The Impact of Extending Employment Protection to Agency Workers on Firms

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We study the impact of a reform that extended employment protection to temporary agency workers. Using a difference-in-differences research design, we show that plants more exposed to the regulation experienced a decrease in revenues and total employment, and that the latter effect was attenuated in industries with high elasticity of substitution between agency and non-agency workers. We also find that labor misallocation increased as a consequence of the regulation. A model of labor demand in the presence of agency work rationalizes these results.

Labor markets are moving beyond standard work arrangements (Katz and Krueger, 2019; Mas and Pallais, 2020), and temporary agency work (TAW) is one of the most characteristic forms of alternative employment. It involves a specific type of contractual relationship in which workers are hired by an agency and temporarily assigned to work in a user plant, creating a triangular relationship between the worker, the temporary agency, and the plant.[1] While this and other alternative types of employment can offer numerical flexibility to firms (Houseman, 2001; Hirsch and Mueller, 2012), they can also be detrimental to workers (Autor, 2003; Katz and Krueger, 2017; Goldschmidt and Schmieder, 2017; Drenik et al., 2020). Indeed, increasing concerns about the labor rights and working conditions of agency workers led to the enactment of specific regulations during the past decades, such as the Directive 2008/104/EC on Temporary Agency Work in Europe.

Despite its relevance, evidence on the impact of extending employment protection to agency workers is scant.[2] Empirical progress on this topic has been hindered by the fact that agency employment is rarely recorded at the user plant-

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[1] As in Drenik et al. (2020), we "*study employment mediated by temporary employment agencies (temp agencies), where the workplace is at a user firm even though the temp agency serves as the formal employer. Temp agency work is a facet of outsourcing and, more broadly, nonstandard work arrangements, which have been associated with lower wages and increased inequality*."

[2] Previous work has focused on the determinants of the demand for agency employment (Jahn and Bentzen, 2012) and on the consequences of this type of employment on workers outcomes (Autor, 2001; Ichino, Mealli and Nannicini, 2008; David and Houseman, 2010; Jahn and Rosholm, 2013; Drenik et al., 2020).

level (the workplace where temporary workers perform their labor). This has limited our knowledge on the extent to which these workers can substitute regular employees in the production function. Lack of data, coupled with absence of quasi-experimental variation in labor costs, has also prevented researchers from gauging the contribution of agency workers to plant-level performance and inputs' misallocation. In this paper, we overcome these hurdles by using rich plant-level data from Chile, a middle-income country that was a pioneer both in the use of agency workers and in its regulation in 2007.

We guide our analysis with a simple model of labor demand in the presence of agency work. From this model, we derive testable implications on the effects of the regulation on plants' performance and labor misallocation. We classify plants based on their pre-reform levels of agency employment to estimate a difference-in-differences model comparing TAW-user to non-TAW user plants. We find that the reform diminished revenues by 9% and total employment by 6% among TAW-user plants, but had no significant effects on non-TAW employment. Reassuringly, we find that among TAW-user plants, those that were more exposed to the regulation (i.e., had a larger agency workers' cost share before the reform) were more affected. Moreover, we find suggestive evidence that employment effects were attenuated at industries characterized by a high elasticity of substitution between types of workers. Finally, we show that TAW-user plants experienced a 12% increase in labor misallocation as a consequence of this reform.

Insofar as agency worker receive lower workplace-specific pay premia (Drenik et al., 2020) or that temporary work agencies do not comply with the required social payments or do not provide the same fringe benefits (Weil, 2014), user plants can lower the cost of hiring additional workers *de facto* by using agency workers. This may have been an important motive behind the surge in the use of temporary agency work observed in Chile; a country with relatively large job security provisions for regular employees, and an unregulated market of temporary work agencies (Rosado Marzán, 2009). To address this issue, a law that regulated the use of agency work was enacted in 2007. The law leveled conditions between regular and agency workers by making user plants responsible for providing equal conditions *at* work (e.g., food, clothing, security, etc.) and liable—in a subsidiary sense—for the required benefits of agency workers (e.g., severance payments, unemployment insurance, etc.).

To study the effects of this regulation on plants' performance we use the National Annual Manufacturers Survey (ENIA, by its Spanish acronym), a census of the manufacturing sector including all plants with more than ten employees. An important feature of our data is that since the year 2000, it not only includes the number of workers hired *directly* by each plant, but also the number of workers hired *indirectly* through an agency. The latter group encompasses both outsourced (subcontracted) and lease workers, who perform their labor *inside* the plant. Thereby, we study the impact of extending employment protection to workers who are hired out by an agency to perform similar work, within the same workplace, than directly hired workers.

We guide our empirical enquiry with a model of labor demand in the presence of TAW. According to our model, the regulation—that increases the cost of agency work—has a negative impact on revenues, but an ambiguous effect on non-agency employment, which depends on the relative importance of the substitution vis a vis the scale effect. Important to the empirical analysis is the fact that the model delivers simple expressions that we can take to the data to obtain estimates of both the elasticity of substitution between agency and non-agency workers and the degree of labor misallocation, i.e., the dispersion in the value of the marginal product of labor at the plant-level. The model predicts that, for a large elasticity of substitution, labor misallocation should increase as a response to the regulation. A generalization of our model suggests that our predictions represent a lower bound on the impact that the reform would have if plants enjoyed some degree of monopsony power in the labor market of non-agency workers.

To study the impact of extending employment protection to agency work empirically, we estimate two difference-in-differences models with plant and year fixed effects. Our first model leverages the increase in the cost of using agency workers induced by the reform to assess its impact on TAW-user plants (treated group) relative to non TAW-user plants (control group). We classify plants as TAW-users if they employed at least one agency worker at the beginning of our sample period, in 2000. As previously mentioned, our estimates indicate that as consequence of the regulation, TAW-user plants experienced a 9% decrease in revenues and a 6% decrease in employment, with no differential impact on non-agency employment. In the spirit of the seminal work by Card and Krueger (2000), we complement this approach using an "exposure design". Specifically, we zoom into TAW-user plants to estimate the relationship between the pre-reform agency workers' cost share (the *exposure* to the regulation) and the percentage change in revenues and employment after the reform. Reassuringly, results from this specification reveal similar patterns: a one standard deviation increase in exposure is associated with a 7% decrease in revenues and with a 5% decrease in total employment, with no effect on non-agency employment. An extension of our analysis also reveals small and imprecise effects of the reform on capital deepening, investment, and inventories.

The threat to identification in our setting is that conditional on time-invariant plant characteristics, year aggregate shocks, and differential trends parametrized by predetermined plant-level controls, there might still be unobserved determinants of plants' performance that correlate with the use of agency work or with the cost share of agency workers at baseline. To assess this "parallel-trends" assumption, we estimate event-studies and show that there are no significant differences between "treated" and "control" plants before the reform. Reassuringly, this visual exercise also shows that the decrease in revenues and employment coincides with the timing of the reform, i.e., it appears in 2007, before the economic crisis. To ameliorate further concerns about the the economic downturn as a confounder, we also show that our results are robust to the inclusion of a full set of sector-by-year fixed effects that allow for a differential sensitivity to the cycle across industries.

Motivated by the null effect of the regulation on non-agency employment—a finding consistent with the substitution effect completely offsetting the scale effect—we study the heterogeneous impact of the reform based on to the elasticity of substitution between agency and non-agency workers. To do so, we split the sample of TAW-user plants based on whether the elasticity of substitution in the industrial sector to which they belong is above or below the median (across-sectors). Our results show that a one standard deviation increase in exposure to the regulation decreased total employment by 10% in plants that belonged to low elasticity sectors, but only by 3.5% in plants that belonged to high elasticity sectors. This finding, somewhat similar to that of Harasztosi and Lindner (2019), underscores the importance of input substitutability (in this case types of employment) when firms face a surge in inputs' costs.

Finally, we assess the impact of the reform on the degree of labor misallocation. Leveraging our theoretical model, we define a plant-level measure of labor misallocation as the standard deviation (across-years) of the gap between the value of the marginal product of labor and its marginal cost. We proxy for the former with the logarithm of the ratio between a plant's revenue and its labor composite and we proxy for the latter with the average of said ratio aggregated by sector and year. We refer to this metric of dispersion as "misallocation" in light of the work of Caballero et al. (2013) showing that adjustments costs induced by labor regulation reduce aggregate output and slows down economic growth.[3] Our results show that TAW-user plants experienced a 12% increase in labor misallocation as a consequence of the reform. In line with the predictions from our model, we also find that labor misallocation increased more at plants in sectors characterized by a high elasticity of substitution; a consequence of plants in these sectors relying more heavily on agency work before the regulation.

This paper contributes to several strands of research. Most importantly, it contributes to the literature on alternative work arrangements (see Mas and Pallais (2020) for a recent review) and the impacts of extending employment protection to these new forms of employment on firms' performance (Abraham and Taylor, 1996; Autor, 2003; Autor, Kerr and Kugler, 2007; Dolado, Ortigueira and Stucchi, 2016; Cingano et al., 2016). Previous work, close to ours, has studied the wage dimension of outsourced labor (Goldschmidt and Schmieder, 2017; Drenik et al., 2020) and the impacts of extending employment protection to workers with temporary contracts (Cappellari, DellAringa and Leonardi, 2012; Daruich et al., 2020). In contrast to them, we focus on the effects of extending employment protection to *temporary agency workers*: outsourced (subcontracted) and lease

[3] In contrast to Asker, Collard-Wexler and De Loecker (2014), dispersion in our case does not come from technological features, but from labor regulation that creates costs associated with the adjustment of the number of workers hired directly by the plants.

workers, in the same occupations than regular workers *within* the same workplace.

By showing that plants in sectors characterized by a low elasticity of substitution are the most affected by the regulation in terms of employment, we contribute to recent empirical research on the impact of labor regulation and the role of input substitutability (Harasztosi and Lindner, 2019). Our work also offers a novel estimate of the elasticity of substitution between agency and non-agency workers. We estimate an elasticity of substitution of 4.3; this is larger than other estimates in the literature (Katz and Murphy, 1992; Card, 2009; Cappellari, DellAringa and Leonardi, 2012), but consistent with the fact that we study workers in the same occupations within the same workplace. Moreover, our theoretical model contributes to the literature on resource misallocation. Relative to previous research (Caballero and Engel, 1993; Caballero et al., 2013; Asker, Collard-Wexler and De Loecker, 2014), we derive a measure of dispersion without imposing assumptions on the elasticity of substitution between inputs.

The paper proceeds as follows. Section I provides the institutional background. Section II presents the theoretical model. Section III presents the data and section IV shows our empirical strategy and results. Finally, section V concludes.

I. Institutional Background

Between 1985 and 2007, real GDP increased by nearly 6% per year in Chile. But despite this significant progress, the labor market underperformed. Labor participation was low with few job opportunities for certain groups. Female labor force participation was 39%, well below the OECD average of 57%. Moreover, informal employment was significant (albeit receding and lower than in most of Latin America). By the end of this period, about one-fifth of all Chilean workers either did not have a formal labor contract or did not contribute to social security. In the specific sector that we study, manufacturing, employment remained fairly stable until 2007 and represented 14% of total employment.[4]

Manufacturing plants can hire workers *directly* or *indirectly* through an agency. The agency work we study encompasses both outsourced (subcontracted) and lease workers, who perform their labor inside the user plants. Importantly, the contractual relationships between the plant and its workers and between the agency and its worker are both regulated by the same labor code, which applies to all private labor relationships. The duration of the contracts between the user plants and the agencies is mostly unrestricted. The only exception are lease workers (replacement workers) whose work at user plants cannot exceed 90 or 180 days, depending on the circumstances (see section 8.4 in del Rey and Mignin (2017) for details). As of 2011, while 37.8% of plants used outsourced (subcontracted) workers, only 3.6% of them used replacement workers.[5]

Importantly, termination of a contract with a directly hired worker is restricted

[4] *Encuesta Nacional de Empleo (ENE)*, collected by the National Institute of Statistics of Chile (INE).
[5] *Encuesta Laboral (ENCLA)*, collected by the National Institute of Statistics of Chile (INE).

in Chile. The labor code mandates a minimum advance notice of one month prior to termination, and establishes the compensation to be awarded to workers depending on the cause of termination, which can be "just" or "unjust" (it is the responsibility of the employer to prove "just" cause). Although the law considers dismissals motivated by the economic needs of the employer to be justified, employers are still liable to pay a compensation equal to one month's pay per year of work, with a maximum amount of eleven months of pay. In an international comparison including a set of 36 European and Latin American and Caribbean countries, Chile ranked 8 in terms of the degree of job security offered to workers.[6]

While collective bargaining agreements may be an important feature of the labor market in countries such as Argentina (Drenik et al., 2020) or Italy (Daruich et al., 2020); they are less common in the Chilean setting, likely as a consequence of the reforms implemented during the dictatorship. According to the labor directorate, the unionization rate was around 15% between 2004 and 2011. For the most part, unionized workers can only bargain with their direct employer: the plant in the case of directly hired workers or the agency in the case of agency workers. One exception comes from inter-company unions, which may include workers from both the plant and the agency. Inter-company unions, however, are rare. As of 2014, only 5% of collective bargaining agreements involved inter-company unions (Huneeus, Flores and Stephanie, 2014).

In this context, Chile experienced a large and unregulated growth in the number of agency workers at the turn of the twenty-first century. As a response, workers and politicians raised concerns about the potentially negative consequences that these new employment arrangements may have on workers' welfare. Public discussion led to a new regulatory framework that has been in force since January 2007. The purpose of this regulation was to level the working conditions between agency and regular workers. Indeed, the spirit of the Chilean law is similar to "the principle of equal treatment" in the Directive 2008/104/EC of the European Parliament and of the Council, which establishes, among other things, that:

> "*The basic working and employment conditions of temporary agency workers shall be, for the duration of their assignment at a user undertaking, at least those that would apply if they had been recruited directly by that undertaking to occupy the same job.*"

The Chilean reform introduced three main changes to the Labor Code. First, user plants became responsible for protecting workers' safety and health in the workplace, regardless of their contractual status. In the case of violations of the Labor Code involving accidents or health concerns, agency workers can now sue either the agency or the user plant for which they work. Second, user plants became subsidiary accountable for agency workers' labor rights and for the payment of their social security contributions. This means that agency workers can now

[6]The metric was constructed by Heckman and Pagés (2000) and reflected the marginal cost of dismissing full-time permanent workers.

sue the user plant, but *only* after the prosecution of their agency's responsibilities have been exhausted. Indeed, the law also gave user plants the right to request information from temporary work agencies regarding their compliance with their workers' labor rights; and in the case that agencies do not prove that they are complying with their duties on time, then the user plants can withhold the appropriate amount from the agency fee to comply the labor rights of agency workers.[7] Third, temporary work agencies must now constitute a financial guarantee on behalf of the Labor Directorate, which can be used to cover unpaid social security contributions of their workers in the case that their employers do not comply with their legal duties.

Labor regulation for other types of employment did not change during the period that we study. Only one reform, called "Nueva Justicia Laboral", was enacted two years after the agency workers' regulation, in 2009. This reform changed the procedures to solve labor disputes from written to oral trials and increased the number of labor courts from twenty to eighty-four to improve the enforceability of labor regulation. However, this reform made no distinction between regular and agency workers, and therefore it should not confound the effects of the TAW regulation (see Rosado Marzán (2009) for details).

The effect of the reform was salient. Panel A of Figure 1 uses our main dataset, the ENIA from 2001 to 2010, to look at the evolution of agency employment in the manufacturing sector. The figure shows that the use of temporary agency workers increased before the reform, with the share of agency work peaking at 20% of total employment, and that it decreased steadily since the law was discussed in 2006 and enacted in 2007. In Panels B and C, we complement our descriptive analysis with secondary data from the largest survey on labor conditions in the country, known as ENCLA, and with records from COCHILCO, the public agency in charge of studying the mining industry in Chile. ENCLA reports the share of plants that outsourced (subcontracted) activities from third parties, inside *and* outside the establishment. Thus, these records not only include agency work but also activities outsourced outside the plant. Records from COCHILCO report the share of temporary agency workers used in the mining industry. Panel B plots the time series from these data and reveals that the use of alternative work arrangements increased steadily before the reform, and that this trend broke once the regulation was enacted. Finally, in Panel C we consider all sectors covered by the ENCLA and plot the share of plants using alternative work arrangements in the years 2006 (pre-reform) and 2011 (post-reform). The figure shows that the share of plants using alternative work arrangements shrunk across all industries, except services.

[7] Since the regulation was enacted, a new industry of private consulting companies that certify labor law compliance of agencies has emerged in Chile. Local and international consulting companies like Deloitte, among others, provide these services.

II. Theoretical Framework

In this section, we develop a simple model of labor demand in the presence of agency work. The purpose of this model is twofold. First, it provides a framework to think about the role of agency workers in the production process. Second, it allows us to derive testable predictions on the effects that the regulation has on plants.

Consider a representative plant of productivity A_{it} that faces a downward sloping product demand function $Y_{it}^{D} = B_{it}\,(P_{it})^{-\eta}$ with elasticity $-\eta < -1$. The plant can hire workers directly or indirectly through an agency, but when changing the number of workers hired directly it faces adjustment costs.[8] Thus, the representative plant maximizes the following profit function over time:

(1)
$$Max_{L_{it},T_{it}} E\left[\sum_{t=t_o}^{\infty}\beta^t\left(B_{it}^{1/\eta}\,(A_{it}\;LC_{it})^{\gamma(1-\frac{1}{\eta})} - L_{it}W_L - T_{it}W_T - \frac{\Phi}{2}L_{it}^{*}\left(\frac{L_{it}-L_{it-1}}{L_{it-1}}\right)^2\right)|t_o\right],$$

where β is a discount factor, γ stands for the plant's returns to scale, and $\Phi/2$ represents the relative importance of the quadratic cost incurred when adjusting non-agency employment L_{it}. In terms of notation, we use * to denote that a variable is in its optimal level in the absence of adjustment costs. Thus, L_{it}^{*} stands for the optimal level of non-agency employment.[9] Finally, the labor composite used by the plant is represented by LC_{it} and its functional form is given by:

$$LC_{it} = \left(\alpha_L{}^{\frac{1}{\rho}}L_{it}^{(\rho-1)/\rho} + \alpha_T^{\frac{1}{\rho}}T_{it}^{(\rho-1)/\rho}\right)^{\rho/(\rho-1)} \quad (2)$$

Notice that this CES function allows for substitution between temporary agency workers (T_{it}) and regular workers (L_{it}), with an elasticity of substitution given by ρ. It also allows for differences in the productivity of these workers ($\alpha_L^{1/\rho}, \alpha_T^{1/\rho}$).

We assume that the representative plant has decreasing returns to scale in revenues, i.e., $\gamma(1-\frac{1}{\eta}) < 1$ and that it takes the market-level cost of regular (W_L) and agency workers (W_T) as given.[10] We also assume that the plant is exposed to volatility coming from innovations in $B_{it}^{1/\eta}A_{it}^{\gamma(1-\frac{1}{\eta})}$, which follow a random walk whose disturbance has a standard deviation given by σ_ϵ. A known result under these assumptions—and one that we leverage to derive our main

[8]In Chile, when firing a worker, plants are liable to pay compensation equal to one month's pay per year of work, with a maximum amount of eleven months of pay.

[9]We assume that adjustment costs are proportional to L_{it}^{*} to obtain a closed form solution, i.e., against this backdrop, the second order Taylor approximation of (per-period) plant's profit is linear in $ln(L_{it}^{*})$. See appendix B for details.

[10]For the interested reader, in Appendix A.A2 we relax the latter assumption and allow the plant to have monopsonistic power in the labor market of regular workers.

predictions—is that the level of employment equals its optimal level (in absence of adjustment costs) in *expectation* (Nickell, 1986; Caballero and Engel, 1993; Hamermesh, 1996).

Using this model, we assess the impact that a reform extending employment protection to agency workers has on plants' revenues and employment, and on their dispersion in the value of the marginal product of labor (i.e., labor misallocation). Since the Chilean regulation increased the cost of agency work both *de jure* and *de facto*, we characterize the reform as an increase in W_T, and we derive three propositions.

Proposition 1: On average, the effect of the regulation on revenues is given by:

$$\frac{dPY_{it}^*}{dW_T}\frac{W_T}{PY_{it}^*} = -\frac{\mu}{1-\mu}ShT^* < 0, \tag{3}$$

where Y^* and ShT^* represents the output and the cost share of agency-work at their optimal level and $\mu = \gamma(1-\frac{1}{\eta})$ represents the curvature of the revenue function, which is concave ($\mu < 1$) given our assumptions.

Proof. This result can be derived directly from the first order conditions without adjustment cost. See Appendix A.A2 for details.

Thus, after an increase in the cost of agency work, the expected level of revenues unambiguously decreases. An increase in the cost of agency work implies an increase in its marginal cost, and therefore a reduction in production. Naturally, the larger the cost share of agency workers, the larger the increase in the plant's marginal costs.

Proposition 2: On average, the effect of the regulation on regular (non-agency) employment is given by:

$$\frac{dL_{it}^*}{dW_T}\frac{W_T}{L_{it}^*} = -\frac{1-\rho(1-\mu)}{1-\mu}ShT^*, \tag{4}$$

where ρ stand for the elasticity of substitution between agency and non-agency workers.

Proof. This result can be derived directly from the first order conditions without adjustment cost. See Appendix A.A2 for details.

In this case, the impact of the reform depends on the relative size of the "substitution effect" vis a vis the "scale effect". Interestingly, this result encompasses the Hicks-Marshall rule of derived demand; it can be shown that for $\gamma = 1$ equation (4) equals $(\rho - \eta)ShT^*$. In that case, as long as the substitution effect (ρ) is larger than the "scale effect" (η), the regulation would unambiguously increase the number of non-agency workers. More generally, for any $\gamma > 1$, there exist a ρ for which equation (4) is positive.

It is worth noting that equation (4) can be rewritten as a function of equation

(3):

(5)
$$\frac{dL^*_{it}}{dW_T}\frac{W_T}{L^*_{it}} = \underbrace{-\frac{\mu}{1-\mu}ShT^*}_{\frac{dPY^*_{it}}{dW_T}\frac{W_T}{PY^*_{it}}} + (\rho-1)ShT^*$$

Thus, on average, an increase in the cost of agency work will decrease revenues by $-\frac{\mu}{1-\mu}$, independent of the elasticity level ρ. However, the extent to which it decreases non-agency employment will depend on the elasticity of substitution through the term $(\rho-1)$; which ultimately should lead to attenuated employment effects in high-elasticity sectors.

Finally, from the plants' dynamic maximization problem, we can derive the following expression for the dispersion in the value of the marginal product of the labor composite (see Appendix A.A2 for details):

(6)
$$\psi(l_i) \equiv \sqrt{\text{Var}(vmp(lc_i) - vmp(lc^*))} \approx \left(\frac{1-\mu}{1+\frac{ShT^*}{ShL^*}\rho(1-\mu)}\right)\frac{(1-\lambda)}{(1-(1-\lambda)^2)^{1/2}}\sigma_\epsilon,$$

where $vmp(lc_i)$ and $vmp(lc^*)$ stand for the logarithm of the current and optimal value of the marginal productivity of the labor composite, respectively. In this expression, λ stands for the speed of adjustment of non-agency workers (i.e., the fraction of the employment gap, between the current and optimal level, that a plant closes each period), and σ_ϵ represents the standard deviation of the innovations in $B_{it}^{1/\eta}A_{it}^{\gamma(1-\frac{1}{\eta})}$, which reflect both demand and productivity shocks.

Thus, the larger the volatility (σ_ϵ), the larger the degree of labor misallocation. Moreover, the faster the speed of adjustment of regular workers (λ) is, the smaller the degree of labor misallocation, i.e., in an economy with shocks but instantaneous adjustment ($\lambda = 1$), the plant would always be at its optimal level ($lc*$) and therefore there would not be misallocation. It is also worth noticing that the elasticity of substitution between types of workers ρ is a key determinant of the degree of misallocation of the labor composite. This is fairly intuitive considering extreme cases: i) when $\rho \to \infty$, misallocation due to adjustment costs in non-agency workers can be completely offset by temporary agency workers; ii) when $\rho \to 0$, misallocation due the adjustment costs cannot be offset by the use of temporary agency workers; iii) when $\rho = 1$ (Cobb-Douglas case), only a fraction of the misallocation due to adjustment costs can be compensated for by other inputs. This leads us to our next proposition.

Proposition 3: The impact of the regulation on the dispersion in the value of the marginal product of the labor composite is given by:

$$\frac{d\psi(lc_i)}{dW_T}\frac{W_T}{\psi(lc_i)} = -\frac{\rho(1-\mu)}{\frac{ShL^*}{ShT^*}+\rho(1-\mu)}\xi_{\frac{ShT^*}{ShL^*},W_T} + \frac{(1-\lambda)^{-2}}{(1-\lambda)^{-2}-1}\xi_{(1-\lambda),W_T}, \tag{7}$$

where $\xi_{(1-\lambda),W_T}$ and $\xi_{\frac{ShT^*}{ShL^*},W_T}$ stand for the elasticities with respect to W_T of $(1-\lambda)$ and of the ratio of cost shares $\frac{ShT^*}{ShL^*}$.

Proof. This result can be derived directly from equation (6). See Appendix A.A2 for details.

It can be shown that for a large enough elasticity of substitution, the misallocation of the labor composite would unambiguously increase as a response to the regulation that increased W_T. Generally, however, the impact of increasing the cost of agency work on misallocation depends on the model parametrization. To explore this, we perform a simulation and numerically compute the value of equation (6) for different wage ratios and for different elasticities of substitution. Figure 2 summarizes this exercise. We see that for $\rho = 5$, labor misallocation increases by 21% when the relative cost of agency workers increases from 0.65 to 0.85, while for the smaller elasticity of substitution of $\rho = 3$, labor misallocation increases only by 4%. Interestingly, labor misallocation does not change for the standard Cobb-Douglas case ($\rho = 1$).[11] Thus, the extent to which the reform has a negative impact on the misallocation of the labor composite is a function of the elasticity of substitution between types of employment. This result, we think, underscores the role that model misspecification can play in the measurement of resources misallocation, an issue recently pointed out by Asker, Collard-Wexler and De Loecker (2019).

Possible extensions: To derive our main predictions we have assumed a competitive labor market. In light of recent evidence (Manning, 2021; Card, 2022), this may be considered a strong assumption. Thus, in Appendix A.A2 we lift this assumption by allowing for monopsonistic power in the market of non-agency workers.

We find that our predictions assuming a completely elastic supply of non-agency workers represent a lower bound of the impact that the reform would have if plants enjoyed some degree of monopsony power. The intuition for this comes from the fact that when a monopsonistic plant increases its demand for non-agency workers, it also increases the cost of them. This, in turn, accentuates the negative impact of the regulation on revenues and employment. Nonetheless, the impact of the reform on labor misallocation under monopsonistic competition is not trivial. To explore this, we perform a simulation and numerically compute the increase in misallocation as a consequence of increasing the cost ratio between agency and non-agency workers (from 0.65 to 0.85) for different labor supply elasticities, and

[11]When $\rho = 1$, the reform does not change the relative importance of agency workers in the labor costs (i.e., it does not change the cost share of agency-work ShT^*), and therefore labor misallocation is not affected.

assuming $\rho = 4.28$. Figure A4, in the appendix, summarizes this exercise. We find that as the labor market becomes less competitive, the increase in labor misallocation becomes larger: the increase in labor misallocation is 15% when the supply of non-agency workers is infinitely elastic, but it is 33% when the supply of non-agency workers is equal to 5. This exercise suggests that assuming perfectly competitive labor markets also underestimates the impact of the reform along the misallocation margin.

Another limitation of our model is that it does not incorporate the idea that alternative work arrangements could lead to a stronger bargaining position of the plant with respect to regular workers. While a model that incorporates bargaining is well beyond the scope of our paper, we conjecture that such a model would deliver predictions similar to ours. Intuitively, if employers enjoyed rents in the use of agency workers, that would improve their outside option which in turn would lead to lower equilibrium wages for regular workers. If this were the case, then the 2007 labor reform—which reduced the rents in the agency work margin—would have worsened the plant's outside option increasing the equilibrium wage of regular workers. In this case, again, our model predictions regarding plants' revenues and employment would represent a lower bound on the predicted impacts of the reform.

III. Main Dataset and Variable Definition

In this section, we briefly describe our main dataset and provide details on the construction of additional variables used in our analysis.

We use data from the National Annual Manufacturers Survey (ENIA) collected by the National Institute of Statistics of Chile (INE). The ENIA is an annual survey of plant-level data that includes all manufacturing plants with 10 or more employees and accounts for approximately half of total manufacturing employment in Chile. The survey started in 1979, but it has only recorded information on agency workers since 2000. Questions about agency workers were added after identifying growing inconsistencies between inputs and revenues (e.g., a plant with 30 machines and 15 workers was reporting revenues similar to those of a plant with 30 machines and 30 workers). It is worth noting that a plant is not necessarily a firm, since firms can have several plants; however, a significant fraction (96.5%) of firms are single-plant firms.

For our analysis, we consider the period 2001-2010. Among the plants characteristics, we observe the number of regular and agency workers, the total cost associated to these workers, total revenues, the value of the raw materials used in the plants' production process, and the value of the investment and stock of capital (buildings and machinery). We deflate all nominal variables using the manufacturing deflator from national accounts. Employment data on agency workers refers to employees who perform occupations equivalent to those performed by regular workers; accordingly, we do not study wholly outsourced functions such as cleaning, food services, or security tasks. As mentioned before, this is an important distinction that allows us to study workers who are close substitutes to each other.[12] The ENIA classifies plants according to the ISIC (Rev. 3) code. For our analysis, and to avoid having sectors with a small number of plants in a given year, we reclassify plants into nine sectors. We consolidate the following 2 digit ISIC (Rev.3) sectors: {15-16}, {17,18,19},{20},{21,22}, {23,24,25}, {26,27}, {28} {29,30,31,32,33}, and {34,35}. Appendix Table A1 presents descriptive statistics of our data.

To implement our empirical analysis, we leverage our theoretical model and data to construct the following additional variables: i) elasticity of substitution, ii) misallocation of the labor composite, and iii) plant-level productivity. We detail the construction of each of them below.

i) Elasticity of Substitution: To obtain a model-based estimate of the elasticity of substitution between regular and agency workers ρ, we consider a simple extension of our model that incorporates materials as intermediate inputs. In particular, we enhance the production function by adding materials M_{it} in a Cobb-Douglas fashion, i.e., $Y_{it} = \left(A_{it}\, LC_{it}^{\theta} M_{it}^{1-\theta}\right)^{\gamma}$, where $\gamma\theta$ and $\gamma(1-\theta)$ stand for the constant output elasticities of the labor composite and materials, respectively. From the observation that the first order conditions with respect to agency workers T_{it} and materials M_{it} always hold (i.e., there are no adjustment cost on these inputs), we can derive the following function amenable for estimation via OLS:

$$ln\left(\frac{\frac{\theta}{1-\theta}P^{M}M_{it}}{W_{it}^{T}T_{it}}-1\right)=\frac{1}{\rho}ln\left(\frac{\alpha_L}{\alpha_T}\right)+\frac{\rho-1}{\rho}ln\left(\frac{L_{it}}{T_{it}}\right). \qquad (8)$$

As standard with the Cobb-Douglas case, we proxy $\theta/(1-\theta)$ using the ratio of the agency workers' cost divided by the expenditures on materials. We calculate $\hat{\theta}$ at the industry level using pre-reform data and obtain an average $\hat{\theta}$ of 0.22. Then, leveraging $\hat{\theta}$, we estimate equation (8) using all pre-reform plant-level observations where L_{it}/T_{it} is properly defined (i.e., the number of agency-workers is above zero). We further account for unobservable time-invariant confounding factors and cyclical shocks by adding plant and year fixed effects. From this procedure, we obtain an estimate of the average elasticity of substitution $\hat{\rho}$ equal to 4.28. In relation to previous estimates in the literature, ours is closer to the estimated elasticity of substitution between capital and low wage workers presented in Harasztosi and Lindner (2019) (3.35); but it is above the range of substitution elasticities among different types of workers: in their seminal paper Katz and Murphy (1992) find a value of 1.4; Card (2009) reports that high school-equivalent and college-equivalent workers have an elasticity of substitution on the order of

[12] Appendix Figure A2 in the apendix shows an extract of the questionnaires. Except for the owners and managers, there are exactly the same categories (same definition) for workers directly hired by the plant and for those provided by a temporary employment agency.

1.52.5; Cappellari, DellAringa and Leonardi (2012) reports that the elasticity of substitution between temporary contracts is 1.4 (with some variation across years) while the elasticity of substitution between permanent and temporary contracts is stable at around unity. Although larger than other estimates, we believe that our estimated elasticity of substitution between agency and non-agency workers is consistent with the fact that, in our setting, these type of workers share the same occupation within the same workplace.

ii) Misallocation of the Labor Composite: We define plant-level "misallocation" as the dispersion in the value of the marginal product of the labor composite. Thus, to proxy for labor misallocation we first need to construct the "labor composite" $LC_{it} = (\alpha_L^{\frac{1}{\rho}} L_{it}^{(\rho-1)/\rho} + \alpha_T^{\frac{1}{\rho}} T_{it}^{(\rho-1)/\rho})^{\rho/(\rho-1)}$. To do so, we use our estimates of the elasticity of substitution $\hat{\rho}$ and construct proxies for $\alpha_L^{1/\rho}$ and $\alpha_T^{1/\rho}$ from equation (8). Assuming that, on average, the first order condition for regular employment L holds, we can proxy the median value of α_L/α_T with $(L/T)^{1-\rho}(ShL/ShT)^{\rho}$. In our data, $\alpha_L^{1/\rho}$ and $\alpha_T^{1/\rho}$ equal 0.99 and 0.44, respectively.

From equation (6), we know that the "misallocation" of the labor composite is a function of $vmp(lc_i)$ and $vmp(lc^*)$. To proxy for the former we use the logarithm of the ratio between a plant's revenue and a plant's labor composite, and to proxy for the latter we use the average of the previous ratio at the sector-year level. Then, within a time window ω (e.g., pre/post-reform period), we construct the measure of dispersion in the value of the marginal product of the labor composite as:

$$\hat{\psi}_{i\omega} = \sqrt{\frac{1}{\omega}\sum_{\tau=0}^{\omega}(v\hat{m}p(lc)_{it+\tau} - v\hat{m}p(lc)_{.t+\tau})^2} \tag{9}$$

In light of Daruich et al. (2020), one may conjecture that extending employment protection to agency work could increase the transition of workers from agency contracts to direct contracts with the user plant (where they work). In turn, this could lead to bias in our measures of contract specific productivity α_T and α_L and consequently to bias in our labor composite. Naturally, the direction of the bias will depend on the intrinsic productivity of the workers under each type of contract. For instance, if agency workers are negatively selected as in Drenik et al. (2020), then these transitions would lead us to overestimate the post-reform labor composite. Nonetheless, we believe that this concern is ameliorated in our setting since we study the effects of the regulation on the dispersion in the productivity of the labor composite, thus if sorting patterns are similar within a sector, biases may cancel out. Moreover, we only use our measure of labor composite misallocation as an outcome variable, which should reduce concerns related to classical measurement error.

iii) Plant-level Productivity: If temporary agency workers are used to cope with productivity shocks, then accounting for plants' productivity is relevant to our study. A key issue in the estimation of production functions is the correlation between unobservable productivity shocks and input levels. To address this issue, we follow Levinsohn and Petrin (2003) who introduce an estimator that uses intermediate inputs as proxies, arguing that intermediates may respond more smoothly to productivity shocks. To estimate pre-reform plant productivity, we use the value of materials as the intermediate inputs that proxy for the productivity shocks, and we consider the labor composite to be the free variable input, while also accounting for the capital at each plant (i.e., the value of buildings and machinery).[13] As shown by Figure A1, both the first and second moment of productivity are strongly correlated with the share of temporary agency workers. In terms of magnitudes, the projections of the share of temporary agency workers on the first and second moment of productivity are .082 (SE: .002) and .045 (SE: .005), respectively. This is consistent with previous research on the relationship between the use of agency workers and both the level and variance of plant's productivity (Jahn and Bentzen, 2012; Ono and Sullivan, 2013).

For robustness checks, and in light of recent research (Bond et al., 2021) showing that Levinsohn and Petrin (2003) and more recent methods such as Ackerberg, Caves and Frazer (2015) are all essentially limited, we also estimate plants' productivity in a more traditional fashion using cost shares as proxies for production elasticities.

IV. Empirical Strategy and Results

In this section we describe our empirical strategy to assess the impact of the 2007 regulation and present our main results. We divide our analysis into two subsections. First, we study the impact of extending employment protection on revenues and employment. Then, we assess the effects of the regulation on labor misallocation.

A. The Impact on Plants' Performance

To assess the effects that extending employment protection to agency workers had on plants' revenues and employment, we estimate difference-in-differences regressions. We begin with the model:

$$y_{it} = \alpha_i + \beta_1 \text{ TAW-User}_i \times \text{Post} + X_i \gamma_t + \epsilon_{it}, \tag{10}$$

where i and t stand for plant and year, and the dependent variable y_{it} corresponds to the logarithm of revenues, total employment, and non-agency employment.

[13]We implement this method using the *levpet* command in Stata. See Petrin, Poi and Levinsohn (2004) for details.

"TAW User" is a dummy variable that takes the value one if a plant used agency workers in 2000, the year agency workers were recorded for the first time; "Post" is an indicator that equals one in the post-reform period (after 2006); α_i is a plant fixed effect; and ϵ_{it} is an error term clustered at the plant-level. We also allow year effects and the impact of plant characteristics to vary flexibly over time. More specifically, $X_i\gamma_t$, includes year fixed effects and their interaction with the (pre-reform) level of plants' productivity.

We complement this approach with an "exposure design" in the spirit of Card and Krueger (2000). For this, we focus exclusively on TAW-user plants and compare those with a higher agency workers' cost share—consequently more exposed to the regulation—to those with a lower agency workers cost share. Our specification, which follows closely that of Harasztosi and Lindner (2019), is given by:

$$y_{it} = \alpha_i + \beta_2 \, \mathrm{ShT}^*_{j(i)} \times \mathrm{Post} + X_i\gamma_t + \epsilon_{it}, \tag{11}$$

where "$\mathrm{ShT}^*_{j(i)}$" is our measure of exposure to the TAW regulation and corresponds to the agency workers' cost share at the industry j level (to which firm i belongs) as of 2001, the first year for which data on the cost of agency work is available. In other words, we use the ratio of the agency workers total cost to the total cost of labor in industry j as our measure of exposure.

The threat to identification in our setting is that conditional on time-invariant plant characteristics, year aggregate shocks, and differential trends parametrized by the predetermined plant-level controls, there might still be unobserved determinants of plants' performance that correlate with the use of agency workers or with the agency workers' cost share at baseline. In other words, the key identification assumption here is that trends in y_{it} would be the same in both types of plants in the absence of treatment, i.e., only the reform induced a deviation from this common trend. While this assumption is essentially untestable (the fundamental problem of causal inference), we use event-study type of regressions to see whether the parallel trends assumption of our research design holds. More specifically, we estimate the dynamic version of models (10) and (11):

$$y_{it} = \alpha_i + X_i\gamma_t + \sum_{j=2001}^{2004} \beta_j \times TAW_i \times I[\text{year} = j] + \sum_{k=2006}^{2010} \beta_k \times TAW_i \times I[\text{year} = k] + \epsilon_{it}, \tag{12}$$

where TAW_i can be either TAW-User$_i$ or $\mathrm{ShT}^*_{j(i)}$. We leave 2005, the year before the discussion of the TAW regulation started, as the omitted year. In Figure 3, panels A to C, we plot the coefficients and confidence intervals obtained from equation (12) when TAW_i corresponds to TAW-User$_i$. In panels D to F of the same figure we plot the coefficients and confidence intervals obtained when TAW_i corresponds to our measure of exposure $ShT^*_{j(i)}$. Reassuringly, these figures provide visual support for our identification strategy. The point estimates tend to be small and not statistically different from zero in the pre-period, suggesting there are no differential trends before the reform. Moreover, in the after period we observe that the decrease in revenues and employment coincides with the timing of the reform, ameliorating concerns about the economic downturn as a confounder.

We present the estimates of our difference-in-differences equations (10) and (11) in Table 1. Results in Panel A are obtained from comparing the evolution of the dependent variable at plants that used agency workers before the regulation to those that did not. We find that as a consequence of the reform, TAW-user plants experienced a decrease in revenues and total employment but no change in non-agency employment. In terms of effect sizes, the impact on revenues and total employment ranges from 7 to 9 percent and from 4 to 6 percent, respectively. Results in panel B are obtained from comparing TAW-user plants that were more exposed to the regulation to other TAW-user plants that were less exposed to it. The results obtained from this approach are similar to those presented in panel A: we find that a one standard deviation increase in exposure decreases revenues by 7% and total employment by 5%. In both panels, flexibly controlling by the (pre-reform) level of plants' productivity increases the effect size of our estimates without diminishing its precision.

Notice that failing to reject the null of a zero effect of the regulation on non-agency employment is consistent with the theoretical model as long as the clash between substitution and scale effects leads to a zero effect on non-agency employment (see equation 4). Motivated by this observation, we split the sample of TAW-user plants based on whether the elasticity of substitution of the industrial sector to which they belong is above or below the median.[14] Then, we estimate equation (11) in each sub-sample. Panels B.1 and B.2. of Table 1 present our results. In line with our model, we find that plants in sectors characterized by a low elasticity of substitution were the most affected in terms of employment. On the one hand, a one standard deviation increase in the exposure of plants in low elasticity sectors decreases total employment by 10%. On the other hand, a one standard deviation increase in the exposure of plants in high elasticity sectors only decreases total employment by 3.5%. We interpret this evidence through the lenses of Harasztosi and Lindner (2019) and believe it underscores the importance of input substitutability, in this case types of labor, when a plant faces a surge in inputs' costs.

Robustness checks and extensions: We verify that the previous results are robust to several tests. To address concerns related to the role of the great recession as a confounder, we allow for differential sensitivity to the cycle across industries. We do so by including a full set of industry-by-year fixed effects. Panel A of Appendix Table A2 shows that the difference-in-differences estimates

[14]Industries (ISIC Rev. 3) with an elasticity of substitution above the median include: {17, 18, 19} {20}, {21, 22} {23, 24, 25} and {26, 27}. Industries (CIIU 3rd revision) with an elasticity of substitution below the median include: {15, 16}, {28}, {29, 30, 31, 32, 33}, and {34, 35}. The number of plants (as of 2006) in industries above an below the median is 2367 and 2323, respectively.

of equation (10) become slightly smaller, but remain significant. These alternative estimands indicate that, as consequence of the regulation, TAW-user plants experienced a 7% (instead of 9%) decrease in revenues and a 5.7% (instead of a 6.4%) decrease in employment, with no differential effects on non-agency employment. For this robustness check, we also extend our "exposure design" that zooms into TAW-user plants. We do so by redefining exposure as the average agency workers' cost share at the plant-level, instead of at the industry level, over *all* the pre-reform years, not just 2001. Naturally, using this broader classification increases the number of plants satisfying $ShT^* > 0$.[15] Results from this approach are also robust to the inclusion of a set of industry-year fixed effects, with the reform decreasing revenues and employment by more at more exposed plants. Panel B of Appendix Table A2 shows that our results are also robust to using an alternative measure of productivity that considers the cost shares as proxies for production elasticities. However, it is worth noticing that while our main specifications include year fixed effects and their interaction with the (pre-reform) level of plants productivity as controls (to allow year effects and the impact of plants productivity to vary flexibly over time), our results do not depend on the addition of these covariates.

We also perform a placebo exercise in which we set the reform year to 2004 (instead of 2007). The treated and control indicators are defined as before, but the "Post" variable now takes value one during the *placebo* post-reform period (2004-2005). For this exercise, we can only consider a two years bandwidth around the placebo reform, i.e., pre-reform period: 2002-2003 and post-reform period: 2004-2005. Reassuringly, Table A3 shows no impact of this placebo reform on the main outcome variables.

Finally, in the spirit of Cingano et al. (2016), we extend our analysis to incorporate other outcomes related to capital. Following Autor, Kerr and Kugler (2007) and Fazzari, Hubbard and Petersen (1987) we construct the capital to labor and the investment to capital ratios. Moreover, motivated by the idea that plants could use inventories to cope with volatility after the increase in the cost of agency work, we also construct the inventories to revenues ratio. Table A4 presents our results. Our main difference-in-differences specification shows a negative (albeit small) impact of the reform on capital deepening (¡1%) and a positive impact of the reform on inventory levels (2%). However, estimands from our exposure design approach show non-significant and opposite sign effects on these margins. All in all, we consider this evidence to be inconclusive.

[15]Our preferred specification uses exposure at the industry level since the agency workers' cost share at the plant-level may be affected by temporary shocks. For example, after a positive productivity shock a plant may hire more agency workers until it learns whether the shock is permanent or transitory. Using a sector-level measure of exposure, the shocks faced by different plants may cancel each other. In this regard, the sector-level measure of exposure is easier to interpret as the optimal ShT^* of our model. Thus, when using the plant-level measure of exposure we adjust it by its precision using inverse variance weighting, i.e., each observation is weighted by the inverse of the (across years) variance of pre-reform agency workers' cost share at the plant-level.

B. The Impact on the Misallocation of the Labor Composite

To study the impact that extending employment protection to agency work had on labor misallocation, we first need to proxy for the dispersion in the value of the marginal product of the labor composite. As discussed in sections II and III, we can use the standard deviation of $vmp(lc_i)$ in the pre- and post-reform periods as a measure of the degree of misallocation at the plant-level. Specifically, we can proxy $v\hat{m}p(lc)_{it+\tau}$ and $v\hat{m}p(lc)_{.t+\tau}$ from equation (9) using the logarithm of the ratio between a plant's revenue and plants' labor composite, and the average of that ratio at the sector-year level, respectively.[16]

Similar to our previous approach, here we distinguish between plants that used agency workers before the regulation and those that did not. In this case, however, we classify a plant as a TAW-user *only* if it hired agency-workers *every* year before the regulation. We do so in order to compute a sharp measure of pre-reform misallocation for each type of plant, i.e., we want to compute labor misallocation among TAW-user plants only considering the pre-reform years in which these plants effectively used a mix of agency and non-agency workers in the production process. Based on this classification of plants, and using our measures of labor misallocation in the pre and post-reform periods, we estimate:

$$\hat{\psi}_{i\omega t} = \alpha + \gamma_{j(i)} + \beta_0 \text{Post} + \beta_1 \text{TAW-User}_i + \beta_2 \text{TAW-User}_i \times \text{Post} + \epsilon_{it}, \tag{13}$$

where $\hat{\psi}_{i\omega}$ is our plant-level proxy for misallocation, as defined by equation (9) in the pre and post-reform periods; $\gamma_{j(i)}$ is a sector fixed effect, and ϵ_{it} is an error term robust to heteroskedasticity. The parameter of interest is β_2 and it corresponds to the differential growth (pre-post reform) in misallocation between TAW-user and non TAW-user plants.

Table 2 presents our results. Columns (1) and (2) show the change in labor misallocation from separate regressions considering non TAW-user and TAW-user plants, respectively. The "TAW-User $\times$ Post" coefficient in column (3) summarizes the difference between columns (2) and (1). Our estimates reveal that the misallocation of the labor composite increased by 12% among TAW-user plants (.033/.275). Column (4) shows that this result is robust to the inclusion of sector fixed effects. Figure 4 depicts this result visually. There we plot the density of our proxy for labor misallocation $\hat{\psi}_{i\omega}$ among non TAW-users (left) and TAW-users (right) plants, before and after the regulation. We added the point estimates and standard errors from the regression of this proxy on a post-period indicator at the top right of each plot. Consistent with the results presented in Table 2, Figure 4 shows that labor misallocation increased in all plants during the post-

[16] Notice that the latter is used as a proxy for the unitary cost of the labor. As pointed out by Caballero et al. (2013), the average value of the marginal labor productivity is a robust proxy in settings where the salary may not represent the actual unit cost of labor. We also account for bias in our measure of dispersion due to variation in labor quality by subtracting the moving average of the nominal labor productivity at the plant-level.

reform period, a finding plausibly related to the great recession that hit Chile the last quarter of 2008. Nonetheless, *relative* to non TAW-user plants, misallocation increased twice as much among plants that used agency workers before the regulation. The difference between periods is more salient among TAW-user plants, where the density of misallocation clearly skewed towards the right. All things considered, we interpret these findings as evidence that the reform increased labor misallocation.

How does the impact of the reform on labor misallocation depend on the elasticity of substitution? As discussed in section II, the impact of increasing the cost of agency work on the misallocation of the labor composite depends on the elasticity of substitution between types of workers; with the negative impact of the regulation increasing with the elasticity parameter ρ. Columns (5) and (6) of Table 2 confirm this prediction. These columns present the estimates of equation (13) on two sets of plants: i) those belonging to industries whose estimated elasticity of substitution is below the median and ii) those belonging to industries whose estimated elasticity of substitution is above the median. We find that among TAW-users plants (and *relative* to non TAW-user plants), misallocation increased twice as much if these plants belonged to industries with high elasticity of substitution. Appendix Figure A3 presents this result visually.

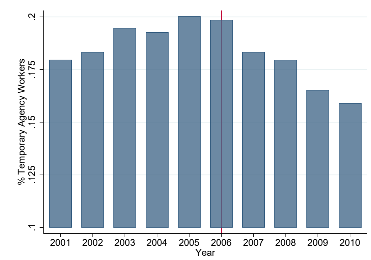
V. Conclusion

During the past decades, countries have witnessed rapid growth in the number of workers engaged in alternative work arrangements. Here, we have studied one of the most prominent non-standard work arrangements: temporary agency work. The nature of this type of employment is controversial. On one hand, some argue that temporary agency jobs allow firms to cope with volatility while helping workers to get experience and reach more stable employment. On the other hand, temporary agency work is seen as a trap, a strategy used by employers to circumvent labor regulations protecting workers' rights. Reflecting on these concerns and responding to the rising importance of new forms of labor, countries have enacted new regulations aiming to balance flexibility and security in the labor market.

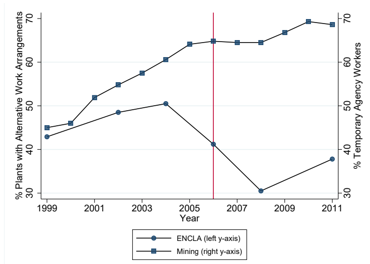
To evaluate the impact of one of such regulations, we developed a model of labor demand in the presence of agency work and we use it to derive testable predictions that we contrast with data from Chile using a difference-in-differences research design. By doing so, we contribute novel evidence on the economic effects that extending employment protection to agency workers has on manufacturing plants. Our results show that a reform leveling conditions between regular and agency workers lead to a decrease in revenues and employment at plants more exposed to the regulation. Moreover, we find suggestive evidence that negative employment effects were larger at plants in industries characterized by a low elasticity of substitution between regular and agency workers. Our analysis also reveals that the regulation increased the dispersion in the value of the marginal product of the labor composite, suggesting that this type of regulation increases inputs' misallocation.

On a final note, we would like to notice that our study is silent about the effects of this regulation on total welfare. Unfortunately, data limitations do not allow us to measure the (likely positive) impact that this reform had on employed workers, a policy-relevant dimension that we hope to address in future work.

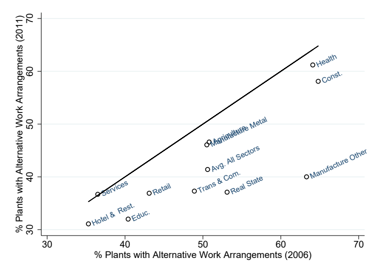
VI. Figures and Tables



A. Temporary Agency Work (ENIA)



B. Alternative Work Arrangements



C. Δ Alternative Work Arrangements

Figure 1. Alternative Work Arrangements in Chile over Time

Note: This figure shows the evolution of alternative employment over time in Chile. Panel A uses data from the manufacturing census ENIA used in our main analysis, from 2001 to 2010. Panels B and C use data from ENCLA (all economic sectors) and from COCHILCO (mining sector). In contrast to the ENIA, these datasets do not distinguish between agency work and activities outsourced (subcontracted) from third parties (inside and outside the establishment). Moreover, they are not available for every year. The law extending employment protection to temporary agency worker was passed in 2006 and enacted in 2007.

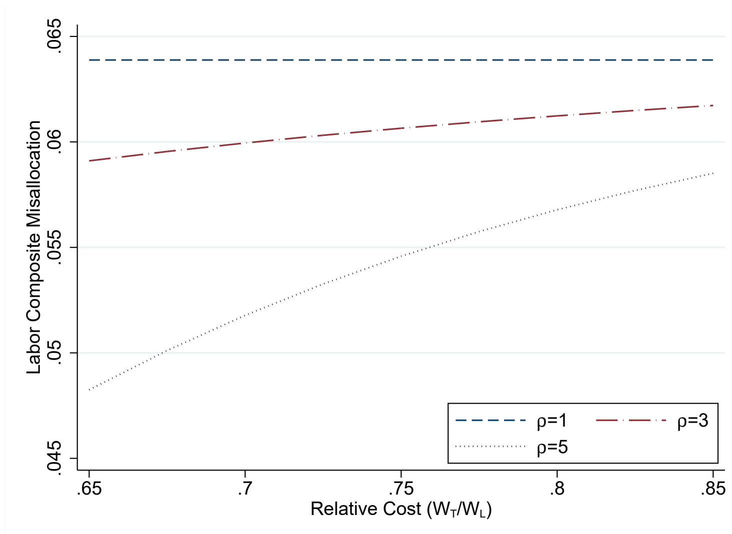
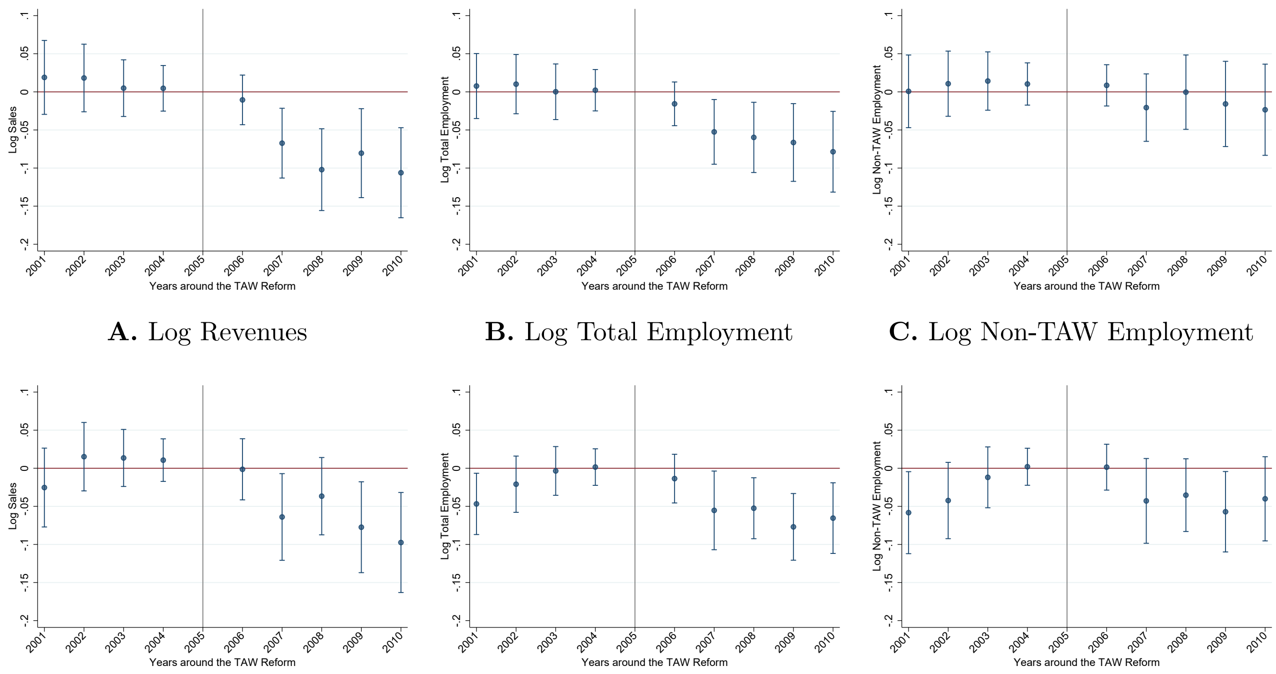


Figure 2. The Effect of the Regulation on Misallocation

Note: This figure shows the degree of misallocation (i.e., dispersion in the value of the marginal product of the labor composite) obtained from the numerically computation of equation (6) for different cost ratios and elasticities of substitution $\rho = \{1, 3, 5\}$.



A. Log Revenues **B.** Log Total Employment **C.** Log Non-TAW Employment

D. Log Revenues **E.** Log Total Employment **F.** Log Non-TAW Employment

Figure 3. The Effect of the Regulation on Employment

Note: These figures assess pre-trends and show the impact of the TAW regulation enacted in 2007. The plot shows the point estimates and 95% confidence intervals estimated from equation (12). Panels A to C consider a TAW-User$_i$ indicator, while Panels D to F consider our measure of exposure $ShT^*_{j(i)}$. The year 2005 is omitted in our regressions. All specifications include plant and year fixed effects as well as pre-determined controls interacted with year dummies. Standard errors are clustered at the plant-level.

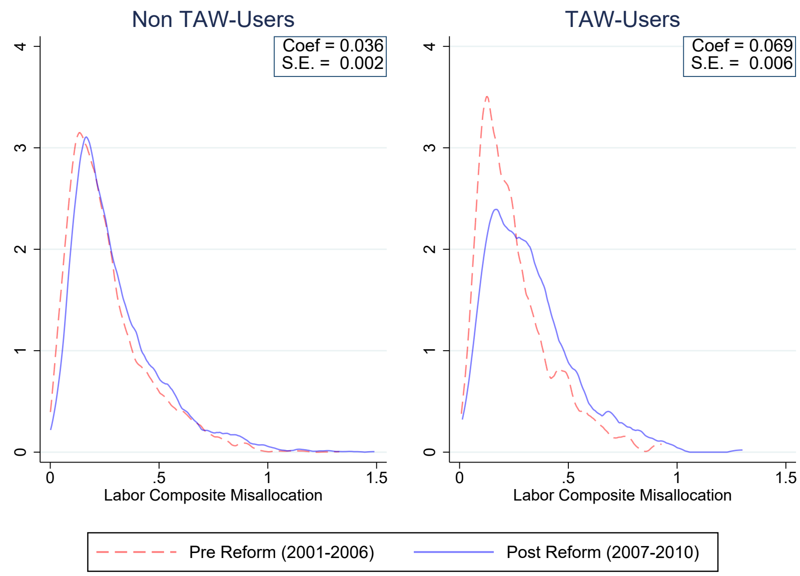


FIGURE 4. THE EFFECT OF THE REGULATION ON MISALLOCATION

Note: These figures plot the distribution of plant-level labor misallocation before and after the regulation was enacted $\hat{\psi}_{i\omega}$. See section 4.ii for details. In the left panel, we plot $\hat{\psi}_{i\omega}$ for Non TAW-User plants. In the right panel, we plot $\hat{\psi}_{i\omega}$ for TAW-User plants. The coefficients and standard errors from regressions of misallocation on a post-period (after 2006) indicator is reported at the top right of each subfigure.

	Log Revenues		Log Total Employment		Log Non-TAW Employment	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Diff-in-Diff [TAW-User = I($TAW_{2000} > 0$)]						
TAW-User × Post	-0.073	-0.093	-0.039	-0.064	0.001	-0.022
	(0.022)	(0.022)	(0.020)	(0.019)	(0.021)	(0.021)
Mean Dep. Var	0.940	0.940	33.85	33.85	31.68	31.68
Observations	44,814	44,814	44,824	44,824	44,824	44,824
Panel B: Exposure Design [Exposure = $ShT \mid ShT > 0$]						
Exposure × Post	-0.068	-0.069	-0.046	-0.048	-0.022	-0.025
	(0.022)	(0.022)	(0.017)	(0.017)	(0.022)	(0.022)
Mean Dep. Var	2.242	2.242	66.46	66.46	53.51	53.51
Observations	6,330	6,330	6,331	6,331	6,331	6,331
B.1. Plants ∈ Low Elasticity Sector						
Exposure × Post	-0.051	-0.055	-0.088	-0.100	-0.038	-0.048
	(0.052)	(0.051)	(0.044)	(0.043)	(0.049)	(0.049)
Mean Dep. Var	2.295	2.295	67.97	67.97	55.94	55.94
Observations	2,545	2,545	2,545	2,545	2,545	2,545
B.2. Plants ∈ High Elasticity Sector						
Exposure × Post	-0.057	-0.058	-0.035	-0.035	-0.012	-0.014
	(0.024)	(0.024)	(0.019)	(0.019)	(0.025)	(0.025)
Mean Dep. Var	2.206	2.206	65.44	65.44	51.90	51.90
Observations	3,779	3,779	3,780	3,780	3,780	3,780
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Table 1—Difference-in-Differences Estimates

Note: This table shows the estimated impact of the regulation that extended employment protection to agency workers on plants' revenues and employment. "TAW-User" is a dummy that takes the value one if a plant used agency workers at the beginning of our sample, in 2000; and "Post" is an indicator for the post-reform period (after 2006). Our estimation sample considers the 2001-2010 period. "Mean Dep. Var" corresponds to the exponential of the dependent variable. Robust standard errors clustered at the plant-level in parentheses.

	Labor Composite Misallocation $\hat{\psi}_{i\omega}$					
	Plant Type		All Plants		Plants ∈ Low Elasticity Sector	Plants ∈ High Elasticity Sector
	Non TAW-User	TAW-User				
	(1)	(2)	(3)	(4)	(5)	(6)
Post	0.036	0.069	0.036	0.035	0.032	0.039
	(0.002)	(0.006)	(0.002)	(0.002)	(0.003)	(0.003)
TAW-User			-0.010	-0.013	-0.010	-0.014
			(0.003)	(0.003)	(0.006)	(0.004)
TAW-User × Post			0.033	0.034	0.021	0.040
			(0.006)	(0.006)	(0.010)	(0.008)
Mean Dep Var	0.275	0.278	0.275	0.275	0.271	0.279
Observations	35,030	4,395	39,425	39,425	19,324	20,101
Sector FE	No	No	No	Yes	Yes	Yes

Table 2—The Effect of the Regulation on Misallocation

Note: This table presents the effects of the regulation that extended employment protection to agency workers on plant-level misallocation $\hat{\psi}_{i\omega}$. See section 4.ii for details. For each plant, we observe two values of misallocation (before and after the reform). "TAW-User" is a dummy that takes the value one if a plant used agency workers every year before the regulation; and "Post" is an indicator for the post-reform period (after 2006). Our estimation sample considers the 2001-2010 period. Robust standard errors in parentheses.

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Appendix

A1. Additional Figures and Tables

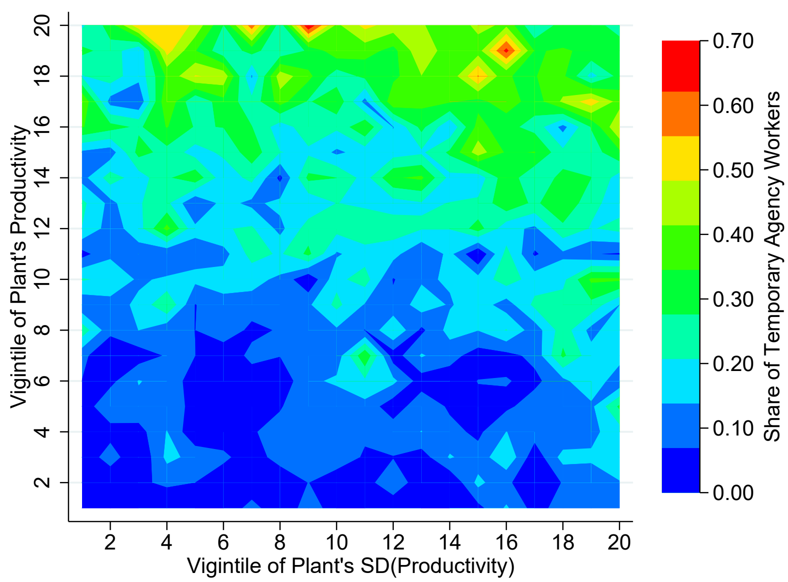
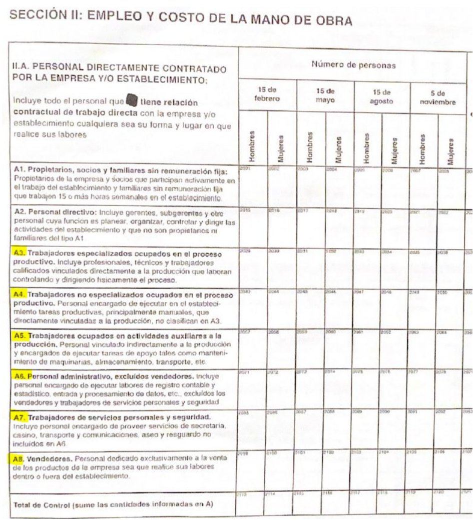


Figure A1. Temporary Agency Work in Chilean Manufacturing Plants

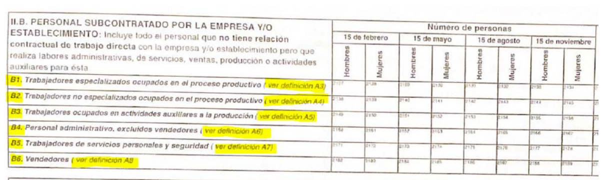
Note: This figure shows the relationship between the share of agency workers and the first and second moment of predetermined (pre-reform) plants' productivity. We estimate plant productivity following Levinsohn and Petrin (2003).



SECCIÓN II: EMPLEO Y COSTO DE LA MANO DE OBRA

II.A. PERSONAL DIRECTAMENTE CONTRATADO POR LA EMPRESA Y/O ESTABLECIMIENTO: Incluye todo el personal que [redacted] tiene relación contractual de trabajo directa con la empresa y/o establecimiento cualquiera sea su forma y lugar en que realice sus labores	Número de personas							
	15 de febrero		15 de mayo		15 de agosto		5 de noviembre	
	Hombres	Mujeres	Hombres	Mujeres	Hombres	Mujeres	Hombres	Mujeres
A1. Propietarios, socios y familiares sin remuneración fija: Propietarios de la empresa y socios que participan activamente en el trabajo del establecimiento y familiares sin remuneración fija que trabajen 15 o más horas semanales en el establecimiento								
A2. Personal directivo: Incluye gerentes, subgerentes y otro personal cuya funcion es planear, organizar, controlar y dirigir las actividades del establecimiento y que no son propietarios ni familiares del tipo A1								
A3. Trabajadores especializados ocupados en el proceso productivo. Incluye profesionales, técnicos y trabajadores calificados vinculados directamente a la producción que laboran controlando y dirigiendo físicamente el proceso.								
A4. Trabajadores no especializados ocupados en el proceso productivo. Personal encargado de ejecutar en el estableci-miento tareas productivas, principalmente manuales, que directamente vinculadas a la producción, no clasifican en A3.								
A5. Trabajadores ocupados en actividades auxiliares a la producción. Personal vinculado indirectamente a la producción y encargados de ejecutar tareas de apoyo tales como manteni-miento de maquinarias, almacenamiento, transporte, etc.								
A6. Personal administrativo, excluidos vendedores. Incluye personal encargado de ejecutar labores de registro contable y estadístico, entrada y procesamiento de datos, etc., excluidos los vendedores y trabajadores de servicios personales y seguridad								
A7. Trabajadores de servicios personales y seguridad. Incluye personal encargado de proveer servicios de secretaría, casino, transporte y comunicaciones, aseo y resguardo no incluidos en A6.								
A8. Vendedores. Personal dedicado exclusivamente a la venta de los productos de la empresa sea que realice sus labores dentro o fuera del establecimiento.								
Total de Control (sume las cantidades informadas en A)								

A. Workers hired *directly*

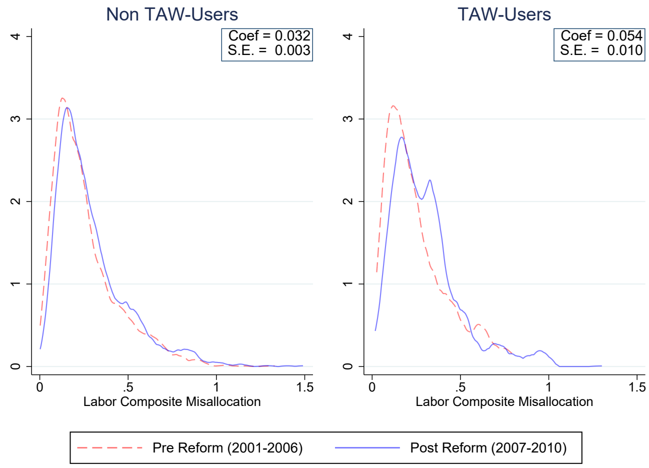


II.B. PERSONAL SUBCONTRATADO POR LA EMPRESA Y/O ESTABLECIMIENTO: Incluye todo el personal que **no tiene relación contractual de trabajo directa** con la empresa y/o establecimiento pero que realiza labores administrativas, de servicios, ventas, producción o actividades auxiliares para ésta	Número de personas							
	15 de febrero		15 de mayo		15 de agosto		15 de noviembre	
	Hombres	Mujeres	Hombres	Mujeres	Hombres	Mujeres	Hombres	Mujeres
B1. Trabajadores especializados ocupados en el proceso productivo (ver definición A3)								
B2. Trabajadores no especializados ocupados en el proceso productivo (ver definición A4)								
B3. Trabajadores ocupados en actividades auxiliares a la producción (ver definición A5)								
B4. Personal administrativo, excluidos vendedores (ver definición A6)								
B5. Trabajadores de servicios personales y seguridad (ver definición A7)								
B6. Vendedores (ver definición A8								

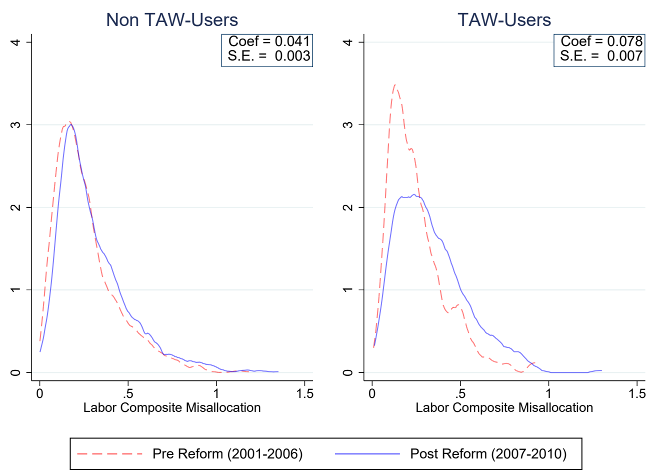
B. Workers hired *indirectly* through a temporary work agency

Figure A2. ENIA's questionnaires

Note: This figure shows that except for owners and managers, there are exactly the same categories (same definition) for workers directly hired by the plant and those provided by a temporary agency, e.g., The B.1 category of agency workers (Panel B) corresponds exactly to the A.3 category of workers directly hired by the plant (panel A).



A. Plants ∈ Sectors with Low Elasticity



B. Plants ∈ Sectors with High Elasticity

FIGURE A3. THE EFFECT OF THE REGULATION ON MISALLOCATION

Note: This figure shows the distribution of plant-level misallocation before and after the regulation was enacted $\hat{\psi}_{i\omega}$. See section 4.ii for details. In the left panel, we plot $\hat{\psi}_{i\omega}$ for Non TAW-User plants. In the right panel, we plot $\hat{\psi}_{i\omega}$ for TAW-User plants. Panels A and B consider plants in sectors with low and high elasticity of substitution, respectively. The coefficient and standard error from a regression of misallocation on a post-period (after 2006) indicator is reported at the top right of each subfigure.

	Mean (1)	SD (2)	pc 50 (3)	pc 10 (4)	pc 90 (5)	N. Obs. (6)
Panel A: *Employment*						
Non-agency Employment	71.94	157.50	25.00	8.00	164.00	59010
Agency Employment	49.16	149.17	9.00	2.00	116.00	10705
1(TAW≥0)	0.18	0.38	0.00	0.00	1.00	59377
Share TAW	0.05	0.15	0.00	0.00	0.13	59377
Share TAW | TAW¿0	0.26	0.26	0.16	0.03	0.66	10705
Panel B: *Revenue Sharing*						
Share Cost of Non-TAW	0.23	0.16	0.20	0.06	0.42	58956
Share Cost of TAW	0.04	0.05	0.02	0.00	0.11	9822
Share Value of Capital	0.38	0.53	0.21	0.04	0.85	48769
Share Int. Inputs (Materials)	0.47	0.20	0.46	0.20	0.73	58928
Share Value-Added	0.37	0.17	0.36	0.16	0.61	57058
Panel C: *Other Variables*						
Investment-Capital Ratio	0.13	0.39	0.00	0.00	0.34	51492
Inventories-Sales Ratio	0.18	0.27	0.09	0.00	0.45	59444
Revenues (in Millions of USD)	10.55	98.19	0.70	0.11	12.82	59427

Table A1—Descriptive Statistics

Note: This table presents descriptive statistics of the main variables used in our analysis.

	Log Revenues		Log Total Employment		Log Non-TAW Employment	
Panel A: *Adding Sector × Year Fixed Effects*						
	No	**Yes**	**No**	**Yes**	**No**	**Yes**
Diff-in-Diff Design						
TAW-User × Post	-0.093	-0.067	-0.064	-0.057	-0.022	-0.012
	(0.022)	(0.022)	(0.019)	(0.020)	(0.021)	(0.021)
Mean Dep. Var	0.940	0.940	33.85	33.85	31.68	31.68
Observations	44,814	44,814	44,824	44,824	44,824	44,824
Exposure Design (plant-level)						
Exposure × Post	-0.080	-0.234	-0.297	-0.077	0.615	0.239
	(0.015)	(0.102)	(0.019)	(0.042)	(0.034)	(0.069)
Mean Dep. Var	2.233	2.233	62.96	62.96	49.75	49.75
Observations	10,661	10,661	10,664	10,664	10,664	10,664
Panel B: *Using an Alternative Measure of Productivity*						
	No	**Yes**	**No**	**Yes**	**No**	**Yes**
Diff-in-Diff Design						
TAW-User × Post	-0.093	-0.072	-0.064	-0.036	-0.022	0.004
	(0.022)	(0.022)	(0.019)	(0.020)	(0.021)	(0.021)
Mean Dep. Var	0.940	0.940	33.85	33.85	31.68	31.68
Observations	44,814	44,757	44,824	44,766	44,824	44,766
Exposure Design						
Exposure × Post	-0.069	-0.065	-0.048	-0.043	-0.025	-0.021
	(0.022)	(0.021)	(0.017)	(0.017)	(0.022)	(0.023)
Mean Dep. Var	2.242	2.242	66.46	66.46	53.51	53.51
Observations	6,330	6,330	6,331	6,331	6,331	6,331

Table A2—Robustness checks

Note: This table presents two robustness checks. Panel A shows the estimates from specifications (10) and (11) but including sector-by-year fixed effects. To estimate the latter, we use a measure of "exposure" at the plant level, and we adjust the estimates by its precision, i.e., each observation is weighted by the inverse of the (across years) variance of pre-reform TAW cost share at the plant-level. Panel B shows the estimates from specifications (10) and (11) but including year fixed effects and their interaction with the (pre-reform) level of plants productivity. In this case, plants productivity is constructed using the cost shares as proxies for production elasticities instead of using Levinsohn and Petrin (2003). "Mean Dep. Var" corresponds to the exponential of the dependent variable. Robust standard errors clustered at the plant-level in parentheses.

	Log Revenues		Log Total Employment		Log Non-TAW Employment	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Diff-in-Diff [TAW-User = I($TAW_{2000} > 0$)]						
TAW-User × Post	0.012	-0.014	0.008	-0.007	0.005	-0.007
	(0.017)	(0.016)	(0.014)	(0.014)	(0.016)	(0.016)
Mean Dep. Var	0.819	0.819	32.45	32.45	30.27	30.27
Observations	20,112	20,112	20,114	20,114	20,114	20,114
Panel B: Exposure Design [Exposure = ShT | $ShT > 0$]						
Exposure × Post	-0.004	-0.007	0.015	0.013	0.031	0.030
	(0.018)	(0.018)	(0.014)	(0.014)	(0.019)	(0.019)
Mean Dep. Var	1.964	1.964	63.42	63.42	49.65	49.65
Observations	2,843	2,843	2,843	2,843	2,843	2,843
B.1. Plants ∈ Low Elasticity Sector						
Exposure × Post	-0.066	-0.035	-0.022	-0.003	0.006	0.020
	(0.057)	(0.058)	(0.033)	(0.032)	(0.037)	(0.037)
Mean Dep. Var	1.966	1.966	64.14	64.14	51.21	51.21
Observations	1,129	1,129	1,129	1,129	1,129	1,129
B.2. Plants ∈ High Elasticity Sector						
Exposure × Post	0.000	0.002	0.020	0.021	0.037	0.038
	(0.018)	(0.018)	(0.015)	(0.015)	(0.021)	(0.021)
Mean Dep. Var	1.964	1.964	62.99	62.99	48.66	48.66
Observations	1,712	1,712	1,712	1,712	1,712	1,712
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Table A3—Placebo Reform in 2004 (2002-2005 window)

Note: This table presents the effects of a placebo exercise that sets the reform year to 2004. “TAW-User” is a dummy that takes the value one if a plant used agency workers at the beginning of our sample, in 2000; and “Post” is an indicator for the post-reform period (2004-2005). This sample only considers pre-reform years in a 2 year bandwidth around the placebo reform (2002-2005). ”Mean Dep. Var” corresponds to the exponential of the dependent variable. Robust standard errors clustered at the plant-level in parentheses.

	Capital-Labor Ratio		Investment-Capital Ratio		Inventories-Sales Ratio	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Diff-in-Diff [TAW-User = I($TAW_{2000} > 0$)]						
TAW-User × Post	-0.004	-0.006	-0.004	0.001	0.020	0.017
	(0.002)	(0.002)	(0.012)	(0.012)	(0.008)	(0.008)
Mean Dep. Var	1.024	1.024	1.135	1.135	1.204	1.204
Observations	44,824	44,824	42,300	42,300	44,824	44,824
Panel B: Exposure Design [Exposure = $ShT \mid ShT > 0$]						
Exposure × Post	0.000	0.000	-0.008	-0.007	-0.005	-0.005
	(0.002)	(0.002)	(0.010)	(0.010)	(0.007)	(0.007)
Mean Dep. Var	1.035	1.035	1.129	1.129	1.249	1.249
Observations	6,331	6,331	6,262	6,262	6,331	6,331
B.1. Plants ∈ Low Elasticity Sector						
Exposure × Post	-0.002	-0.001	0.005	0.009	0.003	0.001
	(0.004)	(0.004)	(0.029)	(0.029)	(0.015)	(0.015)
Mean Dep. Var	1.031	1.031	1.132	1.132	1.206	1.206
Observations	2,545	2,545	2,514	2,514	2,545	2,545
B.2. Plants ∈ High Elasticity Sector						
Exposure × Post	0.000	-0.000	-0.008	-0.008	-0.006	-0.006
	(0.002)	(0.002)	(0.011)	(0.011)	(0.008)	(0.008)
Mean Dep. Var	1.037	1.037	1.126	1.126	1.279	1.279
Observations	3,780	3,780	3,742	3,742	3,780	3,780
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Table A4—Difference-in-Differences: Impact on Other Outcomes

Note: This table presents the effects of the regulation enacted in 2007 that extended employment protection to agency workers. "TAW-User" is a dummy that takes the value one if a plant used agency workers at the beginning of our sample; "Exposure" corresponds to the TAW cost share at the beginning of our sample; and "Post" is an indicator for the post-reform period (after 2006). Our estimation sample considers the 2001-2010 period. Robust standard errors clustered at the plant-level in parentheses.

A2. Theoretical Model

This appendix offers more details on the model presented in section II. Our model has two key features. First, agency workers (T) and regular employees (L) work in the same occupations within the same workplace and can be substitutes of each other. Second, due to the contractual differences, the plant faces a cost when adjusting non-agency employees but can adjust their temporary agency workers freely.

The main text presents a model with an infinite labor supply elasticity of regular workers (i.e., constant W_L). In this appendix, we generalize the model by allowing plants to face an isoelastic upward sloping supply curve of regular workers.[17]

Specifically, we assume that the labor supply of regular workers is given by:

$$L^S = \left(\frac{W_L^m(L)}{W_o} \right)^{\epsilon}, \tag{A1}$$

where W_L^m is the monopsonistic wage and $\epsilon > 1$ is the labor supply elasticity.[18]

Expected Equilibrium Levels. — Building on the fact that the *expected* level of regular and agency workers equal their optimum in absence of adjustment costs (i.e., the static optimum), we begin by solving for the static equilibrium levels of L^* and T^* in absence of adjustment cost, i.e., equilibrium under $\Phi = 0$.

The first order conditions (i.e., the derivates of equation (1) from the main text, with respect to L and T) are given by:

$$\Pi_T : \underbrace{\gamma(1 - \frac{1}{\eta})}_{\equiv \mu} \frac{PY_{it}^*}{T_{it}^*} \underbrace{\frac{\alpha^{T^{1/\rho}} T_{it}^{*(\rho-1)/\rho}}{\alpha^{L^{1/\rho}} L_{it}^{*(\rho-1)/\rho} + \alpha^{T^{1/\rho}} T_{it}^{*(\rho-1)/\rho}}}_{\equiv ShT^*} - W_{Tt} = 0. \tag{A2}$$

$$\Pi_L : \gamma(1 - \frac{1}{\eta}) \frac{PY_{it}^*}{L_{it}^*} \underbrace{\frac{\alpha^{L^{1/\rho}} L_{it}^{*(\rho-1)/\rho}}{\alpha^{L^{1/\rho}} L_{it}^{*(\rho-1)/\rho} + \alpha^{T^{1/\rho}} T_{it}^{*(\rho-1)/\rho}}}_{\equiv ShL^*} - W_{Lt}^{*,m}(1 + \frac{1}{\epsilon}) = 0. \tag{A3}$$

where x^* denotes the value of variable x at the optimal level in absence of frictions, and ShT and ShL stand for the labor shares of agency and regular workers. The second order conditions are given by:

[17] A recent meta-analysis by Sokolova and Sorensen (2021) finds that labor supply elasticity is on average 12.

[18] This a functional form for the labor supply could be derived, for instance, from a model in which households receive wage offers and must choose, after the realization of firm-specific amenity shocks, to which plant they want to work for (Card et al., 2018).

$$\Pi_{TT} = ((\gamma\rho - (\rho - 1))\, ShT^* - 1)\, \frac{1}{\rho} \frac{W_{Lt}^{*,m}(1 + 1/\epsilon) ShT^*\, L^*}{ShL^*\, T^{*2}} \tag{A4}$$

(A5)

$$\Pi_{LL} = ((\gamma\rho - (\rho - 1))\, ShL^* - 1 - \rho/\epsilon)\, \frac{1}{\rho} \frac{W_{Lt}^{*,m}(1 + \frac{1}{\epsilon})L^*}{L^{*2}} \tag{A6}$$

(A7)

$$\Pi_{LT} = \left(\gamma - \frac{\rho - 1}{\rho}\right) ShT^* \frac{W_{Lt}^{*,m}(1 + \frac{1}{\epsilon})}{T^*}. \tag{A8}$$

(A9)

To derive the impact of the regulation that increased W^T on revenues PY, we first need the following intermediate results:

$$\underbrace{\frac{dShL^*}{dW_T}\frac{W_T}{ShL^*}}_{\equiv \xi_{ShL,W_T}} = ShT^*(\rho - 1)\left(1 - \frac{1}{\epsilon}\right) \tag{A10}$$

$$\underbrace{\frac{dShT^*}{dW_T}\frac{W_T}{ShT^*}}_{\equiv \xi_{ShT,W_T}} = -ShL^*(\rho - 1)\left(1 - \frac{1}{\epsilon}\right) \tag{A11}$$

Using equations (A10) and (A11), we can derive:

$$\begin{aligned} \frac{dPY^*}{dW_T}\frac{W_T}{PY^*} &= \mu\left(ShL^*\xi_{L,W_T} + ShT^*\xi_{T,W_T}\right) \\ &= -\frac{\mu}{1-\mu} ShT^* \left(1 - \frac{ShL^*}{\epsilon} \frac{\frac{1-\rho(1-\mu)}{1-\mu} + \frac{\rho-1}{\epsilon}}{1 + \frac{1}{\epsilon}\frac{1-\mu(1-ShL^*)}{1-\mu}}\right) < 0. \end{aligned} \tag{A12}$$

The impact of the regulation on revenues is negative and increasing when the labor supply elasticity is lower than infinity. It is worth noticing that when $\epsilon = \infty$, we get the result from Proposition 1.

Likewise, the impact of the regulation on non-agency employment is given by:

$$\frac{dL^*}{dW_T}\frac{W_T}{L^*} = -ShT^* \frac{\frac{1-\rho(1-\mu)}{1-\mu} + \frac{\rho-1}{\epsilon}}{1 + \frac{1}{\epsilon}\frac{1-\mu(1-ShL^*)}{1-\mu}} \tag{A13}$$

Thus, the impact of the regulation depends on the relative size of the "substitution" effect vis a vis the "scale" effect. In this case, however, the impact of the regulation also depends on the labor supply elasticity ϵ. It can be shown that a sufficient condition for the effect of the regulation on non-agency employment to be positive is $\epsilon > 1 + \mu/(\rho(1-\mu)-1)$. Again, when $\epsilon = \infty$, we get the result from Proposition 2.

Labor Composite Misallocation. — In order to write misallocation in terms of the labor composite LC_{it}, we first need to solve the dynamic maximization problem of the plant facing quadratic adjustment costs on regular workers. For this, we leverage the fact that $B_{it}^{1/\eta} A_{it}^{\gamma}$ follows a random walk and we use a standard Taylor approximation of second order around the static optimum (i.e., without adjustment costs).

From the first order condition for agency workers, we obtain:

$$(t_t - t_t^*) \approx ShL_t^* \left(\frac{1}{1-\rho(1-\mu)} - ShT_t^* \right)^{-1} (l_t - l_t^*), \tag{A14}$$

where t_t and l_t stand for the logarithm of the number of agency and non-agency workers.

The previous expression is important as it allows us to write the second order approximation as a function of the logarithm of non-agency workers l_t. Considering that, the plant solves:

(A15)

$$Max_{L_t} E \left[\sum_{j=t} \beta^j \left(\Pi_{t+j}^* + L_{t+j}^* \Omega(W_T)(l_{t+j} - l_{t+j}^*)^2 - L_{t+j}^* \frac{\Phi}{2} (l_{t+j} - l_{t+j-1})^2 \right) |t \right],$$

which can be shown to be approximately equal to:

$$Max_{L_t} E \left[\sum_{j=t} \beta^j e^{(\frac{\sigma_\epsilon^2}{2})j} \left(\Omega(W_T)(l_{t+j} - l_{t+j}^*)^2 - \frac{\Phi}{2} (l_{t+j} - l_{t+j-1})^2 \right) |t \right], \tag{A16}$$

where β is the discount factor and σ_ϵ is the standard deviation of the disturbances to $B_{it}^{1/\eta} A_{it}^{\gamma}$. The function $\Omega(W_T)$ represents the one-period cost of having a gap between the current and the static optimal level of non-agency employment. Thus, the higher Ω is (in absolute value), the higher the fraction of the gap in non-agency employment that the plant closes each period. In our case, Ω is given by:

(A17)

$$\begin{aligned}
\Omega(W_T) \equiv & \frac{1}{2}\left(\left(\gamma\rho-(\rho-1)\right)ShL^{*}-1-\frac{\rho}{\epsilon}\right)\frac{1}{\rho}W_L^{m,*}(1+\frac{1}{\epsilon}) \\
& +\frac{1}{2}\left(\left(\mu\rho-(\rho-1)\right)_{ShT^{*}}-1\right)\frac{1}{\rho}W_L^{m,*}(1+\frac{1}{\epsilon})ShT^{*}ShL^{*}\left(\frac{1}{1-\rho(1-\mu)}-ShT^{*}\right)^{-2} \\
& +\left(\frac{\mu\rho-(\rho-1)}{\rho}\right)W_L^{m,*}(1+\frac{1}{\epsilon})ShT^{*}ShL^{*}\left(\frac{1}{1-\rho(1-\mu)}-ShT^{*}\right)^{-1} \\
& =-\frac{W_L^{m,*}(1+\frac{1}{\epsilon})}{2\rho}\left(1-\frac{1-\rho(1-\mu)}{1+\frac{ShT^{*}}{ShL^{*}}\rho(1-\mu)}\right) \\
& =-\frac{W_L^{m,*}(1+\frac{1}{\epsilon})}{2}\frac{(1-\mu)}{ShL^{*}+ShT^{*}\rho(1-\mu)}.
\end{aligned}$$

In this equation, i) the first term on the right side is the second derivative of L multiplied by L^{*2}/L^{*}, ii) the second term is the second derivative of T multiplied by T^{*2}/L^{*} and by the square of the relationship between the log difference of T and L, and iii) the third term is the cross derivative multiplied by $L^{*}T^{*}/L^{*}$ and by the relationship between the log difference of T and L. It is also worth noting that sufficient conditions to have $\frac{d\Omega}{dW^{T}}<0$ are that $\rho(1-\mu)>1$ and $\epsilon>1+\mu/(\rho(1-\mu)-1)$.[19]

Finally, in the spirit of Cahuc and Zylberberg (2014) the dynamic solution for l_t is given by:

$$l_t=\lambda l_t^{*}+(1-\lambda)l_{t-1} \qquad \text{and} \qquad l_t-l_t^{*}=(1-\lambda)\sum_{j=0}^{\infty}(1-\lambda)^{j}\epsilon_{t-j},$$

and the variance of $(l_t-l_t^{*})$ is given by:

$$var(l_t-l_t^{*})=\frac{(1-\lambda)^2}{1-(1-\lambda)^2}\sigma_\epsilon^2, \tag{A18}$$

where:

(A19)

$$\lambda=1-\frac{2\frac{-\Phi}{2\Omega}}{1+\frac{-\Phi}{2\Omega}(1+\beta e^{(\sigma^2/2)})+\sqrt{\left(1+\frac{-\Phi}{2\Omega}(1+\beta e^{(\sigma^2/2)})\right)^2-4\left(\frac{-\Phi}{2\Omega}\right)^2\beta e^{(\sigma^2/2)}}}.$$

[19]The condition for ϵ implies that an increase in W^{T} increases the number of regular workers and therefore $W^{m,L*}$.

Thus, leveraging equation (2) from the main text, together with equations (A14), (A17), (A18), and (A19) we can derive our measure of plant-level labor misallocation as:

(A20)

$$\psi(lc_i) \equiv \sqrt{\text{Var}(vmp(lc_i) - vmp(lc^*))} \approx \left(\frac{1-\mu}{1 + \frac{ShT^*}{ShL^*}\rho(1-\mu)} \right) \frac{(1-\lambda)}{(1-(1-\lambda)^2)^{1/2}} \sigma_\epsilon,$$

Equation (A20) corresponds to the one presented in the main text for the special case when the labor elasticity of regular workers is equal to infinity. It is worth noticing, however, that it is not the same in general as the speed of adjustment (λ) is a function of the labor supply elasticity of regular workers (ϵ).

Unfortunately, in this case we cannot derive an analytical expression for the impact of the regulation on labor misallocation.[20] Thus, to assess the impact of the regulation on labor misallocation we perform a simulation in which we numerically compute the increase in the degree of misallocation as a response to an increase in the relative cost of agency workers. We do this for different labor supply elasticities. We consider a surge in the relative cost of agency to regular workers from 0.65 to 0.85; and we fix the elasticity of substitution types of workers at 4. Figure A4 shows that if the labor supply elasticity of regular workers is infinity (i.e., a competitive labor market of regular workers), then labor misallocation increases by 13%. Importantly, we find that the size of the effect of the TAW regulation on misallocation increases as the labor supply elasticity decreases. For instance, when we assume a labor supply elasticity of 5, the increase in misallocation corresponds to 53%.

[20]Proposition 3 in the main text shows an analytical expression for the impact of the regulation on labor misallocation, assuming a completely elastic labor supply of regular workers ($\epsilon = \infty$).

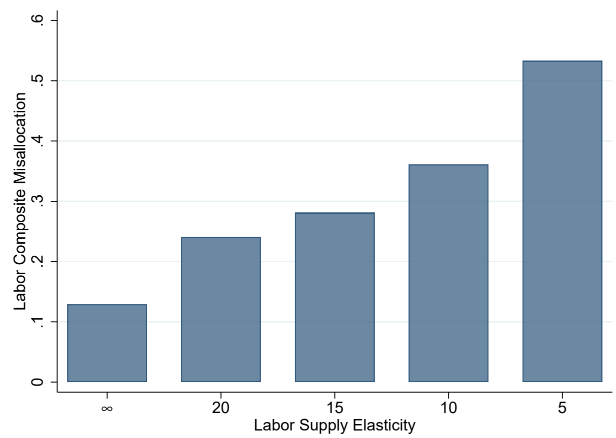


Figure A4. The Effect of the Regulation on Misallocation

Note: This figure shows the increase in the misallocation of the labor composite triggered by an increase in the relative wage of agency workers (from 0.65 to 0.85), for different labor supply elasticities (∞,20,15,10,5). Results are obtained from numerical simulation.