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ARTICLE

Impacts of an employer's contributory pillar: evidence from Chile

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Abstract

We estimate labor demand elasticities to predict the employment effects of an employer's contributory pillar in Chile's pension system. The Chilean system has been a model for reform in many countries worldwide. We find labor demand to be inelastic, with baseline estimates ranging from −0.27 to −0.91. We predict that the implementation of an employer contributory pillar with contribution rates of 1% increase would increase unemployment rates by 0.20 to 0.71 percentage points (pp) from a baseline unemployment of 6.51%. Our results show sizable differences in labor demand elasticities and employment impacts by industry and workforce characteristics. Simulations imply implementing a uniform employer contributory pillar would especially reduce employment for low-skilled workers and workers in industries where labor is easily substitutable.

Keywords: employer contribution; labor demand elasticities; retirement income policy

JEL Codes: J26; J32; I38

1. Introduction

The aging population has challenged the traditional pay-as-you-go pension design. While a unique pension model does not exist, multi-pillar systems have grown in popularity since the World Bank promoted the five-pillar model (World Bank, 1994; Holzmann, 2005).[1] Evidence shows economic and political crises, together with globalization, accelerating the implementation of pension systems with private individual accounts (Fong and Leibrecht, 2020). Multi-pillar systems combining pay-as-you-go and private capitalization can expand pension coverage while improving economic outcomes (Frassi *et al.*, 2019). In reforming pay-as-you-go systems, the Chilean pension model has served as a prototype for designing systems with individual accounts (Orszag and Stiglitz, 2001).[2]

Forty years after its implementation, the Chilean model increased savings rates, investments, employment, productivity, and wages (Corsetti and Schmidt-Hebbel, 1997; Edwards and

[1]Other organizations later promoted similar models based on either four or five pillars, such as the International Labor Organization and the Geneva Association (Gillion *et al.*, 2000; Giarini, 2012).

[2]Several countries in Latin America and Eastern Europe have adopted the Chilean model. There are also recent proposals for reforms in the United States and Europe that consider characteristics of the Chilean system (Joubert, 2015; Krasnokutskaya *et al.*, 2018).

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Edwards, 2002; Corbo and Schmidt-Hebbel, 2003; Cerda *et al.*, 2020). The reform aimed to prevent fiscal insolvencies from the pay-as-you-go system (Edwards and Edwards, 2002) and later reformed it to make sure public expenditures were sustainable (Castañeda *et al.*, 2021). However, evidence shows the system did not achieve adequate pension levels for all affiliates (López García, 2015; Barr and Diamond, 2016); it replicates labor market inequality and gender gaps (Joubert and Todd, 2020; Parada-Contzen, 2023), does not consider discontinuous work trajectories and informality (Joubert, 2015; Madero-Cabib *et al.*, 2019; McKiernan, 2021), and has outcomes that are sensitive to financial shocks (Mesa-Lago and Bertranou, 2016; Krasnokutskaya *et al.*, 2018). To improve pension outcomes, several authors have suggested increasing contribution rates (Barr and Diamond, 2016; Mesa-Lago and Bertranou, 2016; Madero-Cabib *et al.*, 2019).

Recently, in response to the economic hardships caused by the COVID-19 pandemic, the National Congress authorized three rounds of emergency pension fund withdrawals in 2020–2021. These withdrawal processes allowed enrollees to access up to 10% of their individual retirement account balances, subject to a cap (Barraza *et al.*, 2023).[3] The savings withdrawals left approximately 35% of enrollees with a zero balance (Superintendencia de Pensiones, 2021a), putting future retirees' pension outcomes at risk. Policymakers are, therefore, evaluating new mechanisms to increase savings levels and improve pension outcomes.

In November 2022, the Chilean government presented a reform proposal incorporating a new contributory pillar into the Chilean pension model. The new pillar would be funded through an employers' contributory rate of 6% of before-tax gross wages. It seeks to improve pension outcomes for all retirees, including through a redistribution component (Gobierno de Chile, 2022). Similar ideas of introducing an employers' contributory pillar first appeared in 2015 when experts recommended a 4% employer contribution to improve adequacy levels, with a portion (2%) funding social pensions to improve adequacy and redistributional characteristics of the model (Barr and Diamond, 2016). Although several governments have attempted to reform the pension system by including an employer's contributory pillar, the model's design remains unchanged.

Based on this background, this paper evaluates the employment effects of a new pillar based on employers' contributions. Using five rounds of the Chilean firm survey (ELE) from 2007–2017, we estimate labor demand elasticities by industry and worker type. We simulate employment impacts assuming gross wages rise, but net wages remain unchanged. We discuss specific policy recommendations for improving the welfare effects of the Chilean pension model. While our results apply directly to Chile, the Chilean model has served as a template for other pension systems worldwide. Thus, our findings provide relevant background for policymakers considering employer contribution pillars in other settings. Additionally, we contribute with evidence on labor demand elasticities for Chile. We can estimate elasticities for different industries and types of workers, providing new evidence to the scarce existing estimates. Because our data consider a 10-year period, we consider elasticities for a long-run equilibrium that does not depend on specific shocks or policy implementations.

Our results show that labor demand is inelastic. Our baseline estimates indicate a typical labor demand elasticity between −0.91 and −0.27 (as wages increase by 1% in the baseline model), implying unemployment rate increases between 0.20 and 0.59 percentage points (pp) and job losses averaging over 17,000 for a 1% increase in labor costs. In our benchmark model, we estimate labor demand elasticity in the range of −0.33 to −0.28, consistent with prior studies. We predict that the national unemployment rate would increase from a baseline level of 6.5% to about 6.7% with a new 1% employer contribution. These estimates suggest significant impacts on employment because of the proposed policy change but with impacts on unskilled workers. In this context, labor demand elasticities are higher for low-skilled workers and in industries where labor demand is easily substitutable,

[3] Those with pension savings up to US$1,322 were allowed to withdraw all their funds, whereas those with savings above US$1,322 had the option of three different schemes to access their funds with a maximum withdrawal of US$5,664 (Lorca, 2021).

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resulting in heterogeneous effects on job losses across types of workers and industries. When considering these sources of heterogeneity, the unemployment effect increases. Based on the results, we propose an alternative design with contributions computed only on higher-wage workers, with redistributional components. This design would prevent layoffs from low-skilled workers, whose demand is more sensitive to increases in labor costs. Particular attention should be paid to industries where labor is easier to replace.

The rest of the paper is organized as follows. Section 2 presents background information on multi-pillar models and institutional details about the Chilean pension model, while also presenting a review of evidence regarding labor demand elasticities worldwide. Section 3 presents details about the empirical methods and data used for the analysis. Section 4 presents the results and Section 5 policy implications. Finally, Section 6 concludes.

2. Institutional background

The Chilean pension model was implemented in 1981. It has a three-pillar design: a social pillar funded by public funds (Pillar 0), a mandatory individual contributory pillar associated with personal savings accounts managed by private firms (Pillar 2), and a voluntary savings plan introduced after a major reform in 2002 (Pillar 3). Contributors are dependent workers who must save 10% of their paychecks (before taxes) in an individual retirement account (Pillar 2). These contributions are automatically deducted and saved into individual savings accounts within the retirement system. The 10% contribution rate applies up to a monthly earnings cap, above which no additional contributions are made. As of 2024, the cap is set at monthly earnings of US$3,394, equivalent to an annual wage of nearly US$41,000 (Dirección del Trabajo, 2024). As of 2020, independent workers must also contribute to their savings account at a contribution rate that started at 0.75% in 2020 and will increase to 7% in 2028 (Superintendencia de Pensiones, 2022e).

Pensions within the social pillar may take two forms. The first is a basic monthly social pension of US$215.25 for individuals who are not enrolled in the formal pension system and have no other source of retirement income. Alternatively, there is a means-tested pension supplement for individuals who are enrolled in the system but whose pension falls below a designated threshold.[4] In November 2021, over 1.8 million individuals received funds from Pillar 0 (representing over 90% of retirees enrolled with the system). Sixty-one percent of beneficiaries were female. However, mandatory contributions from Pillar 2 remain the primary source of retirement income among retirees (Berstein *et al.*, 2013).

Private firms known as pension fund administrators have only one objective: to manage contributors' investments and savings. For their services, individuals pay management fees defined as a portion of their salary. In April 2022, the average market fee was 1.15% (Superintendencia de Pensiones, 2022c). Individuals can allocate their savings across one or two funds selected from five different options. These funds are labeled A, B, C, D, and E and differ in their financial risk.[5]

Employers have a reduced role in the current system. Employers can only contribute to workers' retirement savings using a specific collective voluntary account (within Pillar 3) where the employer opens an account with an authorized institution, and both the employer and the employee agree to contribute (Superintendencia de Pensiones, 2022a). However, this instrument has yet to be used in larger shares. By November 2021, only 870 collective individual accounts were registered for the system's over 11 million enrollees (Superintendencia de Pensiones, 2022b), of which almost 6 million were active contributors (Superintendencia de Pensiones, 2021b).

[4] As of January 2021, the maximum monthly pension cap for receiving social support was US$636.06 (Superintendencia de Pensiones, 2022d).

[5] The riskiest fund is Account A, which invests 40%-80% in equities, while account E is the safest, investing only up to 5% in equities. The range invested in equities for Account B is 25%-60%, that of Account C is 15%-40%, and that of Account D is 5%-20%. Before 2002, only one account was available (Account C).

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The latest reforms in Chile (2008 and 2021) have only considered extensions of Pillar 0. Table 1 compares the social components of Pillar 0 across the top-10 pension systems. In this comparison, Chile ranks relatively well regarding the generosity of its social pensions relative to per capita GDP and minimum wage. However, the contribution rates for Pillars 1 and 2 are substantially lower in Chile than in the top-10 systems, suggesting a future reform should consider raising contributory rates. Table 1 reports the contribution rates in the top pension systems and the Chilean model. The comparison across systems is not straightforward, as countries have different institutional backgrounds and system designs. There is no unique optimal model; instead, there are different models for different settings. For example, in the Netherlands, the state contributes with funding from general funds (Pillar 1) (Parada-Contzen and Provoste, 2021). This contribution is despite the ample contribution rate for employers and workers. It is the only country in the Table that has this design. In the same way, some countries have generous social pensions (Pillar 0) despite having relatively low contribution rates (e.g., New Zealand, Australia, and Denmark) by providing social pensions funded through general taxes (Parada-Contzen and Provoste, 2021). In this setting, Chile ranks very well in terms of social pension as a fraction of per capita GDP or minimum wages, but it has the lowest contribution rate of all countries.

The remainder of this section reviews existing evidence on labor demand elasticities, which are critical for predicting the employment impacts of pension reforms that increase labor costs. One of the canonical works in estimating labor demand elasticities is reported in Hamermesh (1993), which reports an average elasticity of −0.45 with typical ranges between −0.75 and −0.15. There is large heterogeneity in estimates across countries and industries. However, a consensus is that a 10% increase in labor costs leads to a 3% decrease in employees, implying a point estimate of −0.30 (Hamermesh, 2004, 2021). The scarce evidence for Chile suggests an employment drop of 0.3% for a 1% wage increase. Early evidence from Chile (1981–1986) estimates a labor demand elasticity from −0.48 to −0.32 (Hamermesh, 2004), while a study covering the 2000s finds an elasticity of −0.19 for the manufacturing sector (Lichter *et al.*, 2015).

In the literature on labor demand elasticities, variation across industries, worker type, regions, or other characteristics is typically introduced by estimating separate regression models on subsets of data (Slaughter, 2001; Maiti and Indra, 2016). In a comprehensive meta-analysis, Lichter *et al.* (2015) explore sources of heterogeneity in wage elasticities of labor demand with information from 151 studies containing 1,334 estimates from 37 countries between 1980 and 2012. They find that estimated wage elasticities in the literature show that labor demand is inelastic.

The average elasticity across all 1,334 estimates is −0.55, while estimates for Latin America show a smaller elasticity, averaging −0.37. For the United States, Maiti and Indra (2016) report labor demand elasticities somewhat below those reported for the entire sample in Lichter *et al.* (2015). Across sectors, the labor demand elasticity in construction is larger than that for manufacturing, services, and other sectors (Lichter *et al.*, 2015). While estimating labor demand elasticities has attracted significant attention in the literature, there is only so much evidence for Chile specifically, except for two studies in the manufacturing sector reviewed by Lichter *et al.* (2015).

From Lichter *et al.* (2015), estimation procedures that account for potential endogeneity between wages and labor demand by instrumenting for wages show higher elasticities (in absolute value) than when a single equation model is estimated. In Latin America, labor demand elasticities shift by 7 to −0.44 pp when using instrumental variables (IV) methods. When considering heterogeneity across workers, evidence shows that labor demand for blue-collar and low-skilled workers is more elastic than for white-collar and high-skilled workers. This is consistent with the hypothesis that more specialized workers are harder to substitute for. A summary of the estimates from Lichter *et al.* (2015) is presented in Table 2.

In a meta-analysis for Germany based on 705 estimates, Popp (2023) find results consistent with the meta-analysis of Lichter *et al.* (2015). The average labor elasticity is −0.43, with important heterogeneity across industries, regions, and workforce characteristics. Elasticities increase in about 18%

Table 1. Comparison between top-10 pension systems and Chile of Pillar 0 and contribution rates for Pillars 1 and 2

	Pillar 0 (monthly amounts)				Contribution rate (%)						
					Pillar 1		Pillar 2		Pillar 1 + 2		
Country	US$	Over GDP per capita	Over min wage		W	E	W	E	W	E	W + E
Netherlands		1,353	67.8%	31.0%	17.9	–	7.7	14.8	25.6	14.8	40.4
Denmark	1,008	35.7%	19.9%		1.0	–	4.0	8.0	5.0	8.0	13.0
Israel	486	29.9%	13.4%		–	–	6.0	12.5	6.0	12.5	18.5
Australia	1,281	49.3%	29.7%		–	–	–	12.0	–	12.0	12.0
Finland	781	43.6%	19.1%		7.9	16.4	–	–	7.9	16.4	24.3
Sweden	976	43.8%	22.6%		16.0	–	2.5	4.5	18.5	4.5	23.0
Singapore	790	76.1%	15.9%		13.5	13	–	–	13.5	13	26.5
Norway	1,898	75.3%	33.9%		8.2	–	–	2.0	8.2	2.0	10.2
Canada	494	24.5%	13.7%		5.1	5.1	–	–	5.1	5.1	10.2
New Zealand	1,431	58.5%	41.1%		–	–	–	–	–	–	–
Chile (current)	226	54.3%	20.5%		–	–	10.0	–	10.0	–	10.0
Chile (reform proposal)	291	70.0%	26.4%		–	6.0	10.0	–	10.0	6.0	16.0

Note: (a) Own elaboration based on Parada-Contzen and Provoste (2021) and references therein. (b) Top-10 pension system based on Mercer (2020). (c) Wage data come from Eurofound (2021), Ministry of Manpower (2021), and WageIndicator (2021). (d) There is no legal universal minimum wage for Denmark, Finland, Norway, Singapore, and Sweden as wages depend on collective contracts by sectors. Thus, minimum wage was computed using the average agreed salary for the three jobs with the lowest wages. For Canada, the minimum wage in Ontario was used. (e) For comparison purposes, the hourly wage was transformed, assuming 45 hours per week and 4 weeks per month for all countries. (f) W = Worker. E = Employer. A hyphen (-) indicates that there is no contribution for that agent/pillar (meaning 0 contribution).

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Table 2. Summary of prior evidence on labor demand elasticities

	Whole sample	Latin America	South America	Chile
All estimates	−0.551 ($N = 1{,}332$)	−0.367 ($N = 83$)	−0.376 ($N = 76$)	−0.298 ($N = 4$)
IV estimates	−0.654 ($N = 236$)	−0.444 ($N = 20$)	−0.461 ($N = 18$)	−0.196 ($N = 2$)
Disaggregation by sector				
Manufacturing	−0.520 ($N = 795$)	−0.366 ($N = 61$)	−0.366 ($N = 61$)	−0.196 ($N = 2$)
Construction	−0.629 ($N = 52$)	–	–	–
Services	−0.490 ($N = 47$)	–	–	–
Other sectors	−0.455 ($N = 25$)	–	–	–
Disaggregation by worker type				
High-skilled	−0.565 ($N = 73$)	–	–	–
White-collar	−0.438 ($N = 42$)	−0.199 ($N = 7$)	−0.186 ($N = 6$)	−0.336 ($N = 2$)
Blue-collar	−0.650 ($N = 63$)	−0.627 ($N = 5$)	−0.708 ($N = 4$)	−0.320 ($N = 1$)
Low-skilled	−0.619 ($N = 122$)	−0.520 ($N = 17$)	−0.520 ($N = 17$)	–

Note: (a) Own elaboration based on Lichter *et al.* (2015) complemented with Hamermesh (2004) for estimates in Chile (b) N = number of estimates.

(7 pp) when using IV approaches (Popp, 2023). Regarding workforce skill, Popp (2023) find average elasticities of −0.44 for high-skilled workers, −0.33 to −0.21 for medium-skilled workers, and −0.72 for low-skilled workers.

3. Methods and data

3.1. Empirical model

To find the impact on employment of implementing an employer's contributory pillar, we estimate the unconditional labor demand elasticity by using the following reduced-form log-linear specification.[6] From the specification, we can directly interpret the coefficients as elasticities.

$$\log y_{it} = \beta \log w_{it} + \gamma X_{it} + \phi_i + \theta_t + \varepsilon_{it} \tag{1}$$

where y_{it} represents the number of workers employed at firm i in period t, w_{it} represents the pre-tax average salary per worker at the firm level, X_{it} represents other characteristics of the firm, ϕ_i represents firm fixed effects, θ_t represents time fixed effects, and ε_{it} represents an idiosyncratic shock. The time fixed effects control for shocks to the number of workers in a particular year common to all firms. Firm characteristics and fixed effects are included to control for firm-level determinants of worker pay, such as amenities, market power, productivity, and its sharing (Card *et al.*, 2018; Sorkin, 2018; Berger *et al.*, 2022; Lamadon *et al.*, 2022). Generally, firm fixed effects capture time-invariant variation across firms that affects the number of workers per firm.

The log-log specification is chosen to consider changes in percentage instead of levels; thus, the firm's size does not distort the analysis. Our parameter of interest, β, represents the average elasticity of employment with respect to wages. The specification follows the canonical labor demand model in the literature (Castillo-Freeman and Freeman, 1992; Hamermesh, 1993; Angrist *et al.*, 2000; Hull *et al.*, 2022). Specifically, the key coefficient β represents the percent change in employment for a 1% change in salary per worker (i.e., the labor demand elasticity).

To explore heterogeneity in elasticities across industries and workforce characteristics, we estimate Equation 1 separately by subsets of industry and worker type, defined by industry as follows: (1) agriculture, (2) mining, (3) manufacturing, (4) utilities, (5) construction, (6) commerce, (7) transportation, (8) tourism, and (9) financial services; and by workforce category as follows: (1) managers,

[6] We use the specification of the labor demand described in Hamermesh (1996). Similar specifications have been estimated, for example, in Amiti and Wei (2005), Aguilar and Rendon (2008), Buch and Lipponer (2010), and Aguilar and Rendon (2010).

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professionals and technicians, (2) clerks and office workers, (3) skilled production workers, and (4) unskilled production workers. This subsample analysis allows us to better predict the heterogeneous impacts of the proposed pension reform on employment, depending on specific characteristics of the Chilean labor market.

We estimate a reduced-form specification of labor demand at the firm level, so our results reflect partial equilibrium employment effects. Our estimates thus reflect employment losses for currently employed workers, holding labor force participation and hours worked fixed. This assumption is reasonable in the Chilean context, where labor laws limit firms' ability to adjust hours downward. There are also limitations on firms' reducing wages or replacing workers with lower-paid hires in the same roles. However, our estimates may overstate employment losses if the pension reform causes voluntary labor force exits.

Because wages might be endogenous to employment at firms, we also estimate an IV model where we instrument for wages using exogenous variation in labor market conditions at the region-industry level (see Equation 2). Specifically, we construct four instruments: (1) average wage per worker in other regions, (2) average wage per worker in other industries, (3) regional minimum wages, and (4) regional unemployment rates. These instruments isolate variation in firm-level wages driven by market-level labor supply and demand shocks, which are plausibly uncorrelated with firm-specific labor demand shocks. This approach follows the widely used Bartik (1991) IV strategy, leveraging the fact that labor productivity and wages vary across region-industry cells based on their underlying labor market characteristics (Enrico, 2011; Maiti and Indra, 2016).

The key identifying assumption for the shift-share instrument is that firm-level wage changes apply to the entire firm across locations and are driven by shocks at the region-industry level that are uncorrelated with local labor market conditions. This means that the instruments require that demand for labor in region A is independent of the demand for the same labor in region B in such a way that shocks in one region do not affect all markets. For example, a currency shock would violate this assumption because it would affect all regions. A similar analysis can be extended for industries or sectors. The assumption behind the labor market structure variables is that an individual firm does not influence the aggregated labor market characteristics (i.e., an individual firm's employment decisions do not significantly influence aggregate labor market characteristics, ensuring exogeneity of the instruments). This version of the instrumenting approach was introduced by Hausman (1996) and applied by Nevo (2001), where the prices of products in other markets served as an instrument. We also follow the recent evidence by Hazell *et al.* (2022) for the construction of these instruments. In this version of the model, we use instrumented wages as follows:

$$\log y_{it} = \beta \log \hat{w}_{it} + \gamma X_{it} + \phi_i + \theta_t + \varepsilon_{it} \tag{2}$$

where $\log \hat{w}_{it}$ represents the predicted wage (in logs) for firm i at time t, as obtained from the first-stage regression. To capture employment inertia at the firm level, we also estimate an Arellano and Bond (1991) dynamic panel specification with lagged variables as instruments.

$$\log y_{it} = \alpha \log y_{i,t-1} + \beta \log (w_{it}) + \gamma X_{it} + \theta_t + \varepsilon_{it} \tag{3}$$

Our empirical model allows us to estimate the marginal effect of increasing labor costs on employment levels. In our baseline simulation, we assume employers bear the full incidence of a 1% increase in labor costs, holding net wages fixed. This implies labor supply is perfectly elastic, as workers' net wages are held constant. If the labor supply is upward sloping, the employment losses would be smaller, as workers would bear some tax burden through lower net wages.

The employment effects we compute are job losses for employed workers due to increased labor costs. Results thus reflect extensive margin responses rather than hours change, which we cannot measure. This focus aligns with Chilean labor laws, which limit downward wage and hours adjustments and prohibit replacing workers with lower wage hires in the same roles. Because we estimate a demand-side model, we do not capture potential shifts in labor supply.

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3.2. Data

We construct a panel of firms using five waves of the ELE for 2007, 2009, 2013, 2015, and 2017. The ELE belongs to the Chilean Ministry for the Economy, Development, and Tourism and is managed by the National Institute of Statistics (INE).[7] The ELE covers legally registered firms in all regions of Chile and is representative at the industry and firm size (based on sales) level. This allows us to characterize the universe of Chilean firms (Santi and Santoleri, 2017). The ELE features a rotating sample design to prevent sample size reductions and maintain representativeness.

Our estimation sample comprises 26,556 firms pooled over the five waves. The panel is unbalanced, with 3,257 firms appearing in all waves, which requires redefinition of estimation samples for alternative specifications that required lagged values in one or more periods. The ELE oversamples large firms and undersamples microfirms relative to the population (Santi and Santoleri, 2017).[8] We observe the same pattern in our research sample, so our main results should be interpreted as most relevant for formal employment in larger firms. Microfirms may react differently to the pension reform due to greater labor cost sensitivity and informality.

Variable definitions and summary statistics for our estimation sample are presented in Table 3. The key variables are firm-level employment and average monthly wage per worker. Summary statistics of these two variables by industry are reported in Table A1 of the Appendix.

4. Results

4.1. Baseline labor demand elasticities

Table 4 presents estimates for the entire sample of Equations 1–3. All models control for firm age, firm size, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, and R&D activities, geographical location, economic sector, and year-fixed effects. As expected, labor demand elasticity is negative and significant for all specifications. Labor demand is estimated to be inelastic in all specifications.

Our most conservative estimate is from the fixed-effects model in column (2), which implies a decrease of 0.31% in employment as wages increase by 1%. Using firm-level fixed effects decreases the elasticity estimate by 10 pp. This estimate is in the range of previous evidence from Chile, which averages at 0.30% (Hamermesh, 2004; Lichter *et al.*, 2015). This estimate also aligns with the consensus range for labor demand elasticities worldwide (Hamermesh, 2021). We find no statistical difference in labor demand elasticities when comparing individuals with high wages with other workers. In addition, we find no statistical differences in the estimated elasticities across firm sizes when firm size is defined by sales or by number of workers.

For robustness, we also estimate an alternative specification of Equation 1, considering changes in employment (logs) as a function of changes in wages (logs) following the model in (Hazell *et al.*, 2022) with the same controls as the model in column (2). We do not observe big changes in the estimate, switching from −0.31% to −0.27%, within the same confidence interval (see column 3). This specification though is estimated with less than 40% than the total research sample.

We use two types of instruments (shares and levels), finding estimated labor demand elasticities in the range (absolute) of 0.43% and 0.98% when wages increase by 1%. As previous evidence suggests, instrumenting for wages yields larger (in absolute value). All specifications pass the Sargan test and have a strong first-stage F-statistic, but estimates are very sensitive to specification. Equation 3, which captures employment dynamics at the firm level, yields a labor demand elasticity estimate of 0.57. However, the strength of the dynamic panel instruments is lower. Trying different subsets of

[7] All data are publicly available at https://www.economia.gob.cl/category/estudios-encuestas/encuestas-y-bases-de-datos.

[8] A firm's size is defined according to sales levels, which is the classification that we maintain in the current paper, i.e., large (100,000 UF or more), medium (between 25,000–100,000 UF), small (5000–25000 UF), extra small (2400–5000 UF), and micro (500–2400 UF). 1 UF corresponds approximately to US$44 (2017).

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Table 3. Summary statistics for our estimation sample

Variable	Definition	Mean	St.Dev.
Workers	Number of workers in the firm (in logs).	0.334	1.909
Wage	Average monthly wage per worker (dollars of 2017) (in logs).	6.766	1.020
Economic sector indicators			
Agricultural	1 if agriculture, 0 otherwise.	0.085	0.280
Mining	1 if mining, 0 otherwise.	0.043	0.203
Manufacturing	1 if manufacturing, 0 otherwise.	0.155	0.362
Utilities	1 if utilities, 0 otherwise.	0.022	0.145
Construction	1 if construction, 0 otherwise.	0.121	0.327
Commerce	1 if trade, 0 otherwise.	0.239	0.427
Tourism	1 if hospitality, 0 otherwise.	0.084	0.278
Transportation	1 if transportation, storage, and communication, 0 otherwise.	0.134	0.340
Financial	1 if financial and insurance activities, 0 otherwise.	0.116	0.320
Firm size indicator (sales)			
Large	Sales larger than US$4,355,582.	0.455	0.498
Medium	Sales between US$1,088,895 and 4,355,582.	0.173	0.378
Small	Sales between US$217,779 and 1,088,895.	0.179	0.383
Extra small	Sales between US$104,534 and 217,779.	0.097	0.296
Micro	Sales between US$21,778 and 104,534.	0.096	0.295
Firm characteristics			
Firm age	Years since foundation.	16.14	12.681
Business group	1 if the firm belongs to a business group, 0 otherwise.	0.242	0.428
Male CEO	1 if CEO is male, 0 otherwise.	0.848	0.359
Foreign property	1 if the firm is owned by foreign capitals, 0 otherwise.	0.092	0.289
Exports	1 if the firm has any exports, 0 otherwise.	0.141	0.348
Unlimited liability	1 if legal structure is of unlimited liability, 0 otherwise.	0.207	0.405
CEO is the firm owner	1 if CEO is the owner of the company, 0 otherwise.	0.213	0.410
CEO has some property	1 if CEO has some property over the company, 0 otherwise.	0.363	0.481
Public funding	1 if the firm has received public funding for development, 0 otherwise.	0.085	0.279
R&D	1 if firm does research and development, 0 otherwise	0.246	0.431
Year indicator			
2007	1 if 2007, 0 otherwise.	0.230	0.421
2009	1 if 2009, 0 otherwise.	0.215	0.411
2013	1 if 2013, 0 otherwise.	0.223	0.416
2015	1 if 2015, 0 otherwise.	0.224	0.417
2017	1 if 2017, 0 otherwise.	0.108	0.311

Note: Sample size = 26,556.

instruments reveals large variation in the estimated labor demand elasticity, indicating low robustness in the result when using IVs. For the exact identified case, we find a significant point estimate of −0.98 using sector cost shifts (column 4, Table 4). Using all four instruments (regional and sector shifts plus regional unemployment rate and minimum wages) the point estimate is −0.91 (column 5, Table 4). The estimate is very sensitive to the inclusion of firm fixed effects. Table A.2 in the Appendix presents IV-estimates for the exact identified case using each instrument and subsets of two instruments.

As a benchmark for the remainder of the analysis, we use the results from column (2), which are close to the reported labor demand elasticity estimates from Latin America, South America, and Chile and are in line with worldwide evidence. Importantly, because our data considers a 10-year period, we argue that our estimated elasticities represent long-run equilibrium in the labor market.

Table 4. Regression results (all sectors and workforce)

Dependent variable: Number of workers (in logs) Key coefficient (β): Labor demand elasticity	OLS (1)	FE (2)	FE (3)	IV (4)	IV (5)	IV (6)	IV-FE (7)	A&B (8)
β	−0.410***	−0.305***	−0.269***	−0.978***	−0.909***	−0.430***	−0.706***	−0.566***
(s.e.)	(0.012)	(0.015)	(0.020)	(0.179)	(0.166)	(0.097)	(0.179)	(0.088)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm's size	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical region	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed-effect	No	Yes	Yes	No	No	No	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instrumented	No	No	No	Yes	Yes	Yes	Yes	Yes
(Bartik type inst.)				(share)	(share)	(level)	(share)	(share)
N	26,556	26,556	9,857	26,556	26,556	26,556	26,556	9,857
Adj. R^2 [Wald]	0.640***	0.164***	0.146***	0.581***	0.640***	0.594***	0.186***	[281.41***]
First stage F				75.28***	22.82***	73.74***	51.97***	24.86***
Sargan p-value					0.246	0.199	0.244	0.016**

Note: (a) All models, in addition, control for: firm age, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, and R&D. (b) Clustered standard errors in parentheses. (c) Instruments: average wage per worker in other regions, average wage per worker in other industries, regional minimum wages, and regional unemployment. (d) Column (3) estimates model 1 in variations (employment and wages). Column (4) instruments for wages using sector shifts in shares, column (5) uses sector and regional shifts in shares plus regional unemployment and minimum wages, column (6) uses sector and regional shifts in levels plus regional unemployment and minimum wages, column (7) adds firm fixed effects. Column (8) estimates an Arellano and Bond specification.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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Table 5. Impacts of increasing contribution rates by 1% on employment

Increase in contribution rate: 1%
Baseline unemployment rate: 6.51%

Method	Estimated elasticity [C.I.]	Unemployment rate [C.I.]	Job losses [C.I.]
OLS (1)	−0.410% [−0.43%; −0.39%]	6.78% [6.76%; 6.79%]	23,992 [22,639; 25,374]
FE (2)	−0.305% [−0.33%; −0.28%]	6.71% [6.69%; 6.73%]	17,848 [16,141; 19,558]
FE (3)	−0.269% [−0.31%; −0.23%]	6.68% [6.66%; 6.71%]	15,741 [18,141; 13,459]
IV (4)	−0.978% [−1.33%; −0.63%]	7.14% [6.92%; 7.37%]	57,231 [36,866; 77,829]
IV (5)	−0.909% [−1.24%; −0.58%]	7.10% [6.89%; 7.31%]	53,193 [34,099; 72,273]
IV (6)	−0.430% [−0.62%; −0.24%]	6.79% [6.66%; 6.91%]	25,163 [13,998; 36,342]
IV-FE (7)	−0.706% [−1.06%; −0.36%]	6.97% [6.74%; 7.20%]	41,314 [21,037; 61,984]
A&B (8)	−0.566% [−0.74%; −0.39%]	6.88% [6.76%; 6.99%]	33,121 [22,979; 43,231]

Note: (a) Total unemployment is computed adding employment loss to total unemployed individuals in Chile (587,240 individuals). (b) Unemployment rate is computed considering the total labor force in Chile (9,021,060 individuals). (c) Baseline unemployment rate is 6.51%. (d) Confidence interval in square parentheses. (e) Model 2 estimates Equation 1 in levels and (3) in variations (employment and wages). (4) instruments for wages using sector shifts in shares, (5) uses sector and regional shifts in shares plus regional unemployment and minimum wages, (6) uses sector and regional shifts in levels plus regional unemployment and minimum wages, (7) adds firm fixed-effects, and (8) estimates an Arellano and Bond specification.

Differently from previous estimates, we are able to estimate demand elasticities for most industries and worker categories, without having a straightforward comparison for many of the subsamples.

4.2. Impact on unemployment with baseline results

Using the estimates presented in the previous section and data from the National Employment Bulletin for November/December 2017 and January 2018, we now simulate the impact of the pension reform on employment. At the baseline level, there are almost 600,000 unemployed individuals out of a total labor force of over 9 million, implying a national unemployment rate of 6.5%. We consider that the total labor force in Chile remains constant. Our results only let us estimate the marginal effect of increasing labor costs by 1% and for employed workers.

Table 5 reports the simulated increases in the unemployment rate and job losses with 95% confidence intervals based on the estimated labor demand elasticities from each model. For the calculation, we take the estimated elasticity (and its confidence interval) and compute the number of job losses given an increase by 1% in labor costs. With the calculated job losses, we are able to compute the new unemployment rate. In our most conservative prediction, we estimate an impact on unemployment of 0.20 pp when increasing wages by 1%, leading to a national unemployment rate of 6.7%, with a relatively small confidence interval. This impact is equivalent to about 18,000 job losses. On average, across models, we predict an increase in the unemployment rate of 0.36 pp for increases in wages by 1% and about 32,000 job losses.

4.3. Heterogeneity in elasticities by industry and worker type

4.3.1. Labor demand elasticities by industry

We now estimate Equation 1 separately for subsamples defined by industry. Because economic industries have different production technologies and skill needs, it is expected that elasticities differ across sectors. For example, we can expect differences due to heterogeneity in the capital-to-labor ratio or different opportunities across industries to outsource parts of the production process (Lichter *et al.*, 2015). Because our subsamples are smaller for this new set of estimates, we use the benchmark fixed effect model for computing labor demand elasticities and employment impacts of an employer's contributory pillar.

In Table 6 and Figure 1, we present labor demand elasticities by industry. For all industries, labor demand elasticities are negative, inelastic, and statistically significant. Our results indicate that

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Table 6. Elasticities: regression results by industry

Dependent variable: Number of workers (in logs)
Key coefficient (β): Labor demand elasticity

	FE			
Industry	Coeff.	(s.e.)	[C.I.]	*N*
Agricultural	−0.466***	(0.059)	[−0.581; −0.351]	2,269
Mining	−0.130***	(0.039)	[−0.206; −0.054]	1,149
Manufacturing	−0.243***	(0.038)	[−0.318; −0.168]	4,116
Utilities	−0.180***	(0.065)	[−0.308; −0.052]	573
Construction	−0.455***	(0.037)	[−0.527; −0.382]	3,225
Commerce	−0.367***	(0.033)	[−0.431; −0.302]	6,360
Transportation	−0.337***	(0.049)	[−0.434; −0.240]	2,240
Tourism	−0.236***	(0.038)	[−0.311; −0.161]	3,553
Financial	−0.226***	(0.039)	[−0.303; −0.149]	3,071
All sectors	−0.305***	(0.015)	[−0.334; −0.276]	26,556

Note: (a) All models, in addition, control for: firm age, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, R&D, firm size, geographical region, firm fixed-effects, and year fixed-effects. (b) Clustered standard errors in parentheses. (c) Confidence interval in square parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

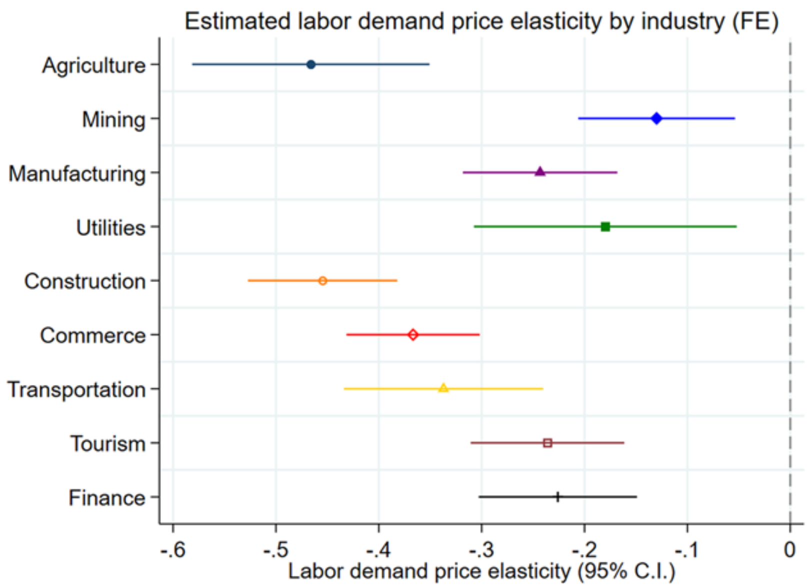

Figure 1. Estimated labor demand elasticity by economic sector (fixed effects model).

labor demand is more responsive to wages in some industries than others. This result shows that employment impacts of increasing labor costs are heterogeneous across industries so that workers in some industries might be more affected than workers in other industries by facing different risks of unemployment.

Elasticities in industries such as agriculture and construction are statistically higher (in absolute value) than the average elasticity estimated when considering all industries. Mining presents an estimated elasticity statistically lower (in absolute value) than the average elasticity. Our estimate for the manufacturing sector is slightly higher than the only available estimate for Chile in

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Table 7. Elasticity: regression results by worker category

Dependent variable: Number of workers (in logs)
Key coefficient (β): Labor demand elasticity

	FE			
Worker category	Coeff.	(s.e.)	[C.I.]	*N*
Managers, professionals, and technicians	−0.420***	(0.020)	[−0.460; −0.381]	18,894
Clerks and office workers	−0.275***	(0.023)	[−0.320; −0.230]	21,339
Skilled production workers	−0.421***	(0.015)	[−0.451; −0.392]	13,343
Unskilled production workers	−0.593***	(0.014)	[−0.619; −0.566]	9,869
All workers	−0.305***	(0.015)	[−0.334; −0.276]	26,556

Note: (a) All models, in addition, control for: firm age, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, R&D, firm size, geographical region, economic sector, firm fixed-effects, and year fixed-effects. (b) Clustered standard errors in parentheses. (c) Confidence interval in square parentheses.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

(Lichter *et al.*, 2015), while we still find it to be a very inelastic sector, which is consistent with previous evidence. We also find, as in previous evidence, that construction has one of the largest labor demand elasticities.

4.3.2. Labor demand elasticities by worker type

We also expect the labor demand elasticity to vary with the characteristics of workers and their specific functions within the firm. The standard hypothesis is that labor demand for low-skilled labor is more responsive to wages than the demand for high-skilled workers because low-skilled tasks are more likely to be more easily automated or outsourced (Lichter *et al.*, 2015). In Table 7, we present the labor demand elasticity by type of workers considering a four-level classification: (i) managers, professionals, and technicians, (ii) clerks and office workers, (iii) skilled production workers, and (iv) unskilled production workers. As expected, all estimated coefficients are negative and statistically significant. For all categories of workers, labor demand is inelastic.

As expected, labor demand is more elastic for unskilled production workers than high-skilled workers. For unskilled production workers, increasing wages by 1% implies a decrease in employment by 0.59% versus 0.42% for skilled production workers. The smallest elasticity is observed for clerks and office workers, with a sensitivity of 0.27%. Our results indicate that labor demand for unskilled production workers is more elastic, meaning that implementing an employer's contributory pillar would increase unemployment more for less-qualified individuals. In the standard US white-blue collar classification, we find elasticities of 0.35 for white-collar and 0.51 for blue-collar workers. Labor demand elasticity by groups are graphically presented in Figure 2.

4.3.3. Labor demand elasticities by industry and worker type

To explore heterogeneity by industry and worker category, we estimate the model by defining subsamples per industry and job type. These results are presented in Table 8. Most elasticities are negative and statistically significant, except for estimates for clerks and office workers in the utilities and mining sectors. The results indicate that the demand elasticity for unskilled production workers is similar across sectors and higher than for the rest of sectors-job-type categories. For managers, professionals, and technicians, we observe particularly high demand elasticities for transportation, financial, and service workers. All the estimates and their confidence intervals are presented in Figure 3 for comparison purposes. Elasticities vary more across industries for white-collar workers than for production workers. The same phenomenon is observed when comparing skilled and unskilled production workers.

As before, the simulated unemployment rate is higher than that when considering a single model or models per industry but aggregating all worker categories. The disaggregated results have important policy implications, as they show that the employment impacts of increasing labor costs are not

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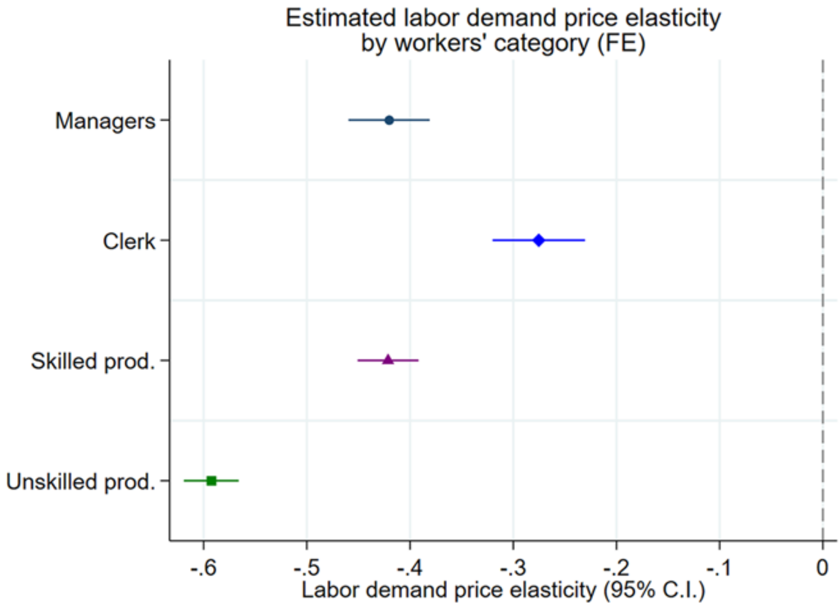

Figure 2. Estimated labor demand elasticity by worker type (fixed effects model).

Table 8. Elasticity: regression results by worker categories and industries

Dependent variable: Number of workers (in logs) Coefficient: Wage per worker (in logs)					
Sector	All workers	Managers	Clerks	Skilled	Unskilled
Agricultural	−0.466*** (0.059)	−0.469*** (0.066)	−0.328*** (0.069)	−0.555*** (0.061)	−0.661*** (0.041)
Mining	−0.130*** (0.039)	−0.303*** (0.065)	−0.018 (0.106)	−0.246*** (0.056)	−0.497*** (0.071)
Manufacturing	−0.243*** (0.038)	−0.329*** (0.037)	−0.221*** (0.040)	−0.436*** (0.035)	−0.585*** (0.025)
Utilities	−0.180*** (0.065)	−0.359*** (0.101)	−0.103 (0.096)	−0.365*** (0.078)	−0.499*** (0.083)
Construction	−0.455*** (0.037)	−0.368*** (0.046)	−0.362*** (0.058)	−0.520*** (0.038)	−0.599*** (0.031)
Commerce	−0.367*** (0.033)	−0.454*** (0.051)	−0.290*** (0.041)	−0.466*** (0.043)	−0.582*** (0.035)
Transportation	−0.337*** (0.049)	−0.641*** (0.080)	−0.649*** (0.084)	−0.529*** (0.044)	−0.704*** (0.051)
Tourism	−0.236*** (0.038)	−0.398*** (0.065)	−0.166** (0.076)	−0.397*** (0.053)	−0.580*** (0.049)
Financial	−0.226*** (0.039)	−0.541*** (0.065)	−0.191** (0.077)	−0.390*** (0.065)	−0.535*** (0.075)

Note: (a) All models, in addition, control for: firm age, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, R&D, firm size, geographical region, firm fixed-effects, and year fixed-effects. (b) Clustered standard errors in parentheses.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

the same across sectors and workers. In particular, we find that unskilled production workers are more likely to be displaced in all sectors. Using the industry and type of worker disaggregation, we find that an increase in labor costs by 1% increases the unemployment rate by 0.5 pp, reaching a total unemployment rate of 7.0%. Our results indicate that job losses for each category would be: 0.4% for managers, 0.3% for clerks, 0.4% for skilled production workers and 0.6% for unskilled production workers. Because the elasticity for unskilled workers is higher than that for the rest of the groups and because unskilled workers account for a higher share of employment, they would experience the largest job losses of all categories. Estimating labor demand for all categories of workers vastly underestimates the elasticity for unskilled workers and managers.

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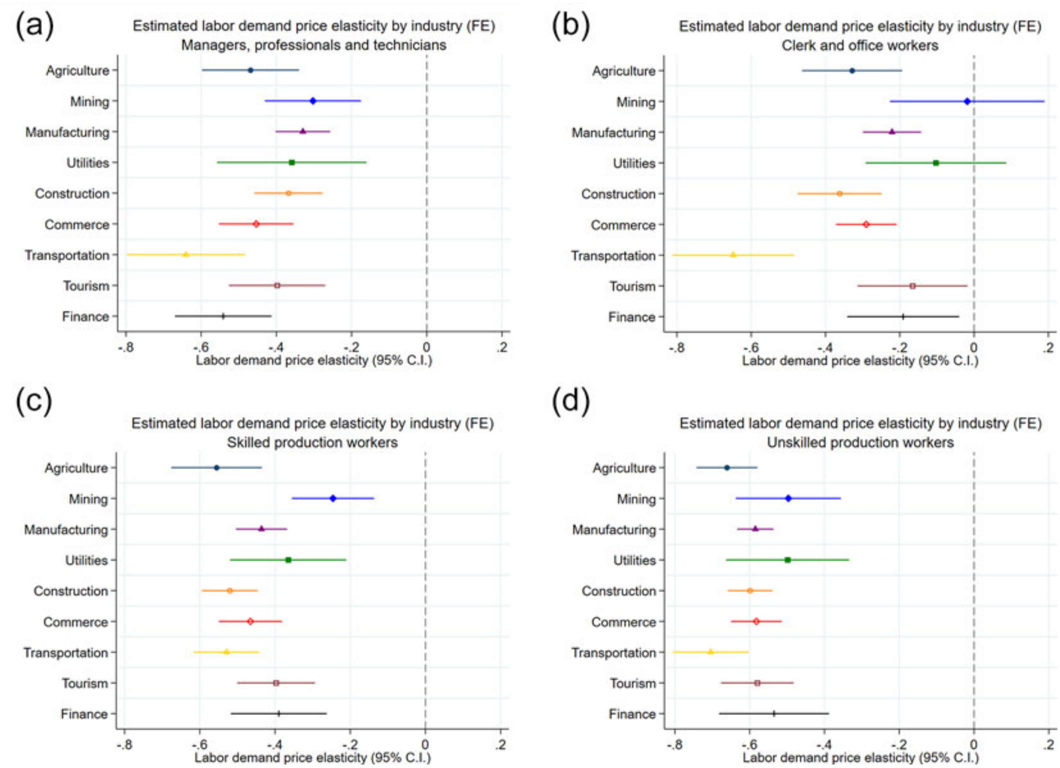

Figure 3. Estimated labor demand elasticity by industry and worker type.

5. Policy implications

The main policy implication of our research is that a uniform contributory pillar would increase unemployment, especially for blue-collar workers and industries that adjust more easily to increases in labor costs. Our findings suggest this policy would be regressive, disproportionately harming low-wage and vulnerable workers. These results provide significant evidence for considering alternative reform proposals and arrangements.

One alternative is a policy where employer contributions apply only to high-wage workers, while including a redistributive component to reduce inequality among retirees. High-wage workers accumulate more lifetime savings, meaning their pension income is higher. Implementing an employer's contributory pillar to a segment of workers prevents layoffs of unskilled workers who accumulate less pension wealth in individual-funded accounts because of lower wages and higher risk of unemployment and discontinuous labor trajectories.

The current proposal taxes risky groups to benefit workers with better financial positions in retirement. Based on our findings, we propose an alternative arrangement, with contributions levied only on high-wage workers and in industries where labor demand is more inelastic. We incorporate a redistributional component, allowing individuals with less accumulated lifetime savings to receive higher pension income from contributions made by high-wage workers. This design is consistent with recent evidence that shows that in a design where an employer contributory pillar of 6%, with all the contribution going to an individual account without redistributional arrangements, the median of the replacement rate reaches 17%; while with redistributional components (3% to individual account and 3% with redistributional arrangements) the median of the replacement rate increases up to 29% (Superintendencia de Pensiones, 2024).

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The current pension system caps contributions at almost US$41,000 per year. The cap measure prevents contributions from being too high for workers at the wealthiest 1% of the distribution and allows firm managers to offer competitive wages for high-level company directors. While the cap limits total contributions under a redistributive scheme, keeping it mitigates opposition from high-wage workers and firms. In terms of labor demand elasticity, with the cap as it is today, elasticity for high-earning workers would be like that of other groups. Indeed, we find no statistical difference in estimated elasticities for wages above 90% of the wage distribution compared to other workers.

Economic sectors also vary in size, meaning that when labor costs increase, sectors with more elastic labor demand that are larger employers would experience higher job losses. For example, the mining sector has smaller labor demand elasticity than other sectors, but only accounts for 3.1% of employment, according to data from the National Statistics Institute (Banco Central de Chile, 2024). However, some sectors with larger elasticities employ larger shares of workers. For example, commerce represents 19.1% of employment, transportation represents 8.8%, and construction represents 7.9%.

A second alternative is to introduce a differentiated employer contributory pillar, with contribution rates varying across sectors and worker types, rather than a uniform contribution rate. With this design, policymakers could mitigate adverse employment effects for unskilled workers and those in sectors more sensitive to labor cost increases.

Our results are from a partial equilibrium model, so the employment effects and estimated job losses represent risks for workers currently employed due to increased labor costs for the firm. Our analysis estimates labor demand elasticities by exploiting wage variation across firms. These elasticities capture a partial-equilibrium response of labor demand to wage changes. We then use these elasticities to predict the impact of a pension reform that raises labor costs economy wide. Our results focus on the extensive margin, consistent with Chilean labor regulations. Chile's labor legislation protects workers. If labor costs increase, firms can only adjust by laying workers off. The law limits firms' ability to cut wages or hours, or to replace workers with lower-paid hires in the same roles.

By aggregating microeconomic responses, we get an estimate of how an economy-wide wage shock could affect aggregate unemployment. This exercise translates our partial equilibrium elasticities into a macroeconomic counterfactual. Extensive literature uses partial equilibrium elasticities to inform macroeconomic questions (Parker *et al.*, 2013; Mian and Sufi, 2014; Giroud and Mueller, 2017; Zwick and Mahon, 2017). However, we recognize elasticities estimated from firm-level variation may differ from the economy-wide elasticity because of general equilibrium adjustments. Intuitively, when all firms experience the same shock, there can be feedback effects through prices, wages, and labor supply that either amplify or attenuate the initial response.

Several general equilibrium channels apply to our analysis. First, an economy-wide increase in labor costs could raise consumer prices as firms pass through higher costs. This product market adjustment would dampen the decline in labor demand. Second, the pension reform may alter workers' labor supply incentives. If the reform reduces labor force participation, it would mitigate adverse employment effects. Finally, equilibrium wages may adjust. If labor supply is elastic, workers may accept lower wages, partially offsetting the reform's direct effect on labor costs. These channels suggest the aggregate elasticity may be smaller than our microeconomic estimates.

Under what conditions are our estimates informative about the aggregate employment effects of the pension reform? Theory highlights three key considerations. First, pass-through from labor costs to product prices matters. With full pass-through, firms shift labor cost shocks to consumers, leaving labor demand unchanged. Second, the elasticity of labor supply is crucial. Highly elastic labor supply implies larger wage adjustments that offset the direct effect of the reform on labor costs. Finally, wage rigidity can play a role. If wages are slow to adjust, the microeconomic elasticities will closely approximate the macroeconomic response in the short run.

Ultimately, our counterfactual predictions depend on the empirical magnitudes of these general equilibrium forces. If pass-through is limited, labor supply inelastic, and wages rigid – all plausible

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in the Chilean context in the short run – then microeconomic estimates can offer a reasonable guide to the aggregate labor response. If these assumptions are violated, microeconomic estimates may overstate the aggregate employment effects. Our estimates would still indirectly inform the macroeconomic question. For example, Nakamura and Steinsson (2018) argue microeconomic elasticities can distinguish between important classes of structural models (that are beyond the scope of the present paper). An alternative interpretation is that our estimates offer a useful bound on the potential macroeconomic impacts, with the true effect lying somewhere between the partial and general equilibrium responses.

Because this is a demand-side model, we do not estimate the policy's impact on labor supply. Increasing contribution rates to workers may cause the exit of workers, as net wages will decrease, for example. Workers may also remain invariant, depending on their intertemporal elasticity of labor substitution, since they will receive additional benefits in the future. While estimating labor supply elasticities is beyond our scope, evidence from the literature suggests the effects of pension reforms on aggregate labor supply are small for plausible values of the intertemporal elasticity of substitution for labor (Imrohoroglu and Kitao, 2009). The literature also suggests changes in labor supply responding to adjustment due to social security reforms should be prominent at the intensive margin (hours) (Cottle Hunt and Caliendo, 2022). Because flexibility regarding the number of work hours is rigid in Chile, labor supply should remain relatively constant as a new pillar enters the pension system. Labor supply responses are also heterogeneous depending on economic, institutional, and cultural differences across countries (Prescott, 2004). Thus, it could be interesting to investigate specific labor supply changes for Chile in future research.

6. Conclusion

This paper estimates labor demand elasticities in Chile using five waves of a representative firm survey. Elasticities are estimated by industry (nine categories) and worker classifications (four categories: managers, clerks, skilled production workers, and unskilled production workers). The estimates are then used to simulate the employment effects of implementing an employer contributory pillar in Chile's pension system. Our simulated reform raises gross labor costs while holding net wages constant. From a labor demand perspective, implementing an employer contributory pillar can be modeled as an exogenous shock to labor costs. Our counterfactual predictions assume the labor force remains fixed, and job losses among the currently employed. While future work could relax the fixed labor force assumption, we cannot model job losses on the intensive margin, since we do not observe hours in our data.

We find labor demand elasticities are statistically negative and inelastic in almost all specifications. Our estimates are consistent with the range of elasticities in the literature. Estimated elasticities range between −0.31 and −0.91. Our preferred specification yields a decrease of 0.31% in employment for a 1% wage increase, with a labor demand elasticity 90% confidence interval of [−0.36; −0.26]. This result is consistent with previous evidence from Chile and the consensus range for labor demand elasticities worldwide. We observe substantial differences across sectors and worker types when estimating elasticities by industry and worker category. Labor demand elasticity is higher for unskilled workers and in industries where labor is easily substituted. These results are consistent with previous evidence. On average, we find an elasticity of −0.35 for white-collar workers and −0.51 for blue-collar workers.

We predict increases in unemployment rates between 0.20 and 0.59 pp from a baseline unemployment rate of 6.51% as wages increase by 1%. In our benchmark model, we predict an unemployment rate of 6.69%-6.73%. Regarding layoffs, we predict an average job loss of 17,848 positions in our most conservative model. Job losses are higher for unskilled workers. The baseline unemployment rate used in the calculations is relatively low regarding unemployment rates after 2017. There was a

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critical increase in unemployment rates during COVID-19. However, the recovery has been slow. By 2024, unemployment rates are between 8.3% and 8.7%, versus 6.51% in our baseline period.

Our model predicts employment effects, holding the total labor force constant in response to gross wage increases. While this assumption could be relaxed by considering estimates of employment elasticity to pension reforms, our results provide a baseline prediction of the impact of such a reform. Most of the employment effect predictions were performed considering our most conservative estimation of elasticity, meaning that we should consider the predicted effects as a baseline level. In our baseline estimations, we also control for potential endogeneity between wages and employment at the firm. While our instruments pass the standard tests for validity and the general inelastic result holds for all specifications, the estimates are sensitive to the instrumentation of wages. For example, when aggregating all sectors and workers, labor demand elasticity doubles after instrumenting wages. Future work could explore other methods and better ways to account for simultaneous processes at the firm level. Extensions should also consider both the demand and supply effects of increasing labor costs and implementing an employer contributory pillar.

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Appendix

Table A1. Average employment levels and average wage by industry

	Average number of workers per firm						
		Management		Production			
Sector	All	Managers	Clerk	Skilled	Unskilled	Average monthly wage (US$)	No. of firms
Agricultural	122.92	11.92	20.55	59.26	102.57	1,158	2,269
Mining	160.70	40.24	25.88	152.14	50.53	1,320	1,149
Manufacturing	186.20	20.21	46.26	82.56	99.26	1,297	4,116
Utilities	155.26	43.95	55.35	77.14	37.89	2,022	573
Construction	317.49	28.62	42.02	156.00	215.71	992	3,225
Commerce	186.60	28.70	105.11	86.72	104.12	1,702	6,360
Transportation	178.66	12.42	103.47	65.68	124.78	734	2,240
Tourism	173.92	41.9	84.58	93.48	83.95	1,628	3,553
Financial	266.60	57.72	127.41	141.34	190.3	2,456	3,071
All sectors	202.08	31.22	77.95	102.51	122.76	1,493	26,556

Table A2. Regression results (all sectors and workforce) – subsets of instrumental variables

Dependent variable: Number of workers (in logs)
Key coefficient (β): Labor demand price elasticity
Estimation method: two-stage least squares

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coefficient (β)	0.317	−0.978***	0.204	−1.593	−0.938***	−0.945***	−0.909***
(s.e.)	(0.872)	(0.179)	(0.812)	(1.243)	(0.174)	(0.175)	(0.166)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm's size	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical region	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Economic sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed-effect	No	Yes	No	No	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instrumented	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments (#)	1	1	1	1	2	2	4
Instrument	Region shift	Sector shift	Min. Wage	Unemplo.	Region shift	Sector shift	Sector shift
					Sector shift	Min. Wage	Region shift
							Min. Wage
							Unemplo.
N	26,556	26,556	26,556	26,556	26,556	26,556	26,556
Adj. R^2	0.543***	0.581***	0.571***	0.385***	0.589***	0.587***	0.595***
First stage F	2.67	75.28***	3.66*	1.89	38.54***	39.71***	21.12***
Sargan (p-value)					0.168	0.2302	0.2458

Note: (a) All models, in addition, control for: firm age, business group, CEO gender, foreign property, international activity, liability structure, if CEO is owner or has some property, participation in public programs, and R&D. (b) Clustered standard errors in parentheses. (c) Instruments: average wage per worker in other regions, average wage per worker in other industries, regional minimum wages, and regional unemployment. *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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