LABOR REGULATION AND TEMPORARY AGENCY WORKERS

MANUSCRIPT

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Abstract: Using a unique panel database, we identify volatility and plant size as relevant characteristics associated with the intensive and extensive margins of using temporary agency workers (TAW). We also evaluate the effects of a regulation that increased the regulatory burden on TAW. We find a negative impact of this regulation on a plant's total employment (2% decrease) but negligible effects on a plant's value added and production levels. We present evidence of substitution effects. On average, plants that used TAW before the regulation increased the use of permanent workers by 1% and inventory share by 2% after the regulation.

Key Words: employment composition, employment protection, temporary agency workers and volatility.

JEL Classification: J41, J08.

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1. Introduction

Firms are increasingly looking beyond standard employment relationships for flexibility. Although part-time work and fixed-term employment have been the main topics of discussion in simultaneously achieving flexibility and reducing unemployment, temporary-work-agency employment has become a central topic of employment policy in the last decade (OECD 2013). Agency workers are created by a specific type of contractual relationship. They are hired by an agency and temporarily assigned to work into an outside, user firm. In most cases they either perform tasks outside the firm's core business or help the user firm to cope with short-term labor fluctuations.

Using a panel data set for Chilean manufacturing, this research focuses on how the use of agency workers and volatility are interrelated and how this relationship is affected by the regulation of work agency employment. In contrast to almost all previous studies using aggregate and micro data, our framework analyzes the use of agency and regular workers in firms' core business. This is an important distinction because user firms also hire agency workers to perform tasks outside of core business, and in many of these cases agency workers provide the entire service for example security or cleaning. In those cases, agency workers are complementary to regular employees, but when agency workers are involved in the core business they are a substitute n for regular workers. Thus, if firms use agency workers in core processes to cope with short-term labor fluctuation it would be expected that firm-volatility affects the number of agency workers and that firms with more volatility were more greatly affected by the more stringent regulations on agency workers in 2006.

Worldwide, the share of agency workers increased rapidly during the 2000s. According to Storie (2002) within this period atypical employment, particularly temporary agency work and fixed-term contracts, has become deregulated. In Great Britain temporary agency workers were 4.7% of the total workforce in 2007.[1] In Australia they represent 3.7% of total employees in 2002, with their share increasing to 6.1% in manufacturing and 11.7% in electricity, gas and water supply. France also had high levels of agency workers in manufacturing in 2009 (6.9%).

[1] See CIETT Agency Work Key Indicators (2012), Freidin, S., Watson, N. and Wooden, M. (2002) and Korning and Michong (2010).

Temporary agency workers guarantee greater flexibility to firms, but temporary work can have negative effects on the workers themselves. According to Jahn (2008) temporary workers are paid less and experience less favorable labor conditions than other employees. In public debates - especially in Germany - it is often argued that the rise in atypical employment is caused mainly by firms trying to avoid employment protection legislation (See Baumann, Mechtel and Stähler, 2011).

Reflecting on the rising importance of temporary labor in Europe, the European Commission (EC) passed the DIRECTIVE 2008/104/EC on temporary agency work. The EC argues that this type of contract should be in line with "the common principles of flexicurity, which strike a balance between flexibility and security in the labor market." A key aim of this directive is to ensure that "the basic working and employment conditions applicable to temporary agency workers should be at least those which would apply to such workers if they were recruited by the user undertaking to occupy the same job."

Understanding the determinants of the use of agency worker stands as a critical first step in evaluation and in the creation of successful policy recommendations. The theoretical literature identifies three main reasons why firms may use agency workers. First, the common and long-standing interpretation is that agency workers provide a flexible buffer of workers that can be adjusted with few costs in the face of uncertain or fluctuating demand. Second, firms use agency workers to circumvent nondiscrimination requirements in the provision of benefits. Third, agency workers help the matching process in the labor market.

The flexible buffer hypothesis says that agency firms have lower adjustment costs because they may have technological or regulatory advantages. They could be taking advantage of the law of large numbers whenever they face shocks, which are not perfectly correlated, or they could take advantage of loopholes (or lack of supervision) in order to avoid unprofitable regulations.[2]

Cahuc et al. (2012) provides a simple model that explains the choice between hiring permanent and temporary employees. They find that the stringency of legal constraints on job

[2] Bassanini and Garnero (2013) claim it is easier for agency firms than for user firms to avoid regulations. See OECD (2013) for a review.

termination has a strong positive impact on the turnover of temporary jobs. Campbell and Fisher (2004) developed a theoretical model describing a firm's decision to adjust employment of two groups of workers with some of the characteristics of temporary and permanent workers. In their model, because temporary workers are costless to create and destroy, firms using temporary employees are more flexible and can better respond to both idiosyncratic and aggregate shocks. If all firms adapt to heightened idiosyncratic risk in this way, the economy as a whole could better respond to a given aggregate shock.

Houseman (2001) surveyed firms about their use of temporary workers and found that a substantial fraction of firms reported using them to meet demand fluctuations. Dräger and Marx (2012) show that workload fluctuations increase the probability of hiring temporary workers in rigid labor markets, but no such effect is observed in flexible markets.

Second, Ono and Sullivan (2013) argue that the use of temporary workers may allow client firms to circumvent nondiscrimination requirements in the provision of benefits. Jahn and Rudolp (2002) find that wages of temporary agency employees in Germany are roughly two thirds of those of permanent employees. With reference to Europe (EU-15) Nienhüser and Matiaske (2006) show that temporary workers' working conditions and compensation are clearly poorer than the conditions of those with standard employment contracts. Boeri (2011) shows that workers with temporary contracts are one of the most vulnerable groups in economic downturns.

The third hypothesis focuses on the matching process in the labor market. Jahn and Rosholm (2012) argue that agency employment is valuable to workers because it allows them to gain experience, thereby representing a stepping-stone into a stable and regular employment. Agency workers allow firms to 'try-out' potential permanent recruits at little or no risk. Workers are able to gain experience and show their abilities. Author (2003a, 2003b) points out that firms may use agency workers to facilitate screening. Agency firms induce self-selection and perform screening of worker ability, and then sell this information to their clients. Given the sometimes significant costs of dismissing poorly performing employees, a firm may want to first observe their performance as temporary workers. Houseman et *al.* (2003) develop this line of reasoning, predicting that the use of agency workers for screening purposes will be pro-cyclical because during a period of tight labor markets firms will be more open to hiring the most risky workers. They also claim that during tight labor markets,

employers will pay agency workers more than their regular employees in order to gain additional time to recruit employees and thereby avoid raising wages for new hires and existing employees. However, the introduction of a two-tier wage system may prove damaging to morale and productivity among the existing workforce. By using agencies, not only can firms benefit from recruiting, screening, and matching advantages, but also new workers can be paid at higher (or lower) rates without upsetting internal wage structures.

Chile is an interesting case to study. First, like most European countries, Chile had a rapid expansion in the number of agency workers during the first few years of this century. Second, it has unique longitudinal and microeconomic business data, allowing for a closer look at these changes. The main distinguishing feature of our dataset is that it has plant-level information for agency and regular workers in the production process (core business). Third, in 2007 Chile regulated the market of agency workers, before many of developed countries.[3]

Figure I presents the share of agency workers involved in the production function in the manufacturing sector. On average, there are 35,000 temporary agency workers in the manufacturing sector between 2001 and 2011. These workers represent 10.2% of total manufacturing employees. The share went from 7% in 2001 to 13% in 2006 and fell after the 2007 labor regulation.

[Figure I here]

The aim of the Chilean regulation on Agency Workers Employment[4] created in October 2006 and enforced since January 2007 was to level working conditions between agency and regular workers and to enforce temporary workers' labor rights. This regulation states that:

i. The user companies become accountable for labor rights of agency workers, including severance payment. In fact, the Law states that in front of a violation of the Labor Code, agency workers may sue either the agency or the user firm.
ii. The user firms have the right to request information from temporary-work agencies about labor status and labor rights compliances of their agency workers. If the agencies do not prove timely compliance with Labor Code obligations, then

[3] For instance, the Agency Workers Regulations in the UK, which came into force on 1st October 2011.
[4] Law 20.123

the user firms are allowed to withhold the appropriate amount from the agency fee in order to accomplish with agency workers labor rights. In this case the user firm has only subsidiary liabilities, which means that agency workers may sue the user firm only after the persecution of the agency responsibility has been exhausted.

iii. The user firms must guarantee the health and safety of agency workers. Since 2007 user firms are responsible of effectively protect the life and health of all workers at their work, whatever their dependence.

Figure II analyzes the impact of this labor regulation on both intensive and extensive margins. We divide the intensive margin in two components: the share of temporary agency workers in plants with this employee type (Int-Marg TAW-Emp Share) and the relative size of plants with temporary agency workers (Int-Marg TAW-Plant Size). The extensive margin is the share of plants with temporary agency workers in the manufacturing sector (Ext-Marg TAW-Plant Share). The multiplication of these three margins is equal to the share of temporary agency workers in the manufacturing sector (Agency Workers Share in Figure I). Formally:

$$TAW\ Share = \frac{\sum_{i \in TAW} S_i}{\sum_{i \in TAW}(S_i + C_i) + \sum_{i \notin TAW} C_i}$$

$$= \underbrace{\frac{\sum_{i \in TAW} S_i}{\sum_{i \in TAW}(S_i + C_i)}}_{Int.Marg.TAW-Emp\ Share} * \underbrace{\frac{\frac{\sum_{i \in TAW}(S_i + C_i)}{N_{TAW}}}{\sum_{i \in TAW} \frac{S_i + C_i}{N_{TAW} + N_{-TAW}} + \sum_{i \notin TAW} \frac{C_i}{N_{TAW} + N_{-TAW}}}}_{Int.Marg.TAW-Plant\ Size} * \underbrace{\frac{N_{TAW}}{N_{TAW} + N_{-TAW}}}_{Ext.Marg.TAW-Plant\ Share}$$

Where S_i and C_i are temporary agency workers (sub-contracted) and regular workers (contracted) in plant i. N_{TWA} and N_{-TWA} are the number of plants with at least one temporary worker and without any respectively.

[Figure II here]

Between 2001 and 2006 the share of plants with temporary agency workers increased from 0.14 to 0.17. On average, the size of these plants is approximately twice the size of others. The relative use of TAW intensified from 24% in 2001 to 35% in 2006. After the 2007 regulation, the share of firms that used temporary agency workers dropped from 0.17 in 2006

to 0.09 in 2011. The share of temporary agency workers went from 35% to 33% in the firms that used them during the same period while the relative size of plants that use these workers increased after the reform. These results suggest that the 2007 reform increased both the relative cost of temporary agency workers *vis-a-vis* permanent workers as well as the fixed cost of having agency workers.

As Ono and Sullivan (2013) say, *"it is rare that a survey collects data on the use of temporary workers at the level of the individual business establishment. Such data limitations have prevented researchers from learning the characteristics of firms that use temporary workers."* In this paper, using Chilean data we are able to identify firm's volatility and plant's size as the main characteristics of firms that use agency workers.

Figure III presents the relationship between the share of agency workers and volatility. We compute volatility as the 7-year standard deviation of log change in log value added (A) and log change in log total employment at the plant level (B).[5] We have divided the plants in quantiles by volatility. Each quantile contains 5% of plant/year observations. Plants in the lower quantile of volatility also have a lower share of agency workers (un-weighted or weighted by total employment at the firm level). The weighted share of temporary agency workers in the 5% of firms that faced the lowest volatility (SD of log change of VA) is 0.06, whereas this same share increases to 0.14 in the 5% of firms that faced the most volatility. Figure IIIB shows the same results when we use the SD of log change of log employment as our measure of volatility. In this case, the same share goes from 0.07 to 0.22. This figure suggests a strong correlation between temporary agency workers and volatility.

[Figure III here]

Furthermore, the Chilean data also shows a strong correlation between the use of temporary agency workers and the plant's size. Figure IV presents the relationship between the share of temporary workers and the plant log value added. Again, plants are divided by size into quantiles.

[Figure IV here]

[5] We consider the period 2000-2006 before the regulatory change was enforced.

Figure 4A presents a strong correlation between temporary agency workers and the plant-size. On average the smallest 5% of plants use only 1% of the temporary agency workers. This percentage increases to more than 11% for the largest 5%. No matter how many temporary workers are used, there have to be contracts with the agency that provides the temporary workers. Figure 4B presents the relationship between plant-size and the average share of temporary agency workers only in plants that have at least one temporary worker. On average, 23% of the workforce are temporary agency workers in these plants and there is not relationship between share of agency workers and plant-size when we only consider plants with at least one temporary agency worker. These two results suggest that there are important fixed costs for hiring agency worker.

Finally, Figure V presents contour diagrams to look at the joint relationship between plant-size, plant's volatility, and share of TAW. The x-axis represents plant volatility and the y-axis plant-size. Diagrams are colored white for the lower share of temporary workers, grey for middle levels, and black for high levels.

[Figure V here]

When we use the standard deviation of the last 7 log changes of value added or employment to capture the volatility faced by plants (Figure VA and VB, respectively), we have that conditional to size quantile, the share of TAW increases when volatility increases. Small plants that face low volatility do not use temporary agency workers, while the share of TAW is significant in large plants that face high level of volatility, independent of how we proxy volatility.

This result seems to be consistent with the hypothesis that firms use TAW to deal with volatility. In the last section of the paper we test this hypothesis by using the regulation on TAW and the plant's inventories share. As Figure VI below suggests, after the regulation temporary agency workers were substituted by an increase in the inventory shares, which supports the idea that TAW help to deal with volatility. During the first part of the sample, plants increased the share of TAW from 7% in 2001 to 13% in 2006, whereas the inventory-sale ratio falls from 16% to 11%. After 2006, TWA share falls to 9% in 2010 and then stabilizes. The inventory-sale ratio increases to 17% in 2010.

[Figure VI]

The paper proceeds as follows. In Section 2 we present a simple theoretical model for a firm's labor demand in a volatile environment with two type of workers, and Section 3 describes the data used. Section 4 presents our estimates and is divided into three parts: i. "Agency Workers, Volatility and Labor Regulation on TAW" in which we test the predictions from the theoretical model; ii. "Effects of the Regulation on TAW" where we report the estimates of the impact of TAW regulation on regular employment, total employment, production and value-added; and iii. "Volatility, Agency Workers and Inventories" presents the relationship between inventories, volatility and the effect of the TAW regulation. Finally, Section 5 concludes.

2. Theoretical Model

Expanding on Bertola (1990), we consider a risk neutral firm with two types of workers that dynamically chooses the optimal combination of regular (C) and agency workers (S) to maximize its discounted cash flows:

$$\text{Max VPD} = \mathrm{E}_t \left\{ \sum_{i=0}^{\infty} \left(\frac{1}{1+r} \right)^i \left(R(Z_{t+i}, C_{t+i}, S_{t+i}) - (W_{t+i}^C C_{t+i} + W_{t+i}^S S_{t+i}) - A(C_{t+i} - C_{t+i-1}) \right) \right\} \tag{1}$$

Where $\mathrm{E_t}$ is the expected value operator, r is the interest rate, $\mathrm{R(Z, C, S)}$ is the revenue function, $\mathrm{Z_t}$ reflects the market conditions, $\mathrm{A(.)}$ is a function of adjustment costs of regular workers, W_t^C denotes the exogenous wage for regular workers, and W_t^S represents the variable costs for the user firm to have an extra agency worker. The agency worker has a contract relationship. Therefore W_t^S is not the wage received by workers because it also includes a variable agency fee and labor benefits required by law.

Assuming a CES production function and a constant demand price elasticity:

$$R(Z_{t+i}, C_{t+i}, S_{t+i}) = Z_t \left\{ (C_t^{1-\frac{1}{\sigma}} + (1-m) S_t^{1-\frac{1}{\sigma}}) \right\}^{\frac{\alpha\sigma}{\sigma-1}}, \ \alpha = 1\text{-}\theta$$

(2)

Where σ is the elasticity of substitution between type of workers, $(1-m)$ represents the relative efficiency of agency workers ($0 \leq m \leq 1$), $|-1/\theta| > 1$ is the price elasticity, and Z_t is the market condition that follows a two state Markov process. There is a good state Z_G that persists with probability P_G, and a bad state Z_B that persists with probability P_B. Naturally, $Z_G > Z_B$. Finally, the firm pays adjustment costs given by the piecewise linear function A(.):

$$A(C_t - C_{t-1}) = \begin{cases} h\, W_t^C\, (C_t - C_{t-1}) & si\ C_t - C_{t-1} > 0 \\ -f\, W_t^C\, (C_t - C_{t-1}) & si\ C_t - C_{t-1} < 0 \end{cases}$$

(3)

Where the cost per hired regular worker is hW_t^C, and the cost per fired regular worker is fW_t^C. From the first order conditions we derive the ratio between agency and regular workers in the good and in the bad state, $(S_t/C_t)_G$ and $(S_t/C_t)_B$ respectively:

$$\left(\frac{S}{C}\right)_G = \left(\frac{(1-m)W^C}{W^S} \ \frac{(1+r) + hr + (1-P_G)(h+f)}{1+r} \right)^{\sigma}$$

$$\left(\frac{S}{C}\right)_B = \left(\frac{(1-m)W^C}{W^S} \ \frac{(1+r) + fr + (1-P_B)(h+f)}{1+r} \right)^{\sigma}$$

(4)

Using these ratios and the probability of each state, is possible to calculate the average or expected ratio:

$$\overline{\left(\frac{S}{C}\right)} = \frac{(1-P_B)\left(\frac{S}{C}\right)_G + (1-P_G)\left(\frac{S}{C}\right)_B}{(1-P_B) + (1-P_G)}$$

For simplicity, in what follows we assume that $P_B = P_G = 1 - \delta$ and $h = 0$.[6] It means that the probability of transition between states is unique and equal to δ. Under these assumptions, our variable of interest, the expected ratio is given by:

$$\overline{\left(\frac{S}{C}\right)} = \frac{1}{2}\left(\frac{W^C}{W^S / (1-m)}\right)^{\sigma}\left[\left(1 + \frac{\delta f}{1+r}\right)^{\sigma} + \left(1 - \frac{(r+\delta)f}{1+r}\right)^{\sigma}\right] \tag{5}$$

Finally, we consider the existence of a fixed cost associated with having agency workers FC_{it}. This mainly refers to the existence of costs of monitoring, searching, designing and administrating a contract with the TAW agency. Therefore, a plant i in sector j will decide to use agency workers ($e_{ijt} = 1$) in period t if the net present value to have them, which include the FC_{it}, is greater than the net present value of not having them:

$$e_{ijt} = \begin{cases} 1 & NPV\left(\Pi\left(Z_t, \delta, f, C^*_{ijt}, FC_{it}, S^*_{ijt}\right)\right) \geq NPV\left(\Pi\left(Z_t, \delta, f, C^{**}_{ijt}, 0, 0\right)\right) \\ 0 & Otherwise \end{cases} \tag{6}$$

Where C^*_{ijt} and S^*_{ijt} represent the optimal level of employment with agency workers and C^{**}_{ijt} without them.

This model helps us to understand the relationship among employment protection, volatility and different worker types. In particular, the cost of firing permanent workers f and the payment W^S for each TAW represent how stringent the labor regulation is while the transition probability δ represents the volatility (how often and by how much the state variable Z_t changes).[7] An interesting result comes from taking the derivative of the average agency to regular workers ratio with respect to volatility:

$$\overline{\left(\frac{S}{C}\right)}_{\delta} = \frac{\sigma}{2}\left(\frac{W^C}{W^S / (1-m)}\right)^{\sigma}\frac{f}{1+r}\left[\left(1 + \frac{\delta f}{1+r}\right)^{\sigma-1} - \left(1 - \frac{(r+\delta)f}{1+r}\right)^{\sigma-1}\right] \tag{7}$$

[6] The results hold without this simplification.

[7] The variance of the market condition is given by: $VAR(Z_t - Z_{t-1}) = E(\Delta Z_t^2) - [E(\Delta Z_t)]^2 = \delta(\Delta Z_t)^2$

Equation (7) shows that whenever there is enough substitution between agency and regular employment ($\sigma > 1$) the optimal ratio will be increasing with respect to volatility.[8] Regarding this relationship between TAW and volatility, Ono and Sullivan (2013) have found that those plants that had more uncertainty about future demand are also those that tend to use more agency workers.

Furthermore, from equation (7) it follows that this derivative of the average agency to regular workers ratio with respect to volatility is increasing in f, the adjustment cost associated with regular workers. Therefore, another prediction of this model is that when labor regulations for regular workers become more stringent, the use of TAW increases by more in firms facing higher volatility. This result seems consistent with previous theoretical and empirical studies that show a relationship among volatility, agency workers and regular employment protection. For instance, Cahuc *et al*. (2012) argue that labor regulation increases the use of TAW when firing costs associated with permanent workers are high and also when it is expected that production opportunities will be limited. Marx and Drager (2013) tested and confirmed these conclusions. Our paper, however, is about the regulation of TAW more than regulation of regular employment. Based on the model, the 2007 Chilean regulatory reform on TAW had two effects: First, the principle of solidarity and subsidiary liabilities created additional costs for firms to hire agency workers because they are required compensate TAW if their agency violates the Labor Code. This is equivalent to an increase in unit cost per workerW^S. Second, this legislation established that firms will not have solidarity liabilities if they enforce their "right to be informed" about the conditions that temporary agencies provide to their employees. This implies an increase in monitoring costs, which seems reasonable to assume as a compound fixed and variable cost (W^S and $FC^S{}_i$).

Theoretically, the increase in fixed costs per subcontracted worker $\Delta FC^S{}_{it}$ will decrease the number of firms for which it is optimal to use TAW. Additionally, the increase in the expected cost per subcontracted worker W^S will decrease the expected ratio of temporary to permanent workers. Furthermore, this model also predicts that the agency-regular ratio should fall more in more volatile firms after the regulation.[9]

[8] Our estimates support the assumption that the elasticity of substitution between agency and regular workers is larger than 1. Details about this calculations are presented in the next section and in the Appendix.
[9] This comes from equation (7) which is decreasing in the variable costs of using temporary agency-workers W^S.

3. Data

Our data comes from the Chilean Annual Manufacturers Survey (ENIA) for 2000 to 2011. The ENIA is an unbalanced panel of all the manufacturing plants with more than 10 employees (approximately 50% of total manufacturing employment). It includes information at the plant level about employees, inventories, raw materials, sales, output, value added, etc. It also provides information on industry classification codes for 29 manufacturing sectors that correspond to the 3 digit ISIC codes (revision 3). It is worth notice that the employment data on agency workers refers to employees who have the same jobs as regular workers. Completely outsourced functions such as cleaning or security tasks are not included.

For our empirical estimations we define two measures of volatility at the plant level: the 7-years standard deviation of log change in log value added and also the 6-year standard deviation of log change in total employment. We only consider the seven-year period before the regulation was enacted (2000-2006) in order to not contaminate this measure with the reform's effects. The construction of these variables naturally excludes plants that do not exist for at least two consecutive periods before 2007. This accounts for 25% of our original sample.

We also compute plant level inventories share as the average annual value of the plant´s stock over the plant´s annual value of sales. Plants for which the value of the stock or of manufactured products sold is zero or not are reported are excluded. Thus we lose an extra 7% of the original sample but all our main results are robust to include these observations.

Finally, we constructed the proxy for each sector's elasticity of substitution between agency and regular workers using the equations in (4) from the previous section. We do so by subtracting the log ratio between the agency-permanent worker ratio in good $(S_t/C_t)_G$ and bad $(S_t/C_t)_B$ states:

$$(s_t^G - s_t^B) - (c_t^G - c_t^B) = \sigma \underbrace{\left[\ln(1+r+\delta f) - \ln(1+r-(r+\delta) f)\right]}_{K>0} \tag{8}$$

We use (8) to compute the substitution elasticity at the sector level (σ_j) up to a positive constant (*K*). We define good and bad states using an indicator function $I_{\Delta E_{ijt}}$ that takes a value of one when total employment increases and minus one when it decreases. We use OLS to get $\hat{\sigma}$ from the following specification:

$$\Delta \ln(S_{ijt}) - \Delta \ln(C_{ijt}) = \sum_{isic} \sigma_{isic} I_{\Delta E_{ijt}} + \sum_{isic} D_{isic} + \sum_{year} D_{year} + \varepsilon_{ijt} \quad (9)$$

The sample average $\hat{\sigma}$ (from estimated sector coefficients $\hat{\sigma}_{isic}$) is 0.18.[10] Thus, based on (8) if we used a reasonable annual real interest rate of 5%, a severance payment of one month per year of tenure (1/12), and a probability of transition equals to 0.5, then K equals to 0.08.[11] This value of K implies an average substitution elasticity of 2.2 (>1).

Finally, we construct two measures of temporary agency workers, the first is the log ratio between temporary agency workers and regular workers and the second is the share of temporary agency workers on total employment. Total employment is defined as the sum of agency and regular (or permanent) workers. Data on agency workers is available only since 2001.

In Table 1 we include all the variables that we use in our empirical set up and present descriptive statistics for two samples: (a) all plants and (b) plants with at least one TAW.

[Table I here]

The elasticity of substitution corresponds to our calibrated estimates at the sector level while ratio wages correspond to the ratio between the average wage paid to agency workers over the average wage paid to regular workers at the sector level. Value added and Output are expressed in millions of Chilean 2012 pesos.

[10] 24 out of 27 sectors have the positive substitution elasticity that we assume in our theoretical model. The other 3 industries have a negative coefficient, although they are not different from zero at conventional levels. Twenty sectors present a positive coefficient that is statistically different from zero at conventional levels. The estimates are available upon request.

[11] Our measure of K goes from 0.006 when the probability of transition is 0.01 to 0.16 when this probability is 0.99. Hence, the elasticity of substitution goes from 18 to 1.125 respectively.

4. Econometric Set-up and Results

4.1 Agency Workers, Volatility and Labor Regulation on TAW.

Following our theoretical model, we are interested in estimating the relationship between the ratio of agency to regular workers S/C, firm volatility and the regulation on TAW. For doing so, we use both a sample selection model and a fully non parametric model. The former is needed to tackle down the sample selection bias arising from not observing the ratio of agency workers for those plants that do not use TAW. The latter is for checking the robustness of our results.

Regarding the sample selection model, following Puhani (2000) we implement a Full-Information Maximum Likelihood approach to jointly estimate the following sample selection model:

$$Log\left(\frac{S}{C}\right)_{ijt} = \beta_0 + \beta_1\delta_{ij} + \beta_2\sigma_j + \beta_3\left(\frac{W_s}{W_c}\right)_{jt} + \gamma_t + \epsilon_{ijt}$$

Main equation

$$Log\left(\frac{S}{C}\right)_{ijt} = \alpha_0 + \alpha_1\delta_{ij} + \alpha_2\sigma_j + \alpha_3\left(\frac{W_s}{W_c}\right)_{jt} + \alpha_4 Z_{ijt} + \gamma_t + \epsilon_{ijt}$$

Selection equation

Where i stands for firm, j for sector (ISIC code) and t for year. Explanatory variables include firm's volatility δ, the log ratio of wages between permanent and agency workers, the quintile of the substitution elasticity in the firm's sector σ_j and year dummies to assess the effect of the regulation on TAW employment. We also include the logarithm of the lag value added to control for firm size. In a second specification we include an interaction between a post-reform dummy and the firm´s volatility.

It is worth noticing that using the log agency-permanent ratio $Log\,(S/C)_{ijt}$ allows us to control for all variables that simultaneously affect agency and regular workers. For the selection equation we use a dummy for small firms as the exclusion variable Z_{ijt}. The intuition is that only large firms (high value added) are able to support the fixed cost of

having contracts with agency firms. This intuition seems to be corroborated by Figure 4. The fixed cost dummy takes a value of one for firm-year observations of value added that are in the 54th percentile or below. Using a probit model, we find that this percentile maximizes the predicted power to use TAW (to have at least one agency worker) .

Table II reports our main results using this maximum likelihood selection model for the log-ratio of agency-regular workers. Specification (1) shows the basic model and specification (2) includes the interaction term between firm volatility and the post reform dummy. In both specifications we use robust standard errors. The 1st column of each specification shows the main equation or intensive margin while the 2nd column shows the marginal effects from the selection equation or extensive margin.

[Table II here]

The results confirm the main prediction from our theoretical model regarding the intensive margin. First, the number of TAW relative to permanent workers increases with plant volatility. The volatility coefficient 0.494, which is statistically significant at 1%, implies that plants that faced a volatility environment one standard deviation above the average have 23% more temporary agency workers relatively. Second, the agency to regular workers ratio decreases with an increase in the relative wages of TAW. One standard deviation increase in TWA relative wages implies a 3.4% reduction in temporary agency workers relative to the regular ones. Third, the positive coefficient for the quantiles of elasticity of substitution between agency and regular workers is in line with theory. Sectors with higher elasticities of substitutions between TWA and regular workers have more TWA workers relative to regular ones.

Figure VIIA shows the coefficients for the year dummies. *Ceteris paribus*, the ratio of TWA to regular workers increases from the beginning of our sample until the 2005. The 2005 dummy is different from zero with a 99% confidence level, implying that the average TAW-regular employment ratio was approximately a 47% higher in 2005 than in 2001 (the omitted year dummy). The ratio started to fall in 2006, the year when the regulation was legislated before the regulatory reform was implemented in 2007. As predicted by theory, a stringent employment protection law (EPL) for temporary agency workers increases their relative costs and therefore reduces their use. The 2008 dummy implies that, *ceteris paribus* the number of

TWA falls by 35% relative to regular workers between 2006 and 2008.[12] This difference is statistically significant at a 99% level of confidence. This lower level of TWA remains until the end of our sample period. The difference between the Year dummy 2011 and 2008 is not statistically significant at standard levels.

When we move to the selection equation we also find that volatility is also an important determinant to have at least one TAW. Moving from the average level of volatility to a level one standard deviation above implies that the probability to have at least one TAW increases by 17 percent. The estimated coefficient for relative wages has the predicted sign although it is not different from cero at standard levels of confidence. The coefficient for the sectoral elasticity of substitution is negative suggesting that an increase in the substitutability of agency and regular workers decreases the probability of using TAW.

Figure VIIB shows the coefficients for the year dummies from the selection equation. Likewise the main equation, the year dummies imply that the more stringent EPL for TWA put in place at the beginning of year 2007 is related with an important fall in the probability of using TWA. For the average firms, the probability to have at least one TWA falls 3.4% from 2006 to 2008, and 8.2% from 2006 and 2009. This 8% reduction in the probability to use TWA remains until the end of our sample (2011). In all cases these differences are statistically significant at standard levels.

Our exclusion variable, the Fixed Cost Threshold, is highly significant. The selection equation confirms the presence of fixed cost. Being below the fixed cost threshold reduces the probability of having at least one agency worker. The estimated coefficient implies that the marginal effect (at the average) of being below this threshold is a 7 percentage points drop in the probability of using TAW. All these results –with small changes in magnitudes – are robust to use volatility as the standard deviation of log change in total employment and to include sector fixed effects. Finally, the significance of the Athrho coefficient supports the use of the Heckman correction for estimating the model.

[Figure VII here]

[12] For large change the log difference is not a good approximation for the rate of growth, therefore we compute the exact change. Exp(-0.099) / Exp(0.34) – 1 = -0.355

Additionally, specification (2) in Table II allows us to look at heterogeneity in the response to the regulation across firms facing different levels of volatility. In particular we see that plants one standard deviation above the average level of volatility have 28% (0.607*0.46) more agency over regular workers than other plants before the regulatory change. However, after the reform this difference decreases by more than a fifty percent to 13%, showing that more volatile plants were more affected by the more stringent EPL on TAW.

As a robustness check we use OLS to estimate the following specifications:

$$\left(\frac{TAW}{Total\ Employment}\right)_{ijt} = \beta_0 + \beta_1\delta_{ij} + \beta_2\delta_{ij} * t + \beta_3\delta_{ij} * D_{t>2006} + \beta_4 VA_{ijt} + \gamma_i + \epsilon_{ijt}$$

$$\left(\frac{TAW}{Total\ Employment}\right)_{ijt} = \beta_0 + \sum_{t=2002}^{2011} \beta_{t-2001}\delta_{ij} * t + \beta_{11} VA_{ijt} + \gamma_i + \epsilon_{ijt}$$

Where the dependent variable is the Share of TAW, $D_{t>2006}$ is a Post-Reform dummy and t stands for yearly periods. Finally, VA_{ijt} corresponds to the logarithm of the lag value added which we include to control for firm size. Table III below presents these non-parametric estimates for the Share of TAW with and without firm fixed effects γ_i. The results confirm the relationship between TAW and volatility as well as the effects of the reform.

[Table III here]

Specifically, from specification (2) we can see that plants one standard deviation above the average level of volatility have 13% more TAW respect to a plant with the average share of TAW (0.00943*(0.46/0.03)). Again, we can see - from the F test presented at the bottom of the table - that this relationship between agency workers and volatility becomes weaker after labor regulation on agency workers becomes stringent. The null hypothesis of the test is that the average of the pre reform coefficients (2002-2006) is equal to the average of the post reform coefficients (2007-2011). In both cases we reject this null hypothesis with more than a 99% confidence. From looking at the coefficients we confirm the fact that the reform had a stronger impact on the more volatile firms.

In summary, the 2007 regulation reduced the probability of using agency workers (extensive margin) and also reduces the agency/regular workers ratio (intensive margin). The latter effect is stronger for more volatile firms. This result is consistent with our theoretical model and with previous studies on the impact of labor regulation on employment in sectors with different intrinsic volatility (see Micco and Pagés, 2006).

4.2 Effects of the Regulation on TAW.

To evaluate the effects of the regulation on TAW we use a difference in differences approach on the levels and growth rates of regular employment, total employment, value added and output. Specifically, we consider the regulation as the treatment and then we compare the treated firms (those that were using TAW before the regulation, in 2006) with two different control groups: i) All Sample: includes all other firms that did not use TAW before the regulation, and ii) Selected Sample: includes other firms that did not use TAW before the regulation but had a similar probability of using TAW, based on observable characteristics. [13] We estimate the following specifications by OLS:

$$Y_{ijt} = \beta_0 + \beta_1 DTAW_{2006} * t + \beta_2 DTAW_{2006} * t * D_{t>2006} + \gamma_i + \chi_t + \epsilon_{ijt}$$

$$Y_{ijt} = \beta_0 + \sum_{t=2002}^{2011} \beta_{t-2001} DTAW_{2006} * t + \gamma_i + \chi_t + \epsilon_{ijt}$$

Where Y_{ijt} corresponds to regular employment, total employment, value added and output. $DTAW_{2006}$ is a dummy variable equal to 1 if the plant used TAW in 2006, zero otherwise and $D_{t>2006}$ is the Post-Reform dummy. We also include year dummies χ_t and a time trend t for the treatment group because treated and untreated plants may have different trends before the 2007 labor reform. Finally, to estimate the effect on the growth rate we run $\Delta\%Y_{ijt}$ against

[13] We construct these groups from 1:1 matching (without replacement) using the propensity score on the probability of having TAW in 2006. We estimate the propensity score based on the following observables at the firm level: lag log value added, volatility of value added, volatility of total employment, averages and growth rates of total employment, regular employment, value added, and inventories share as well as the ratio of wages. This approach allows us to estimate the effect of the regulation on firms that were using TAW with respect to "comparable" plants

$DTAW_{2006} * D_{t>2006}$ and a constant term. All of our specifications include plant's fixed effects γ_i.

Table IV shows the effect of the regulation on the number of regular workers. All specifications include year and firm fixed effect as well as robust standard errors.

[Table IV here]

Column A from specification (1) shows that the level of employment for firms that used TAW in 2006 grew 1.7% faster than untreated firms each year during the pre-reform period. This faster growth increases from 1.7% to 2.3% post the labor reform. The 0.6 percentage point increase is the difference in the rate of growth between treated and un-treated firms before and after the labor reform and is significant at the 5 percent level. Column 1B shows that treated and control group firms have the same pre-reform trend (the "Firm with TWA 2006 x Year" coefficient is not statistically different from, zero). This results is not surprising due to the matching technique used (pre reform treated and control firms should be similar). But after 2007 treated firms started to grow 1.4% faster than the control group. These results suggest that firms substituted TWA with regular workers after the 2007 labor reform that increased the relative cost of TWA workers.

This result is also confirmed by specification (2), where the F test on the difference between the average of the pre reform (2002-2006) and the average of the post reform (2007-2011) "Firm with TAW 2006 x Year" dummy's coefficients is significantly different from zero at the 1 percent level. These dummy´s coefficients are depicted below in Figure VIII:

[Figure VIII]

The selected sample estimates in column (3B) show that the year in which the regulation took place, regular employment on those plants that were using TAW in 2006 started to grow a 4% percent faster than in untreated plants. This increase in the relative rate of employment growth is statistically significant at 1 percent level. As before, we interpret this result as a "substitution effect" coming from the increase in the cost of using agency workers.

In spite of the fact that there was some substitution between agency and regular workers, Table V below shows that total employment decreased after the regulation.

[Table V here]

Estimates in (1) show that treated firms, using TWA in 2006, decrease the rate of growth post reform relative to untreated firms. This fall in growth after the labor reform is between 1.6 and 2.3 percent points and statistically significant at standard level. The selected sample estimates in (2) show how the total employment was increasing in plants with TAW, until the regulation took place. After the reform in 2007, total employment decreases and never return to the pre reform level, as shown by Figure IX.[14] According with 2B, the 2011 employment level of these plants is not different than the employment level in comparable firms that did not use TAW. Thus, even though there was some substitution effect given by the increase in regular employment, the income effect of the regulation on TAW seems to have been stronger triggering a negative impact on total employment.

[Figure IX here]

Surprisingly, this negative impact on total employment does not map directly to a negative impact on output and valued added. All our different specifications in Table VI and Table VII below show that there was a very small effect of this regulation on the Output produced by the plants and a zero effect on their Value Added.

Column A in specification (1) for output shows that the output's rate of growth for treated firms with TWA in 2006, falls between 0.8 and 0.03 percentage points after the reform relative to control firms. Although these results are not different from cero at standard levels of confidence. We find similar results for Value Added.

[Table VI here]

[Table VII here]

[14] The inverted U-shape of the graphed coefficient explains the smaller significance of out F test.

The almost null impact of regulation on firm activity seems striking given the negative effect of the regulation on total employment. However, this result also suggests that there were other channels that might have helped to substitute agency workers after the regulation. First, as showed in Table IV, treated firms substituted TWA with regular workers after the labor reform. Second, in the next section we present evidence that plants also substituted agency workers with inventories in order to respond to the regulation.

4.3. Volatility, Agency Workers, and Inventories

Finally, based on the old idea that plants accumulate existences to deal with volatility[15] we can offer a test for the hypothesis that agency workers are also used as a volatility buffer. We show that actually there is a strong relationship between the share of inventories and plant's volatility. Moreover, we also show that plants that use TAW have lower inventory levels and that those plants using TAW before the regulation increased their inventories share after the increased in the cost of TAW triggered by the 2007 regulation.

To study this idea, first we estimate the following specification:

$$\left(\frac{Inv.}{Sales}\right)_{ijt} = \beta_0 + \beta_1\delta_{ij} + \beta_2 DTAW_{2006} + \beta_3\delta_{ij} * D_{t>2006} + \beta_4 DTAW_{2006} * D_{t>2006} + \chi_t + \epsilon_{ijt}$$

Where the dependent variable is the Share of Inventories defined as the average annual value of the plant's stock over the plant's annual value of sales. The variables of interest are the plant's volatility δ_{ij}, a dummy variable indicating the use of TAW in 2006 (treatment) and their interactions with the Post-Reform dummy $D_{t>2006}$. If the hypothesis that TAW are used to deal with volatility is true, then we should expect - *ceteris paribus*- that those plants using TAW have smaller inventory shares ($\beta_2 < 0$) and also that the inventory share of plants that were using TAW increased after the regulation on TAW ($\beta_4 > 0$). We use the same control groups used in the previous section: All Sample and Selected Sample.

[15] For instance, see Buch C. et al. (2009), Christiano L. (1988) and Kahn J. (1987).

Additionally, to look at the yearly evolution of the Share of Inventories on treated firms ($DTAW_{2006} = 1$) with respect to controls, we estimate the following specification:

$$\left(\frac{Inv.}{Sales}\right)_{ijt} = \beta_0 + \sum_{t=2002}^{2011} \beta_{t-2001} DTAW_{2006} * t + \beta_{11}\delta_{ij} + \beta_{12} DTAW_{2006} + \chi_t + \epsilon_{ijt}$$

All specifications include the Lag Value added to control by firm size as well as year and sector fixed effects. Furthermore, we also estimate these models including plant fixed effects. Table VIII presents the estimated coefficients from all our different specifications.

[Table VIII here]

As expected, more volatile plants use more inventories. For the median firm, a one standard deviation rise in volatility increases the share of inventories from 19% to around 23%. This relationship is strongly significant across all specifications. Secondly, plants using TAW in 2006 have lower inventory levels, which goes in line with the idea that plants can use temporary agency workers to deal with volatility, substituting the use of inventories with the use of temporary agency workers. The set of plants that used TAW in 2006 have, on average, inventory shares that are 3 to 4 percent smaller than those of plants that do not used TAW.

More evidence comes from looking at the "Dummy TAW in 2006*Post Reform" interaction. In all specification, the inventory share increased after the regulation. Plants that used TAW in 2006 increased their inventory share by around 2 to 3 percent with respect to the plants that did not used TAW at the time of the reform. We interpret this as new evidence in favor of the hypothesis that TAW are used to deal with firm volatility. Figure X plots the year-by-year coefficients for plants that used TAW in 2006.

[Figure X here]

One year after the reform firms that were using TAW in 2006 have larger inventory shares relative to those that were not. As we said, we interpret this result as suggestive evidence that TAW could be used to cope with volatility. Moreover this result could also help to explain why there was no significant impact of this regulation on production and value added. In

particular, we interpret the response of the inventory share as an additional substitution channel that was used in order to attenuate the impact of the regulation on temporary agency workers.

5. Conclusion

Firms are increasingly looking beyond "standard employment relationships" for flexibility options. Using a panel database from the Chilean manufacturing industry, we identify the main characteristics of the firms that use agency workers in the same roles as their regular employees. The evidence shows that plant volatility is related with the decision to use agency workers as well as its share in total employment. Firm size is an important determinant in the decision to use agency workers; this evidence is in line with the presence of fixed costs in this decision.

The rapid increase in this type of contract during the 2000s induced regulation on the use of temporary workers in Chile as well as in other countries. The fact that the Chilean reform took place earlier than other regulations allows us to study the potential impact of labor regulation that increase the regulatory burden and thus the costs for the firm of using on temporary agency workers.

We find that the use of these workers falls in the both intensive and extensive margins after the reform. Regarding the intensive margin, we find that more volatile plants are the most affected by this type of regulation. Furthermore, we show that plants that used temporary agency workers previous to the regulation diminished their total employment after it. However, there were not relevant effects on the value added or the level of output produced by these plants. We interpret this result as a consequence of the substitution of TAW with permanent workers and inventory accumulation. This result also contributes new evidence to the hypothesis that firms use temporary agency workers as a buffer to deal with volatility.

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