regulations: Alternative Definition of Exposure to Minimum Wages Increases

	(1)	*(2)*	*(3)*	*(4)*
Log TFP(-1)	0.239	0.239	0.239	0.239
	(11.71)**	(11.69)**	(11.68)**	(11.86)**
Log(MinWage)*Unskilled Ratio	-0.070	-0.073	-0.070	-0.073
	(5.61)**	(6.17)**	(5.72)**	(6.24)**
Tariff*Trade	-0.004	-0.004	-0.004	-0.004
	(2.27)*	(2.36)*	(2.23)*	(2.37)*
Labor Reg. *Volatility	-0.002			-0.307
	(0.00)			(0.48)
Labor Reg.* Unskilled Ratio		0.040		0.045
		(1.10)		(1.33)
Labor Reg. *KL			-0.012	-0.007
			(0.64)	(0.48)
Finance*Financial Dependence	-0.275	-0.272	-0.280	-0.269
	(2.87)**	(2.97)**	(3.03)**	(2.79)**
Constant	3.949	3.939	4.001	3.995
	(30.72)**	(34.59)**	(33.63)**	(24.66)**
Observations	38805	38805	38805	38805
Plants	6775	6775	6775	6775
R-squared	0.39	0.39	0.39	0.39

Robust t statistics in parentheses. Standard errors clustered at 3-digit industries. It includes 3-digit industry dummy variables and year fixed effects. MinWage is minimum wage (in constant pesos). Trade is exports plus imports over output of the industry in 1992, Volatility is a measure of industry excess job reallocation from Micco and Pagés (2006), Unskilled ratio is the industry median in 1992 of unskilled to skilled workers, K/L is the industry median of capital per worker (in logs) in 1992, Finance is a measure of financial development (Private credit by deposit money banks to GDP) and Financial dependence is a measure of industry external finance dependence form Rajan and Zingales (1998). All explanatory variables are one-year lagged. * significant at 5%; ** significant at 1%

Table 7

Productivity and Regulations: Industry Average TFP

	(1)	(2)	(3)	(4)	(5)
Log TFP (-1)	0.537	0.535	0.535	0.527	0.536
	(21.31)**	(19.34)**	(20.55)**	(15.70)**	(21.51)**
Log(MinWage/Median)	-0.119	-0.144	-0.138	-0.138	
	(1.81)	(2.69)*	(2.41)*	(2.24)*	
Tariff*Trade	0.003	0.002	0.003	0.004	0.003
	(0.58)	(0.45)	(0.80)	(0.76)	(0.73)
Labor Reg.*Volatility	-0.703			-2.339	-0.723
	(0.37)			(0.89)	(0.39)
Finance*Financial Dependence	-0.310	-0.324	-0.315	-0.258	-0.288
	(0.83)	(0.90)	(0.84)	(0.71)	(0.75)
Labor Reg.*Unskilled Ratio		0.103		0.161	
		(1.30)		(1.04)	
Labor Reg.*K/L			-0.034	-0.041	
			(1.00)	(0.91)	
Log(MinWage/P(25))					-0.113
					(3.35)**
Constant	3.298	3.289	3.465	3.648	3.314
	(13.21)**	(11.18)**	(7.77)**	(7.39)**	(13.28)**
Observations	336	336	336	336	336
R-squared	0.30	0.30	0.30	0.30	0.30

Robust t statistics in parentheses. Standard errors clustered at 3-digit industries. It includes 3-digit industry dummy variables and year fixed effects.. Median is the median unskilled wage of the industry. P(25) is 25th percentile unskilled wage of the industry. Trade is exports plus imports over output of the industry in 1992, Volatility is a measure of industry excess job reallocation from Micco and Pagés (2006), Unskilled ratio is the industry median in 1992 of unskilled to skilled workers, K/L is the industry median of capital per worker (in logs) in 1992, Finance is a measure of financial development (Private credit by deposit money banks to GDP) and Financial dependence is a measure of industry external finance dependence from Rajan and Zinagales (1998). All explanatory variables are one-year lagged. Size (-1) is the lagged value of employment (in logs). Exit is dummy variable for plant exit. * significant at 5%; ** significant at 1%

Appendix: The Effect of Minimum Wage and Adjustment Cost on TFP

The objective of this appendix is to give some theoretical framework for understanding how labor market regulations, specifically changes in minimum wage may affect firm productivity. We also show a simple empirical illustration of the mechanism showing how firms differ in their response to positive real exchange rate shocks.

Firms in Chile face labor cost of adjustment and minimum wage that is compulsory for formal firms. Assuming that firms use only labor for production and that there are labor adjustment costs, firms maximize the present value of profit flow:

$$V = \sum_{t=0}^{\infty} \delta^t E_t \left[p_t f(l_t) - w_t l_t - \frac{\lambda}{2}(l_t - l_{t-1})^2 \right]$$

Where δ is the relevant discount factor, pt represents the price of the good produced at time t, f is the production function, l stands for labor, wt for the wage rate at time t and $\lambda>0$ is a parameter that captures adjustment cost. The firs order condition for this problem becomes:

$$p_t f'(l_t) - w_t - \lambda(l_t - l_{t-1}) - \delta\lambda E_t(l_{t+1} - l_t) = 0$$

This condition could be written as:

$$\lambda l_t = \frac{1}{1-\delta}(p_t f'(l_t) - w_t) + \frac{\lambda}{1-\delta} l_{t-1} - \frac{\delta\lambda}{1-\delta} E_t(l_{t+1}) \qquad \text{(A1)}$$

Equation (A1) shows the dynamic of demand for labor for a typical firm in this economy. Note that the amount demanded will be higher the higher is the labor in *t-1*; this is due to the cost of adjustment. At the same time if the expected demand for labor increase in next period it will be reduce today's demand for labor. Without cost of adjustment the quantity demanded for labor comes from the equality between the value of marginal product and the wage market.

If in the previous period there was no minimum wage and firm do not expect any shock in the future, then the optimal amount of labor hired is l^*. If they do not expect any change in condition for period *t* the amount hired will be again l^*, since the first term in the RHS of (A1) will be zero and $l_{t-1}= l_t=E_t(l_{t+1})= l^*$.

The authority unexpectedly increase the minimum wage in *t*, that is expected to last with some changes in the future, and then the value of the marginal product will not be equal to the wage rate, since there is cost of adjustment there would be a gap between this two magnitudes. This gap cannot be eliminated by contracts since in Chile is difficult for firms to reduce wage rate to the worker unless it fire and rehire her, but paying the severance cost.

Let assume, to illustrate the point, that the distortion of minimum will remain in the future in the way that $l_t=E_t(l_{t+1})$, then the condition will become

$$p_t f'(l_t) = w_{min,t} + \lambda(l_t - l_{t-1}) \qquad \text{(A2)}$$

Equation (A2) shows that the value of the marginal product is lower than the minimum wage, since $l_{t-1} > l_t$, implying that the amount of labor hired is greater than the one that equates the value of the marginal product to minimum wage. The reason is the existence of labor adjustment cost.

Due to the adjustment cost, a exogenous increase in the minimum wage will "force" the firm to keep an amount of worker above the equilibrium, let say $l_t=(1+\tau)l^*$ where l_t is the amount of labor kept, l^* is the optimal amount of labor if there is no adjustment cost and τ is the percentage of labor above the optimum. In a general production function with unskilled labor (*l*), skilled labor (*h*) and capital (*k*) of the type:

$$y_t = A_t l_t^{\alpha} k_t^{\beta} h_t^{1-\alpha-\beta}$$

Total factor productivity becomes:

$$\frac{y_t}{(l_t^*(1+\tau))^{\alpha} k_t^{\beta} h_t^{1-\alpha-\beta}} = A_t(1+\tau)^{-\alpha}$$

Where l_t^* is the optimal amount of labor hired when there is no restrictions and all the other factors are assumed to be at their optimum. Note that the effect of the same distortion may affect in a different magnitude each sector, since the parameter α is different for different sectors. Therefore those more unskilled-worker-intensive sectors will be more affected by a minimum wage shock.

In a more general framework, this intuition may be expanded to consider regulation that induces distortions in other inputs markets. Following Parente and Prescott (2002), if the other factors are not at the optimal because there are some costs of adjustment or other restrictions, the TFP will become $A_t(1+\tau)^{-\alpha}(1+\tau_k)^{-\beta}(1+\tau_h)^{-(1-\alpha-\beta)}$, where τ_k and τ_h stand for distortion in the other factor. For instance, the severance payment also affects the skilled workers; therefore a negative supply shock that reduce the marginal product of skilled labor, but due to adjustment cost the firm will keep more workers than the optimal.

For illustrating the mechanism that we have in mind, we use real exchange rate (RER) shocks to show how exposure to minimum wage reduces the effect of RER on firm's employment. For instance, if a RER depreciation increase firms profitability we should expect an increase in output and employment. But, in the presence of labor adjustment costs that are potentially more important for firms more exposed to minimum wages regulations, we expect that more exposed firms exhibit a lower increase in employment, since labor regulation deter hiring.

We carry out a difference-in-difference estimation using the period before the minimum wage increases (1994 through 1996) and the period where the minimum wage increased substantially (1999 through 2001). We differentiate firms by their ex-ante exposure to minimum wages increase. Exposure is defined as a dummy variable equal to one for firms with average unskilled wage relative to legal minimum wage lower than a certain threshold; here we use a threshold of 1.2 for the first period

The following table shows that a positive RER shock (dRER) increase employment in more export oriented industries, but this effect is lower for firms highly exposed to minimum wage increases. This result holds after controlling for firm specific characteristics.

RER Shocks and Plant Employment

	(1)	(2)	(3)	(4)	(5)	(6)
dRER*Export Oriented	2.671	--	2.552	1.821	1.790	--
	(6.38)**	--	(6.16)**	(3.99)**	(3.98)**	--
dRER*Min wage Exposure	-0.380	-0.421	-0.293	-0.259	-0.258	-0.335
	(4.62)**	(4.86)**	(3.48)**	(2.87)**	(2.90)**	(3.63)**
dRER*Exporter			0.487	0.628	0.594	0.558
			(5.01)**	(6.20)**	(5.67)**	(5.14)**
dRER*TFP				-0.058	-0.078	0.109
				(0.97)	(1.30)	(1.62)
dRER*Foreign					0.311	0.030
					(1.45)	(0.14)
Time fixed effects	Yes	no	yes	Yes	yes	no
Time*Industry Fixed effects	No	yes	no	No	no	yes
Constant	3.588	3.796	3.574	3.764	3.775	3.846
	(410.87)**	(36.13)**	(389.11)**	(449.37)**	(444.15)**	(35.12)**
Observations	24542	24542	24542	18604	17657	17657
Plants	6744	6744	6744	5034	4351	4351
R^2	0.05	0.09	0.06	0.05	0.06	0.09

dRER is the annual change in the real effective exchange rate, Export Oriented in the export to sales ratio of the industry, Exporter is dummy for exporter firms, TFP is the log of TFP, Foreign is a dummy for foreign firms, and Min Wage Exposure is a dummy for firms more exposed to minimum wage increases (those with a ratio of average unskilled wage over legal minimum wage lower than 1.2). Robust t statistics in parentheses. * significant at 5%; ** significant at 1%