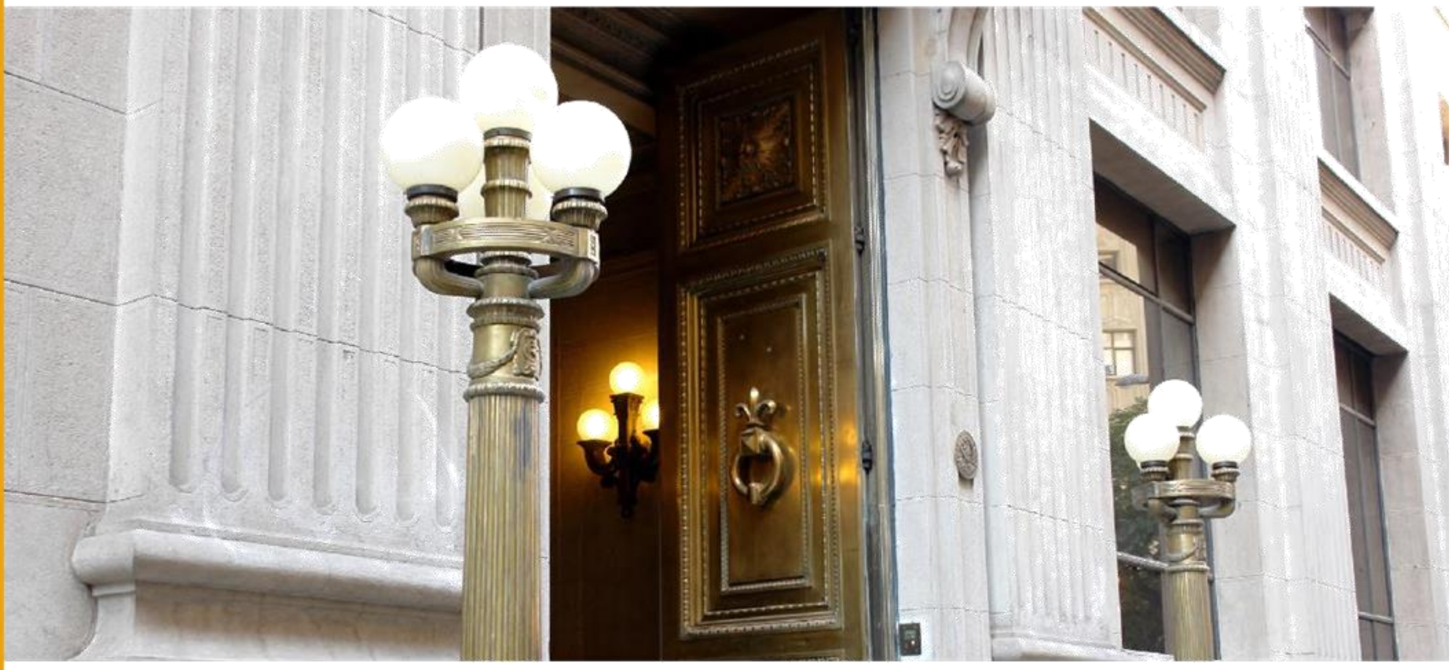
DOCUMENTOS DE TRABAJO

Firm Shocks, Workers Earnings and the Extensive Margin

Álvaro Castillo
Ana Sofía León
Antonio Martner
Matías Tapia

N° 1010 Marzo 2024
BANCO CENTRAL DE CHILE



banco central Chile

Documentos de Trabajo del Banco Central de Chile
Working Papers of the Central Bank of Chile
Agustinas 1180, Santiago, Chile
Teléfono: (56-2) 3882475; Fax: (56-2) 38822311

Documento de Trabajo N° 1010

Working Paper N° 1010

Firm Shocks, Workers Earnings and the Extensive Margin*

Álvaro Castillo
Central Bank of Chile

Ana Sofía León
U. Diego Portales

Antonio Martner
UCLA

Matías Tapia
Central Bank of Chile

Abstract

We study the effect of idiosyncratic firm shocks on the earnings and employment trajectories of workers. We use a matched employer-employee census between 2007 and 2019 for Chile, a developing economy with a significant degree of earnings inequality. The dataset allows us to explore different dimensions of heterogeneity for workers. Our results suggest that the pass-through of changes in firm sales on the wages of continuing workers can be significant, especially for large negative shocks, and that the effects vary significantly with labor market conditions. We show that responses along the extensive margin of employment also play a relevant role, as workers can face a significant risk of displacement. Our findings suggest that considering the earnings of workers who leave the firm after a negative shock provides a more precise assessment of how firms transfer risks to workers since displacement can have relevant implications.

Resumen

Estudiamos el efecto de shocks idiosincrásicos a las empresas en las trayectorias salariales y laborales de los trabajadores. Utilizamos el universo de relaciones empleador-empleado entre 2007 y 2019 para Chile, una economía en desarrollo con un grado significativo de desigualdad de ingresos. La riqueza de los datos nos permite explorar diferentes dimensiones de la heterogeneidad de los trabajadores. Nuestros resultados sugieren que el traspaso de los shocks en las ventas de las empresas sobre los salarios de los trabajadores que mantienen su empleo puede ser significativo, especialmente para shocks negativos de gran magnitud, y que los efectos varían significativamente con las condiciones del mercado laboral. Mostramos que las respuestas a lo largo del margen extensivo del empleo también desempeñan un papel relevante, ya que los trabajadores pueden enfrentarse a un riesgo significativo de desplazamiento. Nuestros resultados sugieren que considerar los ingresos de los trabajadores que abandonan la empresa tras un shock negativo proporciona una evaluación más precisa de cómo las empresas transfieren los riesgos a los trabajadores, ya que el desplazamiento puede tener implicancias relevantes.

*This study was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in the economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities by virtue of collaboration agreements signed with these institutions. The views expressed are those of the authors and do not necessarily represent the views of the Central Bank of Chile or its board members. Corresponding author: mtapia@bcentral.cl

1 Introduction

A large literature has studied the sources of earnings volatility for workers, and their role as an important driver of income inequality and the intertemporal risk faced by individuals (see, for example, Katz and Autor (1999) and Haider (2001)). Instability in labor earnings can be a source of relevant financial risk for workers, especially for those who face liquidity constraints and cannot smooth out consumption. Earnings risks can not only generate welfare costs to workers, but can also have reduce the incentives to invest in human capital, either as formal education or on-the-job learning, as well as on parental investments on children (Levahri and Weiss (1974), Carneiro and Ginja (2016)).

In that context, an empirical question that has received a great amount of attention over several decades is the degree to which the wages of incumbent workers are affected by firm level shocks. This has been traditionally interpreted as way to measure whether firms are willing to, or able, to provide risk insurance, isolating workers from adverse shocks. As argued above, it seems likely that workers can be better off if their earnings are less volatile, and that they can be willing to trade off a lower average wage in return for a higher degree of stability in their income profiles. As long as firms find this trade off profitable, and are willing to bear a higher risk burden, they can try to buffer workers earnings from the impact of firm level shocks. On the other hand, isolating wages from firm performance might not be optimal in terms of incentives, especially in contexts where performance is affected by unobservable effort.

Earlier literature suggested that the earnings of workers were affected by firm level shocks (Gottschalk and Moffitt (1994)), especially in the case of permanent shocks for which the firm could not provide a buffer (Guiso et al. (2005)). However, most recent papers, leveraging on matched employer-employee datasets for the US and other advanced economies, have found that the effects of firm-level shocks on the wages of workers are relative modest (Chan et al. (2023); Juhn et al. (2018); Lamadon et al. (2022)), although there is some degree of heterogeneity across different types of workers, firms, and shocks.

This article makes three empirical contributions to this literature, providing novel evidence that can complement and extend previous finding, and provide further insights into the operation of labor markets.

While most of the previous literature has focused on the effects of shocks on the earnings of incumbent workers that stay employed in the firm, it seems likely that the highest earnings risk is faced by those workers that face the threat of termination after a negative shock. In fact, as the set of workers that stays in the firm after a negative shock is not random, most previous estimates probably underestimate the true effects of shocks, as they exclude the effect of the shock on the earnings of workers that leave the firm (Chan et al. (2023)). Therefore, a complete measurement of the ex ante actual risk faced by workers in response to firm shocks must take into account the earnings trajectories of continuing workers (stayers) and non-continuing workers (leavers), whether their exit was voluntary or involuntary. In fact, in the simplest possible world, with perfectly competitive markets and homogeneous workers, firm level shocks in productivity (sales) that affect the firm's labor demand will only impact employment. Wages would always be unaffected by idiosyncratic shocks, and therefore the measured passthrough to the earnings of stayers would be zero. In that world, laid off workers would bear the complete burden of the labor demand contraction, especially if finding a new job does not occur instantly due to the presence of search frictions. If the distinction between stayers and workers being laid off is simply random, all workers might face a relevant risk ex ante, and regressions on the wages of stayers might be misleading. We address this issue by providing evidence on the relationship between firm level shocks and the extensive margin (as in Carlsson et al. (2021)), as well as the potential earnings costs of non-voluntary job separations.

Second, we provide evidence on the way in which the effect of shocks depends on labor market conditions. In particular, we test whether the elasticity of incumbent's earnings and the sensitivity of the extensive margin are affected by the cyclical stance of the market, as measured by the aggregate unemployment rate as well as by sectoral poaching indexes. As suggested by search and matching models, market tightness will be relevant for the determination of equilibrium wages in bilateral firm-worker bargaining and, therefore, to their adjustment in response to shocks that can change the firm-worker surplus. Weaker labor markets, with relatively high levels of unemployment or low levels of poaching, can increase the wage effects of negative idiosyncratic shocks, as firms become less willing/able to isolate workers from adverse consequences.

Third, we expand the scope of the literature, typically focused on data for the US and Europe, with data from an emerging economy. While most of the previous literature has provided evidence for high-income countries with high levels of average human capital, we provide novel evidence for Chile, a middle-income country where earnings inequality has been relatively large by international standards. Moreover, it is a small open economy with substantial exposure to relative price shocks, particularly in commodities. Chile also has a very large degree of labor mobility, one of the highest among OECD countries (Albagli et al. (2023)), and workers earnings appear to be flexible in the face of aggregate cyclical conditions (Albagli et al. (2022)). This presents an interesting laboratory to understand the dynamics of earnings instability in the face of firm level shocks, and in particular to exploit their effects on the extensive margin. Moreover, the nature of firms and occupations can have relevant differences[1] to those observed in high-income countries.

We leverage our analysis on a matched employer-employee dataset constructed from a census of tax statements of all firms that hired formal salaried workers between 2004 and 2019. Thus, the data covers all formal employment in the country and has the advantage of reporting uncapped labor earnings. The dataset allows us not only to look at the effect of firm sales shocks, as has been in most of the literature, but also to analyze the effect of firm-level TFP shocks.

We highlight three main results.

In line with previous results for high-income countries using matched employer-employee data, the earnings elasticity of incumbent workers to both sales and TFP shocks are relatively modest, although the magnitudes are not economically negligible. However, our results also suggest that the effects of shocks can be highly non-linear, so that the earnings effects of large negative firm-level shocks can be quite significant. This implies that, while to an extent workers are sheltered from negative shocks, this insurance weakens severely as the magnitude of the shock increases.

Second, as expected, cyclical labor market conditions can play a relevant role in the transmission of shocks. When the labor market becomes weaker, and outside options for workers deteriorate, earnings respond less to positive shocks, and are more affected by negative shocks. Therefore, risk exposure is countercyclical.

Third, shocks have relevant effects on the probability of remaining employed. Therefore, the extensive margin plays a key role in the advent of firm-level shocks. In consequence, while the earnings of continuing workers may remain relatively unscathed ex post, an important share of workers might face a relevant ex ante risk of losing their

[1] For example, in Chile, 47% of workers work in a firms with 200 or less employees (Encuesta Longitudinal de Empresas, 2017)

job. Our results confirm the long and lasting earnings losses associated to job displacement found elsewhere in the literature (Jacobson et al. (1993); Krolikowski (2017)), which are likely associated to the destruction of specific human capital or valuable job ladders. Therefore, the risk of being laid off can be a massive source of earnings risk, especially among older workers with longer tenures.

The rest of the paper is organized as follows. Section 2 provides an overview of the data and the Chilean labor market. Section 3 presents our empirical strategy, while Section 4 presents our results. Section 5 concludes.

2 Data

2.1 General Characteristics

Our main source of data is a matched employer-employee dataset provided by the Chilean Internal Revenue Service (SII, by its Spanish acronym) between the years 2005 and 2019[2]. Because all formal firms must report to the SII, the data covers all workers with a formal wage contract. Workers with a formal contract correspond to more than 80% of wage employment in the country.[3]

Affidavit 1887, reported annually by each firm, records each employee's annual taxable earnings and the specific months of the year in which the worker was employed. Annual taxable earnings are the sum of all the forms of worker compensation, excluding social security payments. The aggregate figure cannot be separated into individual components, and it includes the base salary, incentive pay, bonuses, employer-provided benefits, and overtime pay.

Therefore, for each employment relationship, the data can be used to calculate the worker's monthly average earnings in any given year. This measure of average earnings

[2]Affidavit N. 1887 of *Servicio de Impuestos Internos*. To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the Central Bank of Chile processed the disaggregated data. All the analysis was implemented by the authors and did not involve nor compromise the Chilean IRS. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service

[3]Given our interest in the effects of firm shocks on workers earnings , our focus is on wage employment, which represents more than 70% of total employment. For details, see Central Bank of Chile (2018).

differs from a pure measure of monthly wages. As discussed in Albagli et al. (2022) in the context of this same dataset, it can be argued that earnings provide a better representation of the relevant economic concept underlying labor compensation, both in terms of the income flow received by the worker and the marginal cost faced by the firm.

To preserve anonymity, each firm and worker in this administrative dataset are assigned unnamed and unique identifiers by SII. This allows us to track each worker's labor history across firms and time (with monthly frequency), as well as the details of the firm's payroll at any given month. Covering the period 2005 to 2019, the original dataset includes information of about 600,000 firms, 9 million workers, and 36 million employment relationships.

The data is silent on the whereabouts of the workers in the months in which they are not employed in the formal sector. Therefore, we can not distinguish whether non-employed workers are unemployed, self-employed, working in the informal sector or inactive, although a simple search model would suggest that during a non-employment spell the best of those alternatives dominates any potential standing job offer in the formal sector.

Given the monthly frequency of the information available for each worker, their employment status at any given month can be identified with a large degree of precision. The tax dataset is combined with information provided by the Chilean Register Office (*Servicio de Registro Civil e Identificación* in Spanish), to obtain the basic demographic characteristics (gender and date of birth) of each worker.

2.2 Sample

We apply several filters to the data. At the firm level, we drop firm-year observations that have negative values for sales or intermediate goods expenditures, as well as any observation coming from a firm with less than five employees.[4]

[4]We exclude firms with very few workers since separating aggregate firm performance from the performance of individual workers can be complicated in those cases. We also winsorize firm sales data, dropping out observations ten times larger than the 99th percentile. As our interest lies in firm shocks, defined in our current version as changes in firm sales, we also winsorize extreme events, dropping changes above (below) the 99.5 (0.05) percentile.

On the worker side, we want to focus on males aged 25-64 years old in full-time jobs. Since we have no information on hours, we drop all employment relations in which the worker earns an implied full-time wage that is less than the minimum wage for 80% of her tenure. These jobs, which account for 20% of the initial set of observations, are probably part-time. Similarly to the sales values, we drop earnings changes above (below) the 99.5 (0.05) percentile. Our final sample includes 11,870,357 employee-employer matched observations for 2005-2019.

3 Empirical Strategy

To analyze the extent of firm-risk passthrough to workers, we define two types of firm-level shocks: changes in sales and changes in estimated (revenue) total factor productivity (TFP). We then estimate the impact of both shocks on the intensive and extensive margins of workers' earnings: the change in earnings for workers that remain in the firm after the shock, and the effect on separation probabilities for all workers that were employed in the firm at the time of the shock. Finally, to get a quantitative measure of the potential earnings implication of job separations, we look at the earnings trajectories of workers that lose their jobs in massive layoffs, following the literature on displacement pioneered by Jacobson et al. (1993).

Therefore, we are not only interested on the earnings implications of shocks for workers that remain in the firm, but also on the potential impact on those workers that leave the firm after the shock hits, in particular after a negative event that can lead to involuntary separations. We think that separation risk is a relevant source of the earnings risk faced by workers. This can be particularly relevant in a labor market that offers limited flexibility to adjust existing contracts, either in hours worked or in terms of contracted wages. In that context, nominal rigidities to the non-variable component of earnings might prevent rapid downward adjustments, which can only be done - in real terms- through inflation. This can be true if wages are already bound by regulations such as the minimum wage. In that context, rapid adjustments to negative shocks might naturally come through the extensive margin, by reducing the number of workers or by substituting workers and paying lower wages to the new hires.

3.1 Firm Shocks Measurement

We quantify firm shocks through two different measures: year-to-year log variations in firms' total sales (revenue) and variations in firms total factor productivity (TFP).

3.1.1 Sales

Data on firms annual revenue comes from the tax information reported in form F22. Panel (a) of Figure 1 presents the distribution of the firm level sales shock, and compares it with the change in the average wages paid by firms included in our sample. Both distributions are slightly skewed towards the right, reflecting that on average both wages and revenue increase over time. Still, annual sales and wages variation are concentrated in the zero although the variance of revenue is much larger than the variance of average wages, providing an early insight into the notion that the impact of shocks to firm profitability to worker earnings will be likely muted.

Figure 1: Log growth distributions of wages, firm sales, and TFP, from 2006 to 2019, firms with more than 5 employees from all sectors and workers earning more than the minimum wage.

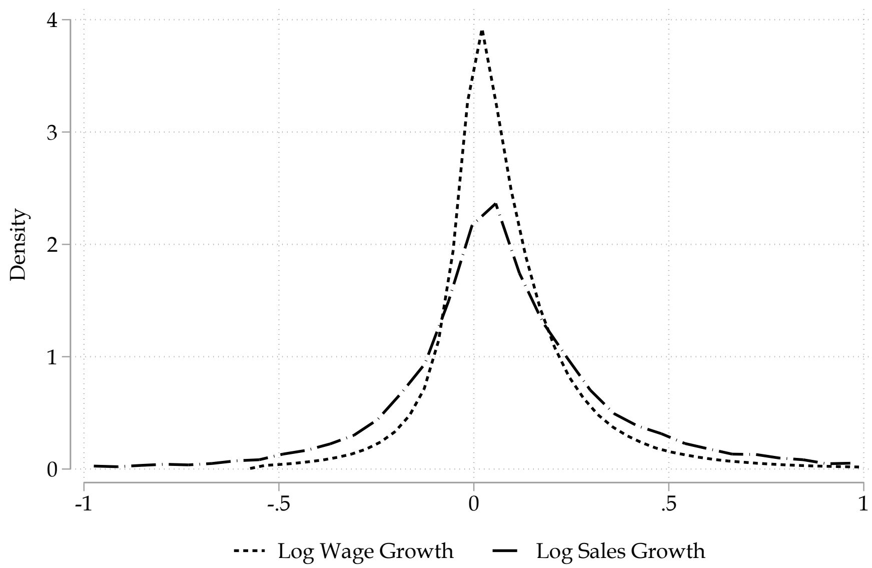


Figure 2: Log sales and log wages growth distribution

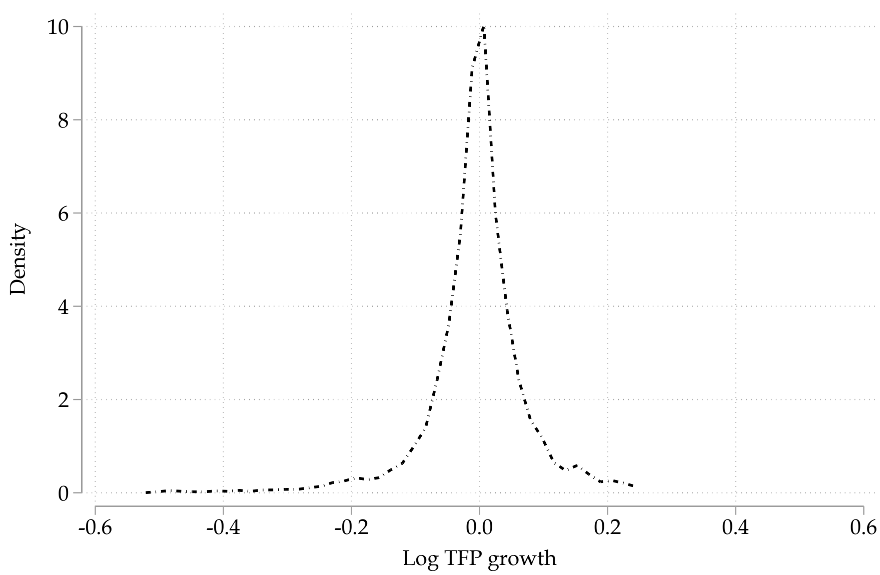


Figure 3: Log TFP growth distribution

3.1.2 Alternative measure: TFP

While changes in revenue are a natural approximation to firm level effects that can be transmitted to earnings, and have been widely used in the literature, they are subject to endogeneity concerns. We address this in two ways. First, we follow Juhn et al. (2018) and use revenue growth at different dates as instruments, estimating in Appendix B an IV regression that complements our baseline OLS estimates.

Second, we leverage on the richness of our data and, as Chan et al. (2023) look at the effect of total factor productivity (TFP) shocks, under the implicit assumption that firms face an exogenous productivity process. To do so, we estimate TFP at the firm level using the methodology in Ackerberg et al. (2015) adjusting the labor input by quality.[5] In particular, we follow Chan et al. (2023) and use an *ability-adjusted labor input* (A_{jt}) as the labor component in the production function. Crucially, this ability measure is not affected by the wage firm-specific component of the workers' current employer, as it is calculated from his wages across jobs, netting out firm fixed effects. The input quality-adjusted labor input A_{jt} at the firm level is constructed from the *ability unit* of each worker in the firm j at time t as:

$$A_{jt} = \sum_{i \in J_t} \exp(\hat{\alpha}_i + \hat{\gamma} X_{it}) E_{ijt} \tag{1}$$

in which J_t is the set of workers in firm j at time t, $\hat{\alpha}_i + \hat{\gamma} X_{it}$ is the estimated ability unit of worker i at time t, and E_{ijt} is the share of months worked of worker i in firm j in year t. We compute a variation of the AKM methodology of Abowd et al. (1994) in which the monthly wage of worker i working in firm j in period t is given by:

$$w_{ijt} = \alpha_i + \gamma X_{it} + \psi_{j(i,t)t} + \xi_{ijt} \tag{2}$$

where $\alpha_i + \gamma X_{it}$, the worker fixed effect and worker observables define the worker's *ability units*. The sum of the firm-by-time fixed effect and the residual, $\psi_{j(i,t)t} + \xi_{ijt}$, could be interpreted as a *per-unit ability price* paid by firms. The high mobility of workers in our dataset implies that the connected set of firms required for estimation covers near to 99% of the workers in the sample.

We then follow Ackerberg et al. (2015) to estimate the coefficients of a Cobb-Douglas

[5] As discussed in Chan et al. (2023), the measure of labor input L_{ij} in productivity estimations should be considered carefully. Two measures traditionally used in the literature, total working hours and total wage bill, can introduce a significant bias in any estimate of firm productivity, as they cannot correctly address the endogeneity of labor quality and the fact, that under imperfect competition, wages can be affected by the firm.

production function for real revenues, using the measure of quality-adjusted labor, and then use the residuals for the estimated firm's productivity. Panel (b) from Figure 1 shows the distribution of the log change of the estimated TFP.

3.2 Wage Pass-Through Estimations on Stayers

We start by estimating worker-level equations of the form:

$$\Delta ln(w_{ijt}) = \alpha + \beta \Delta F_{jt} + X_{it}\sigma + Z_j \gamma + \theta_t + \epsilon_{ijt} \tag{3}$$

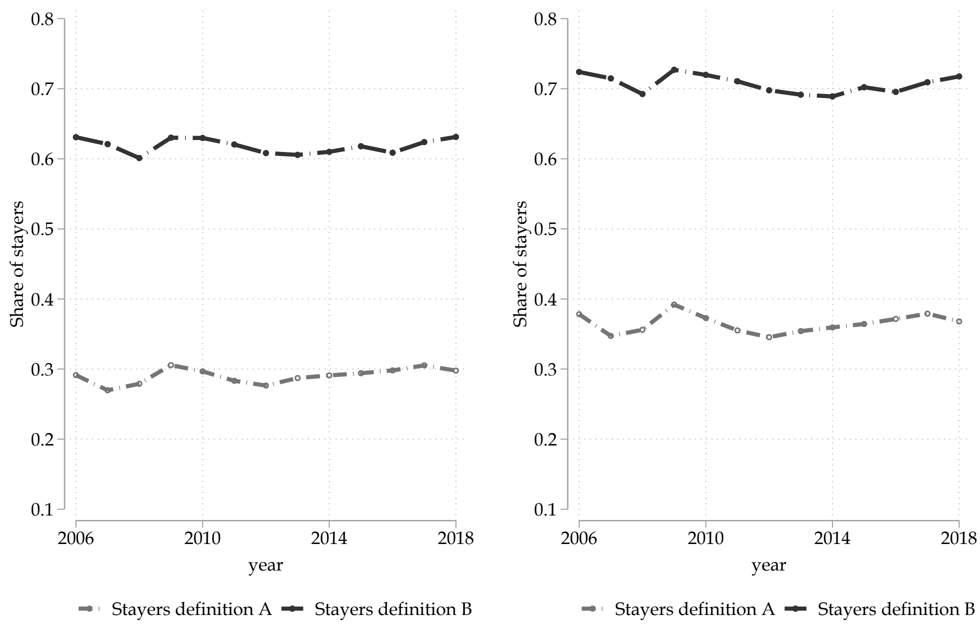
where w_{ijt} is the wage of worker i in firm j at time t. This baseline regression, directly comparable to most of the previous literature, focuses on job stayers, workers that were employed in the firm during the last period and remain employed in the current period. Given the nature of the data, a period is given by a calendar year. The change of the log of the worker's average monthly earnings is a function of a vector of worker characteristics, X_i, such as age and gender; a vector of firm characteristics, Z_j, including size and industrial sector, and time fixed effects, θ_t. Our coefficient of interest is β, which measures the earnings effect of the shock faced by the firm, ΔF_{jt}. As discussed above, we use two definitions of shocks: changes in firms sales, which provides comparability with most of the previous literature, as well as the change in firm total factor productivity (TFP). The baseline specification provides comparability with previous literature. We extend the baseline specification on several dimensions, including asymmetries and non-linearities in the effects of shocks.

3.2.1 Stayers Definition

Previous literature has adopted different criteria to define stayers. Under *definition A*, as in Juhn et al. (2018), a worker is a stayer in year t if he worked for firm j in the last quarter of year $t-1$, and remains in that same firm at least during the first quarter of year $t+2$. Under *definition B*, used by (Chan et al., 2023),a worker is considered a stayer in year t if he worked for firm j during the years t and $t+1$.

Figure 4 shows the share of stayers under both definitions for the complete data set and the sub-sample of firms used in our estimations. Under *definition A*, about 30% of the workers meet the criteria to be considered stayers, while under *definition B*, twice as many workers meet the requirements. This pattern holds in the entire sample of firms and workers and the sub-sample used for our estimations. Throughout the rest of the paper, we use *definition B*, as it includes a larger sample of workers, and is also more representative of the comparatively large turnover in the Chilean labor market.

Figure 4: Share of firms' stayers, by selected sub-sample.



Notes: Stayers are defined as the proportion of workers staying in the firm at least 10 consecutive quarters (Def.A)/ or two consecutive years after their firm suffered a shock on its sales (Def.B). Panel (a) takes into account all the workers observed in the data. Panel (b) takes into account only the sub-sample of workers with earnings above the minimum wage and working in firms with at least 5 workers.

3.3 Effects on Workers that Leave the Firm

3.3.1 Extensive Margin Estimations at the Individual and Firm Level

As argued earlier, the effects of firm shocks on workers are not limited to the earnings of employees that stay in the firm, but can also have a relevant impact on the extensive margin. This margin can be specially important in the aftermath of negative shocks, as workers might leave the firm, and potentially experience significant earnings losses during their transitions. As shown in the literature of displacement, these losses can be specially large in the case of involuntary separations. Therefore, we want to provide an approximation to the earnings risk over the extensive margin by estimating the effects of shocks on the likelihood of separation, and the potential earnings consequences of separation.

We first estimate the effects of shocks on the firm's extensive margin using linear probability model. In particular, we estimate the effect of sales shocks on the worker's probability of leaving the firm during the first quarter of the year after the shock, controlling by worker and firm characteristics. We also use year, industry, and year-industry fixed effects to control for business cycle and industry-specific trends. Similarly than with the stayers estimations, we will look into asymmetric effect of negative and positive shocks and non lineal effects.

Secondly, we look at the effect of sales shocks on firm's employment at the firm level, using changes in firms' total employment and wage bill as dependent variables in our regression estimations. We measure employment growth through the annual change in the number of full-time-equivalent workers. In both regressions, firm-level weights are computed and applied to account for the yearly firm's share of the market total employment. Again, our regression include fixed effects for year, industry, and year-industry.

3.3.2 Intensive Margin Estimations on Displaced Workers

Finally, we want to approximate the wage losses suffered by displaced workers due to a firm shock by estimating the earnings costs of job displacement. To do so, we follow the seminal work of Jacobson et al. (1993), and rely on mass layoffs to proxy for involuntary separations that are not directly related to the worker's individual performance. We define a displacement event (treatment) as a combination of worker and firm conditions. Workers in the treatment group must have had a tenure of at least one year before the shock, get a new job before the end of our sample, and have experienced displacement before the last quarter of 2016. On the firm's side, a firm is "treated" if it experienced a significant mass layoff, defined as a workforce reduction of more than 30%, accompanied by moderate changes in the number of employees three quarters before and after the treatment period.[6] Considering all job separations at the quarterly level, displaced

[6]Specifically, we require that the change in the headcount in the three quarters prior to the displacement period be in the range of -10 to 10%, and that the three quarters after the negative shock occurs, its headcount does not grow by more than 10%.

workers represent about 0.1% of the sample.

We then use an exact matching procedure to identify the control group. Workers in the control group must belong to firms that did not experience mass layoffs as the ones described above. The match is based on firm characteristics such as industry classification, geographical area, size (using IRS classification), and our available observable worker variables such as gender, age, tenure, and wage in $t-1$.

Notice that our goal is to use the estimated losses from displacement after a mass layoff to provide a measure of the earnings risks faced by agents due to firms idiosyncratic shocks and their potential impact on job separation. Therefore, an implicit assumption is that the nature of the firm shock has no bearing on the future trajectory of displaced workers. This is, earnings losses are, at least to a large extent, independent of the size of the shock that lead to separation. Mass layoffs provide an identification strategy that provides estimates that address endogeneity concerns, but the actual consequences of displacement -and therefore the risks faced by workers- are assumed to be the same regardless of the magnitude of the shock experienced by the firm.

4 Results

4.1 Intensive Margin: Wages Elasticity to Firm-Level Shocks

4.1.1 Average effects on stayers' wages

The upper panel of Table 1 presents the baseline regressions of the change in the log of real earnings to changes in the log real firm sales and log for male job stayers between 2007 and 2019. The sample includes more than 11 million year-worker observations across all industries. The regression controls for polynomials of age and tenure, the number of workers in the firm, and year, industry and year-industry fixed effects. Similarly, the bottom panel focuses on the sensitivity of wages to productivity shocks.

Consistent with most existent literature, the effect of firm level sales shocks on earnings are not large. For the whole economy, the elasticity of the earnings of stayers to sales shocks is 5.0% (column (1)), a figure that grows to 6.1% when we look at manufacturing (column (3)). While this is larger than the effects found for the US in Juhn et al. (2018), the impact on the earnings of continuing workers of firm level sales shocks are relatively

Table 1: Elasticity of workers' wages with respect to firms' sales shocks

	All sectors		Manufacturing	
	(1)	(2)	(3)	(4)
Sales shock	0.050***		0.061***	
	(0.002)		(0.004)	
Positive Sales shock		0.045***		0.049***
		(0.002)		(0.005)
Negative Sales shock		0.059***		0.081***
		(0.004)		(0.006)
N	11,206,172	11,206,172	2,484,457	2,484,457
Adjusted R2	0.064	0.064	0.075	0.075
Productivity shock	0.061***		0.099***	
	(0.010)		(0.018)	
Positive Productivity shock		0.097***		0.143***
		(0.014)		(0.027)
Negative Productivity shock		0.030***		0.066***
		(0.011)		(0.025)
N	11,206,172	11,206,172	2,484,457	2,484,457
Adjusted R2	0.059	0.059	0.068	0.068

Note: Estimations include controls for worker's age, age^2, tenure, tenure^2, number of workers in the firm, year, industry, and year-industry fixed effects. Robust standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1

modest, although far from being economically negligible. A worker that remains employed in a firm experiencing a decline in sales equal to one standard deviation (31%) experiences a (1.7%) reduction in earnings. Therefore, the results suggest that the impact of firm level uncertainty, while muted, can still be a relevant source of earnings volatility, even when we look at individuals who keep their job.[7]

Similarly to Juhn et al. (2018) and Chan et al. (2023)), the point estimates for the effect of shocks appears to be asymmetric: the sensitivity of worker earnings to negative shocks is statistically larger. Across all sectors, the elasticity to negative sales shocks is 5.9%, roughly a third larger than the 4.5% elasticity to positive shocks. Similarly, the earnings of workers in manufacturing respond almost 50% more to a negative shock than to a positive shock of the same size (a 8.1% elasticity to sales reductions, compared to a 4.9% elasticity to sales increases). The differences between the estimated coefficients are statistically significant, and suggest that downward risks to workers are more relevant.

[7] As seen in Table 11 in Appendix B, results are qualitatively similar if we instrument the sales shock on past revenue growth, as in Juhn et al. (2018). While the OLS estimate is 5.7%, the IV coefficient is 5.2%. Notice that the use of instruments, which are based on previous sales, implies that the sample becomes shorter. Therefore, throughout the rest of the paper we rely on OLS estimates, although IV results are available upon request.

Notice that the positive relationship between earnings and firm shocks does not necessarily mean that workers suffer an explicit wage cut after the firm face a negative shock: as wages are contracted in nominal terms, a reduction in real earnings can simply be attained by keeping nominal wages constant or growing less than inflation (average annual inflation in Chile was 3.2% throughout the period). Moreover, as our measures of earnings does not only include base-rate wages, but any taxable components, it seems likely that the variable components of labor earnings such as performance bonds or sales commissions are specially affected.

The second panel of Table 1 repeats the exercise for TFP shocks, as defined in Section 3.2. The estimated elasticity across all sectors is 6.1%, somehow smaller to the result in Chan et al. (2023) for Norway. Although quantitatively similar, the estimated coefficient for TFP is less precise than the one for sales, probably due to the additional noise introduced by the production function estimation. In any case, the result confirms the main finding that the effects of firm level shocks on worker earnings are limited, they are far from negligible, and can become a relevant source of risk for workers. As with sales shocks, the elasticity of earnings to TFP shocks is larger in manufacturing, reaching 9.9%. Regarding asymmetries, point estimates are, unlike sales shocks, now larger for positive shocks. However, as these estimates are noisier, these differences are not being statistically significant for manufacturing.

4.1.2 Asymmetries and Non Linearities

It seems likely that the response of earnings to shocks is non linear. For example, in the aftermath of small shocks, wage adjustment frictions or renegotiation costs may prevent a relevant adjustment in earnings, as deviations from the optimal wage (as defined by the firm-employer bargaining) might be relatively trivial. Similarly, a firm might want to insure workers earnings from volatility, but doing so can become increasingly costly in the face of larger perturbations, specially if they are associated to relevant negative shocks that can threaten the firm's viability. In those cases, isolating workers earnings - either through the extensive or intensive margins- becomes unfeasible. Conversely, the earnings effects of large positive shocks might become marginally smaller, as firms decide to extract larger rents or operate on the extensive margin by hiring more factors.

Table 2 shows the estimated shock effects when we also allow for a quadratic term. As seen in the upper panel, the elasticity of earnings to sales shocks appears to be concave, as the estimated coefficient for the quadratic term is negative and significant. However, this result appears to hide a relevant asymmetry, as seen in the third and sixth columns. While the response to positive shocks does seems to be concave, the effects of negative shocks appear to be convex. These differences are statistically significant, and imply a relevant distinction in the way in which workers earnings adjust to positive and positive shocks.

The marginal response to a positive shock is decreasing, suggesting that firms experiencing large increases in sales transmit proportionally less to the earnings of their incumbent workers. As mentioned, this can suggest that firm can extract proportionally more rents. In contrast, workers earnings fare proportionally worse as firms face more severe negative sales shocks. Therefore, firms might be less able to provide earnings insurance in the face of major shocks. This implies that the adverse risks faced by workers are exacerbated as volatility increases. Negative firm level can become a relevant source of uncertainty for workers.

Table 2: Asymmetries and Non Linearities in the elasticity of earnings to firms' shocks.

	All sectors			Manufacturing		
	(1)	(2)	(3)	(4)	(5)	(6)
Sales shock	0.050***	0.054***		0.061***	0.070***	
	(0.002)	(0.002)		(0.004)	(0.003)	
Sales shock^2		-0.013***			-0.031***	
		(0.002)			(0.006)	
Positive Sales shock			0.076***			0.114***
			(0.005)			(0.008)
Positive Sales shock^2			-0.037***			-0.082***
			(0.004)			(0.010)
Negative Sales shock			0.080***			0.111***
			(0.009)			(0.015)
Negative Sales shock^2			0.043***			0.081***
			(0.011)			(0.021)
N	11,206,172	11,206,172	11,206,172	2,484,457	2,484,457	2,484,457
Adjusted R2	0.064	0.064	0.065	0.075	0.076	0.077

	All sectors			Manufacturing		
	(1)	(2)	(3)	(4)	(5)	(6)
Productivity shock	0.061***	0.067***		0.099***	0.112***	
	(0.010)	(0.010)		(0.018)	(0.019)	
Productivity shock^2		0.160***			0.308***	
		(0.024)			(0.069)	
Positive Productivity shock			0.117***			0.166***
			(0.032)			(0.064)
Positive Productivity shock^2			-0.172			-0.337
			(0.119)			(0.379)
Negative Productivity shock			0.131***			0.221***
			(0.029)			(0.068)
Negative Productivity shock^2			0.410***			0.856***
			(0.082)			(0.243)
N	11,206,172	11,206,172	11,206,172	2,484,457	2,484,457	2,484,457
Adjusted R2	0.059	0.059	0.059	0.068	0.069	0.069

Note: Estimations include controls for worker's age, age^2, tenure, tenure^2, total number of workers in the firm, year, industry, and year-industry fixed effects. Robust standard errors in parentheses; ***p<0.01, **p<0.05, *p<0.1

The lower panel of Table 2 repeats the exercise for TFP shocks. The estimated quadratic effect for the average regression is positive and significant, indicating that average elasticities are strongly convex, unlike the case with sales shocks. However, when looking at asymmetries, the results are qualitatively similar to the ones for sales, although once again the estimates are much noisier than the ones for sales. The quadratic term for positive shocks is negative, suggesting that the elasticity becomes more muted for larger shocks, although the point estimate is not statistically significant. However, elasticities to negative shocks seem to be strongly convex in the size of the shocks, consistent the earlier result about the downward risks faced by workers.

Overall, results indicate that workers earnings are affected by firm level shocks (defined either in terms of sales and TFP). Although average coefficients might appear modest, continuing workers can still bear a significant level of risk. In fact, although our estimates in terms of asymmetries and non-linearities to depend on the particular shock measure, there seems to be strong evidence of convex effects associated to negative shocks. This implies that workers earnings can suffer significantly in the face of large adverse shocks.

4.1.3 Heterogeneity in Earnings Elasticities by Worker's characteristics

Tables 3, 4, and 5 explore the heterogeneity of the passthrough across different types of workers[8]. Results indicate that there is a significant degree of heterogeneity in the earnings elasticities, specially in terms of the asymmetric responses to positive and negative shocks.

Table 3 presents the results for the earnings of workers along quintiles of the within-firm earnings distribution. As we do not have data on occupations, this exercise wants to capture how the exposure varies across the organizational structure of the firm, from workers in the lower rungs to those in the highest positions, likely associated to management and workers with specialized human capital. In particular, we divide workers within each firm in earnings quintiles, and then look at the differential effects between the first quintile (workers with the lowest earnings within the firm), workers in the middle of the distribution (quintiles 2 to 4), and workers at the very top (likely managers or high-skilled professionals.

[8]While our main interest throughout the paper is on worker heterogeneity, Tables 12 and 13 also results of the main regression for measures of firm heterogeneity.

Results suggest that the responses of earnings vary across different types of positions within the firm. Both for sales and TFP shocks, the estimated earnings sensitivity of workers at the bottom rung seems to be the smallest, although differences are not statistically significant. Differences appear to be more striking when we look at asymmetries. When looking at revenue shocks, workers in the lowest rung suffer the most from negative shocks, and benefit the least from positive shocks. The reverse holds true for workers at the top, potentially suggesting a larger prevalence of performance bonuses. This implies that risk exposure in earnings varies significantly within the firm. Although magnitudes differ, the same pattern holds for TFP shocks, with workers at the top gaining the most from positive shocks and those at the bottom suffering the most from adverse events.

Table 4 separates workers by tenure at the time of the shock, distinguishing between those that have been employed at the firm for more than one year from those with shorter tenures. Workers with short tenure benefit less from positive shocks (none at all for sales shocks) and appear to be more exposed to negative shocks, consistent with the notion that firms might place more value on workers with longer tenure, which have a larger likelihood of being better matches.

Table 3: Heterogeneity of wages elasticity on firm shocks (a): OLS regression of firms' sales shocks on change in log worker wages, by workers' earnings rank (men)

	All sectors				Manufacturing			
	All workers (1)	Quintile 1 (2)	Quintile 2-4 (3)	Top 5 (4)	All workers (5)	Quintile 1 (6)	Quintile 2-4 (7)	Top 5 (8)
Sales shock	0.050***	0.043***	0.050***	0.045***	0.061***	0.053***	0.060***	0.060***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)	(0.004)	(0.004)
Positive Sales shock	0.045***	0.026***	0.044***	0.048***	0.049***	0.015**	0.049***	0.071***
	(0.002)	(0.004)	(0.003)	(0.003)	(0.005)	(0.006)	(0.006)	(0.006)
Negative Sales shock	0.059***	0.070***	0.059***	0.041***	0.081***	0.115***	0.077***	0.041***
	(0.004)	(0.005)	(0.004)	(0.003)	(0.006)	(0.007)	(0.007)	(0.007)
N	11,206,172	2,214,602	6,998,016	441,378	2,484,457	490,955	1,557,216	95,084
Adjusted R2	0.064	0.062	0.064	0.115	0.075	0.078	0.074	0.123
	All workers (1)	Quintile 1 (2)	Quintile 2-4 (3)	Top 5 (4)	All workers (5)	Quintile 1 (6)	Quintile 2-4 (7)	Top 5 (8)
Productivity shock	0.061***	0.048***	0.064***	0.061***	0.099***	0.107***	0.101***	0.057***
	(0.010)	(0.012)	(0.010)	(0.010)	(0.018)	(0.021)	(0.019)	(0.016)
Positive Productivity shock	0.097***	0.056***	0.097***	0.119***	0.143***	0.083**	0.144***	0.159***
	(0.014)	(0.018)	(0.014)	(0.023)	(0.027)	(0.033)	(0.030)	(0.030)
Negative Productivity shock	0.030***	0.040**	0.036***	0.019*	0.066***	0.126***	0.069***	-0.010
	(0.011)	(0.019)	(0.012)	(0.011)	(0.025)	(0.033)	(0.026)	(0.022)
N	11,206,172	2,214,602	6,998,016	441,378	2,484,457	490,955	1,557,216	95,084
Adjusted R2	0.059	0.058	0.059	0.111	0.068	0.071	0.067	0.117

Note: Quintiles and rankings are constructed based on the within-firm wage distribution in the period preceding the sales' shock. Estimations include controls for worker's age, age^2, tenure, $tenure^2$, total number of workers in the firm; year, industry, and year-industry fixed effects.
Robust standard errors in parentheses;*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 4: Heterogeneity of wages elasticity on firm shocks(b): OLS regression of firms' sales shocks on change in log worker wages, by workers' tenure (men)

	All sectors			Manufacturing		
	All workers (1)	Short tenure (2)	High tenure (3)	All workers (4)	Low tenure (5)	Long tenure (6)
Sales shock	0.050*** (0.002)	0.018*** (0.003)	0.057*** (0.002)	0.061*** (0.004)	0.013** (0.005)	0.074*** (0.004)
Positive Sales shock	0.045*** (0.002)	-0.004 (0.004)	0.062*** (0.003)	0.049*** (0.005)	-0.017** (0.007)	0.079*** (0.004)
Negative Sales shock	0.059*** (0.004)	0.075*** (0.005)	0.051*** (0.004)	0.081*** (0.006)	0.107*** (0.009)	0.068*** (0.006)
N	11,206,172	2,244,206	8,961,966	2,484,457	420,739	2,063,718
Adjusted R2	0.064	0.069	0.040	0.075	0.069	0.048

	All sectors			Manufacturing		
	All workers (1)	Short tenure (2)	Long tenure (3)	All workers (4)	Short tenure (5)	Long tenure (6)
Productivity shock	0.061*** (0.010)	0.077*** (0.009)	0.059*** (0.012)	0.099*** (0.018)	0.092*** (0.021)	0.117*** (0.021)
Positive Productivity shock	0.097*** (0.014)	0.035** (0.016)	0.108*** (0.016)	0.143*** (0.027)	-0.016 (0.051)	0.184*** (0.025)
Negative Productivity shock	0.030*** (0.011)	0.107*** (0.013)	0.016 (0.014)	0.066*** (0.025)	0.157*** (0.025)	0.062** (0.032)
N	11,206,172	2,244,206	8,961,966	2,484,457	420,739	2,063,718
Adjusted R2	0.059	0.068	0.033	0.068	0.066	0.038

Note: Controls include age, age^2, tenure, tenure^2, number of workers in the firm, year, industry, and year-industry fixed effects. Robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1
1/Short tenure are workers with a tenure of less than a year at the time of the shock.
2/Long tenure are workers with a tenure of more than a year at the time of the shock..

Finally, Table 5 ranks workers using the worker fixed effect coefficients from the AKM estimates described in Section 3. Therefore, it does not refer to the worker's relative position within the firm, as in Table 3, but to their position within the whole earnings distribution. This provides a proxy for the workers' relative market skills, reflecting human capital acquired through formal education, innate ability and learnings by doing. Earnings elasticities are estimated for each of the five population quintiles, plus workers at the top 5% of the distribution.[9] For both types of shocks, estimated earnings elasticities have an inverted U-shape, being the highest for workers at the middle of the distribution. However, most of the difference between estimated coefficients are not statistically sig-

[9]Notice that, while each quintile has the same number of workers, the number of observations varies significantly, being much lower for workers at the bottom of the distribution. This reflects that these workers have more gaps in formal employment across their lifetime, and tend to have shorter tenures. Therefore, they are less likely to be stayers.

nificant. In terms of asymmetries, there is some evidence, specially for TFP shocks, that the elasticity to negative shocks is smaller for workers at the bottom end of the earnings distribution, which could reflect factors such as the existence of the minimum wage or the fact that these workers have a more elastic labor supply as they more willing to move to the informal sector.

Table 5: Heterogeneity of wages elasticity on firm shocks (a): OLS regression of firms' sales shocks on change in log worker wages, by workers' skill rank (men)

	Q1	Q2	Q3	Q4	Q5	Top 5
Sales shock	0.042***	0.046***	0.050***	0.054***	0.051***	0.046***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Positive Sales shock	0.042***	0.041***	0.041***	0.045***	0.048***	0.046***
	(0.003)	(0.002)	(0.003)	(0.004)	(0.003)	(0.003)
Negative Sales shock	0.042***	0.054***	0.065***	0.069***	0.055***	0.046***
	(0.006)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
N	776,231	1,752,883	2,310,515	2,841,850	3,484,421	967,861
Adjusted R2	0.043	0.047	0.048	0.052	0.059	0.056
Productivity shock	0.022*	0.048***	0.061***	0.084***	0.066***	0.053***
	(0.013)	(0.008)	(0.009)	(0.016)	(0.011)	(0.010)
Positive Productivity shock	0.090***	0.100***	0.095***	0.109***	0.079***	0.058***
	(0.022)	(0.015)	(0.017)	(0.020)	(0.015)	(0.015)
Negative Productivity shock	-0.035*	0.005	0.032**	0.061***	0.054***	0.049***
	(0.021)	(0.012)	(0.013)	(0.019)	(0.012)	(0.010)
N	776,231	1,752,883	2,310,515	2,841,850	3,484,421	967,861
Adjusted R2	0.041	0.043	0.043	0.046	0.054	0.051

Note: Controls include age, age^2, tenure, tenure^2, number of workers in the firm, year, industry, and year-industry fixed effects. Robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1
1/Low tenure is defined as less than a year working in the firm.
2/High tenure is defined as at least one year working in the firm.

4.1.4 Cyclical Conditions and Earnings Elasticities

We now look at the way in which cyclical labor market conditions can affect the transmission of firm shocks to earnings. It seems likely that, as the outside options of workers change with the strength of the labor market, the willingness of firms to increase earnings in response to positive shocks and isolate earnings in response to negative shocks can also change. Therefore, the exposure of workers to risk is likely to be countercyclical, being larger during a downturn in which market conditions deteriorate.

Table 6 shows results on how the evolution of market conditions can affect the transmission of sales shocks.[10] We proxy market conditions by the change in the poaching rate, the share of direct transitions to overall new hires in the economy. A higher poaching rate can be seen as reflecting a more active labor market, where job-to-job transitions are more frequent, movements up the job ladder more likely and employed workers can face better outside options (Haltiwanger et al., 2018). A positive change in the poaching rate, therefore, reflects an improvement in labor market conditions for workers, while a negative change is associated to a deterioration.

Conceptually, it seems likely that, as the labor market becomes stronger, and the outside options of workers are better, firms must transmit a larger share of positive shocks - they can extract less rents -, and might be willing to provide a stronger buffer to negative shocks. Conversely, the reverse should hold when the labor market deteriorates. Therefore, elasticities to positive shocks should become larger when poaching becomes more prevalent, while the sensitivity to negative shocks should fall.

Results seem to be consistent with this idea. Column (2) shows that the evolution of market conditions has no effect on the average transmission of shocks, a result that is not entirely surprising as conceptually effect should depend on the sign of the shock, and effects can cancel out on average. This is reflected in column (3): when the poaching rate grows (falls) - the labor market becomes stronger (weaker) - earnings respond more (less) to positive shocks, and less (more) to negative shocks. Therefore, a look at the average earnings elasticity might be misleading, as the coefficient is acyclical, and might suggest that the risk exposure of workers to earnings shock does not vary with market conditions. In fact, results indicate that risk exposure to earnings risk increases when market conditions deteriorate: a reduction in poaching simultaneously reduces the sensitivity to positive revenue shocks while it increases the elasticity to negative shocks. While this leaves the average coefficient unchanged, it shifts the risk balance against workers. As the labor market becomes weaker, the downward risks on earnings at the firm level grow, even for those workers that keep their job.

[10] Throughout the rest of the paper, we focus on revenue shocks for the sake of brevity.

Table 6: Earnings Elasticities to Firm Shocks and Labor Market Conditions

	(1)	(2)	(3)
Sales shock	0.0502***	0.0492***	
	(0.0016)	(0.0019)	
Sales shock × Δ Agg. Poaching rate		0.0010	
		(0.0007)	
Positive Sales shock			0.0399***
			(0.0029)
Negative Sales shock			0.0631***
			(0.0039)
Positive Sales shock × Δ Agg. Poaching rate			0.0044***
			(0.0013)
Negative Sales shock × Δ Agg. Poaching rate			-0.0042***
			(0.0014)
N	11,206,172	11,206,172	11,206,172
Adjusted R2	0.064	0.064	0.064

Note: We control for age, age^2, tenure, $tenure^2$, gender, and number of workers in the firm. We also use year, industry, and year-industry fixed effects. Poaching rates are expressed as percentage points.

4.2 Extensive Margin: Firm-Level Shocks and Employment Responses

4.2.1 Firm-level shocks and effect on individual separation probabilities

As argued early, effects of firm shocks on the earnings of workers are not limited to the wages of employees that stay in the firm, but can also have a relevant effect on the extensive margin.

Table 7 shows the impact on firm sales shocks on the individual probabilities that workers leave the firm in the year after the shock. The average elasticity is negative, -3.8%, consistent with the idea that workers are less likely to leave if firms experience positive shocks, and more likely to leave (voluntarily or involuntarily) if the firm faces a negative shock. However, when looking at asymmetries, the negative average coefficient seems to be driven by the response to negative shocks, where the coefficient is -8.1% [11]. This suggests that the probability that a worker leaves the firms can increase significantly after the firm experiences a negative shock, either because he chooses to quit (as her earnings prospects might have deteriorated) or because he is let go. Therefore, overall earnings risk does not only come from a reduction in earnings within the firm, but potentially through non-voluntary separation.

[11] Interestingly, the coefficient associated to positive shocks is positive; a worker is more likely to leave after the firm experiences a positive shock. This could reflect, for example, changes in firm composition.

Table 7: Probability to leave the firm as function of firm shocks: linear probability model

	All sectors			Manufacturing		
	(1)	(2)	(3)	(4)	(5)	(6)
Sales shock	-0.038***	-0.038***		-0.028***	-0.031***	
	(0.001)	(0.001)		(0.003)	(0.003)	
Sales shock^2		0.017***			0.017***	
		(0.001)			(0.001)	
Positive Sales shock			0.026***			0.050***
			(0.005)			(0.013)
Positive Sales shock^2			-0.003**			-0.008*
			(0.001)			(0.004)
Negative Sales shock			-0.081***			-0.075***
			(0.005)			(0.014)
Negative Sales shock^2			0.005***			0.006
			(0.002)			(0.005)
N	14,368,164	14,368,164	14,368,164	2,999,773	2,999,773	2,999,773
Adjusted R2	0.100	0.106	0.107	0.106	0.112	0.114
Mean prob. leave	0.328	0.328	0.328	0.356	0.356	0.356

Note: Controls include age, age^2, tenure, tenure^2, number of workers in the firm, year, industry, and year-industry fixed effects. Robust standard errors in parentheses;*** p<0.01, ** p<0.05, * p<0.1

4.2.2 Firm level effects on total employment and the wage bill

Tables 8 and 9 present an assessment of the role of the extensive margin at the firm level, looking at the response of firm level employment and the wage bill to the sales shock, for different specifications of controls and the inclusion of firm-level employment weights. Across all specifications, the employment elasticity is large, and close to 0.5. Therefore, the extensive margin, in the form of hires and layoffs, plays an important role in the way in which the firm adjusts to idiosyncratic shocks. Firm level responses in employment are almost an order of magnitude larger than the sensitivities of individual earnings.

Responses are larger to positive shocks, suggesting that hiring might be more sensitive than layoffs. This seems consistent with the notion that firms might be more reluctant to destroy high quality matches that can be difficult to recover under search frictions. Still, the number of workers employed in a firm can decline significantly in the advent of a negative shock. Therefore, while the earnings of workers that keep their job are, at least to an extent, buffered from a negative shock, there seems to be a relevant risk of facing unemployment, with can have potentially large adverse effects in future earnings, as we discuss in the next section.

Consistent with our previous estimates, elasticities for the wage bill are in general slightly larger than those for total employment, reflecting that individual earnings adjust modestly. This reaffirms the idea that, while the earnings of continuing workers can be significantly affected by firm shocks, the bulk of the response is channeled through the extensive margin. We now look at the adjustments occurs through the extensive margin, rather than through the intensive margin of the wages of continuing workers.

Table 8: OLS Regression of sales shocks on firm's employment*

	All sectors				manufacturing			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sales shock	0.496***	0.509***			0.534***	0.512***		
	(0.002)	(0.007)			(0.004)	(0.009)		
Sales shock^2	0.062***	0.134***			0.069***	0.152***		
	(0.002)	(0.008)			(0.005)	(0.013)		
Positive Sales shock			0.460***	0.507***			0.500***	0.493***
			(0.006)	(0.019)			(0.012)	(0.027)
Positive Sales shock^2			0.111***	0.146***			0.122***	0.190***
			(0.006)	(0.020)			(0.012)	(0.031)
Negative Sales shock			0.331***	0.409***			0.351***	0.323***
			(0.007)	(0.022)			(0.013)	(0.031)
Negative Sales shock^2			-0.127***	0.009			-0.149***	-0.108***
			(0.008)	(0.027)			(0.016)	(0.042)
N	594,928	30,085,399	594,928	30,085,399	132,075	6,001,073	132,075	6,001,073
Adjusted R2	0.310	0.343	0.312	0.344	0.340	0.337	0.342	0.340
Weight		✓		✓		✓		✓
FE	✓	✓	✓	✓	✓	✓	✓	✓

*We measure employment growth through the annual change in the number of full-time-equivalent workers. [a] Firm-level weights are given by the firm's share of the market total employment in that particular year. [b] Controls include firm's sales and fixed effects are year, industry, and year-industry.

Table 9: OLS Regression of sales shocks on firm's wages bill*

	All sectors				manufacturing			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sales shock	0.516***	0.514***			0.556***	0.527***		
	(0.002)	(0.007)			(0.004)	(0.009)		
Sales shock^2	0.061***	0.123***			0.073***	0.152***		
	(0.002)	(0.008)			(0.005)	(0.013)		
Positive Sales shock			0.498***	0.520***			0.553***	0.523***
			(0.006)	(0.017)			(0.012)	(0.023)
Positive Sales shock^2			0.094***	0.127***			0.101***	0.175***
			(0.006)	(0.018)			(0.013)	(0.029)
Negative Sales shock			0.359***	0.421***			0.350***	0.351***
			(0.007)	(0.021)			(0.014)	(0.029)
Negative Sales shock^2			-0.115***	0.011			-0.160***	-0.083**
			(0.008)	(0.025)			(0.017)	(0.039)
N	594,928	594,928	594,928	594,928	132,075	132,075	132,075	132,075
Adjusted R2	0.322	0.398	0.324	0.399	0.349	0.400	0.352	0.402
Weight		✓		✓		✓		✓
FE	✓	✓	✓	✓	✓	✓	✓	✓

*Wage bill is expressed in real pesos of 2018. [a] Firm-level weights are given by the firm's share of the market total employment in that particular year. [b] Controls include firm's sales and fixed effects are year, industry, and year-industry.

4.2.3 Earnings Effects of Job Losses

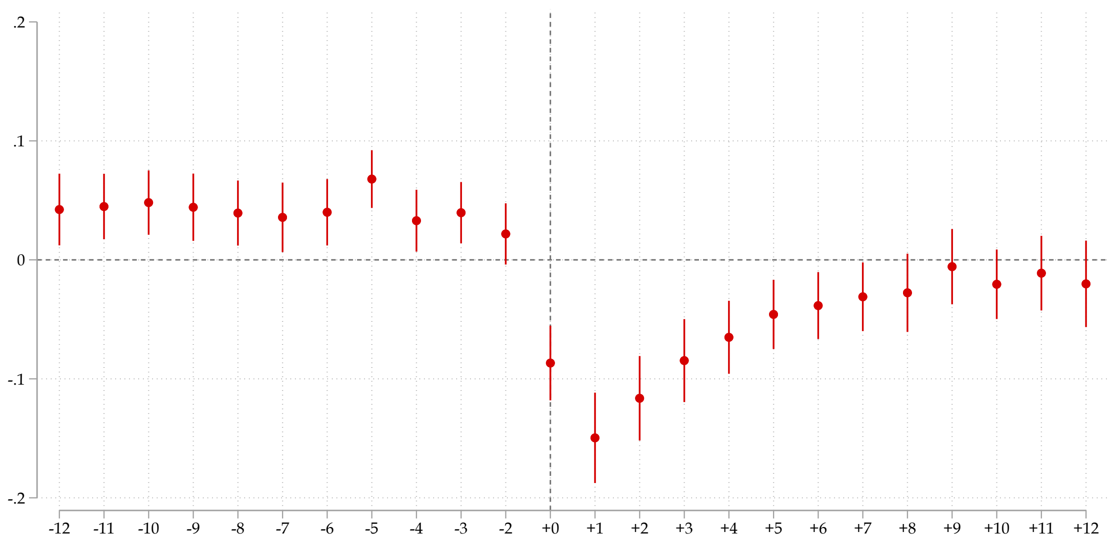
We now turn our attention to the potential earnings losses for workers that are displaced following a negative firm shock. As discussed in Section 3, we follow the spirit of the identification strategy in Jacobson et al. (1993), and look at the differential earnings trajectories of workers displaced in mass layoff events relative to workers in a control group.[12] This provides an approximation of the earnings risk faced by a worker that loses a job after the firm faces a negative shock, even if that shock does not lead to a layoff with a large headcount at the firm.[13]

[12]There is a very large literature on the earnings consequences of job displacement. See, for example, Schwerdt (2011), Flaaen et al. (2019) and Couch and Placzek (2010). Albagli et al. (2024) provide detailed evidence for Chile, distinguishing between the effect of anticipated and unanticipated separations.

[13]As discussed earlier, the argument here is that the impact that losing a job has on a worker's earnings does not depend on the magnitude of the shock suffered by her firm, but on the fact of being displaced involuntarily. This is, mass layoffs provide an identification strategy for the exogeneity of displacement, but there is nothing particular to mass layoffs in terms of its earnings implications: the actual consequences of displacement do not depend on the size of the shock suffered by the firm

Figure 5 presents the earnings implications of displacement using our sample. Displacement events are associated to relevant earnings losses, with workers that are reemployed during the first quarter experiences earning losses of almost 20% relative to the control group. In fact, the earnings of displaced workers lag relative to the control group for up to two years. This indicates that the monetary costs of losing a job are not trivial, and therefore the risk of facing displacement is a relevant component of the overall risk faced by workers. Moreover, the effects of displacement are expected to be heterogeneous, being larger for workers for whom reallocation can be costlier, such as older workers or workers with longer tenures.

Figure 5: Average effects of displacement



Note: X-axis represents quarters after the displacement event.

Figures 6 to 8 explore heterogeneity among dimensions that can be relevant to the type of job transitions experienced by workers. The results show that the average cost of displacement vary significantly across workers with different characteristics. Figure 6 divides workers by agem from young workers aged 18 to 29, mid-career workers from 30 to 49 and older workers from 50 to 65. As expected, earnings costs of displacement are larger for older workers, who experience bigger and more persistent earnings losses. Upon reemployment, young workers experience earnings losses of close to 10%, and their earnings become statistically identical to the control group in less than one year. In contrast, workers older than 50 experience losses larger than 20% upon reemployment, and their earnings lag behind the control group for up to two years. Middle age workers fare somewhere in between, with more modest losses than their older counterparts, but their earnings still lag after two years. Therefore, as expected, reallocation seems to be easier for younger workers. Older workers, who are more likely to have firm-specific human capital that can become obsolete or to have constructed valuable job ladders that take time to build due to search frictions, can find job reallocation much costlier.

This intuition is reinforced by Figure 7, which looks at workers depending on their tenure at the moment of displacement. Workers with longer tenures, which as discussed earlier are probably better matches and have more firm-specific human capital, suffer more from displacement. While displaced workers who had a tenure shorter than a year experience earning losses of about 10% that dissapear after one year, workers with longer tenures suffer losses that are twice as large, and that still persist after three years. Therefore, the earnings risk from displacement, associated to a costly process of reallocation, are much larger for workers with longer tenures. Therefore, although the earnings of those workers are relatively more isolated from shocks in the case in which workers keep their job, in the event of displacement the earnings costs are much more important.

Finally, Figure 8 looks at the earnings implications of displacement for the same skill groups defined on the previous section. Job reallocation seems to be costlier, both in terms of magnitude and persistence, for workers in the middle of the skill distribution (quintiles 3 and 4). Workers in the bottom of the distribution (quintiles 1 and 2) experience relatively large losses in their first job, but differences with the control group become non-significant within the year. High-skill workers (quintile 5) experience the smallest losses, and also back in track within the year. This suggests that this group, due to the nature of the occupations in which they are employed or the more general nature of the human capital they hold, can be reemployed at a similar job more easily. Workers on the middle, on the other hand, face a harder reallocation, as they might be associated to more specialized jobs. On impact, their earnings losses amount to more than 20%, and they still lag behind the control group after three years.

In summary, the evidence shows, consistent with the literature, that earnings losses associated to job displacement can be large and persistent. This is specially true for workers for which reallocation is likely to more difficult, such as older workers, workers with longer tenures or workers with more specialized skills. While the identification of separations that are exogenous to the worker comes from mass layoffs, the implications are far more general, and can be applied to all involuntary separations associated to events, such as firm level shocks, that not directly related to the worker. Therefore, these results highlight the relevance of the extensive margin when looking at the earnings risk of workers in the face of firm-level shocks.

Figure 6: Earnings effects of displacement by age

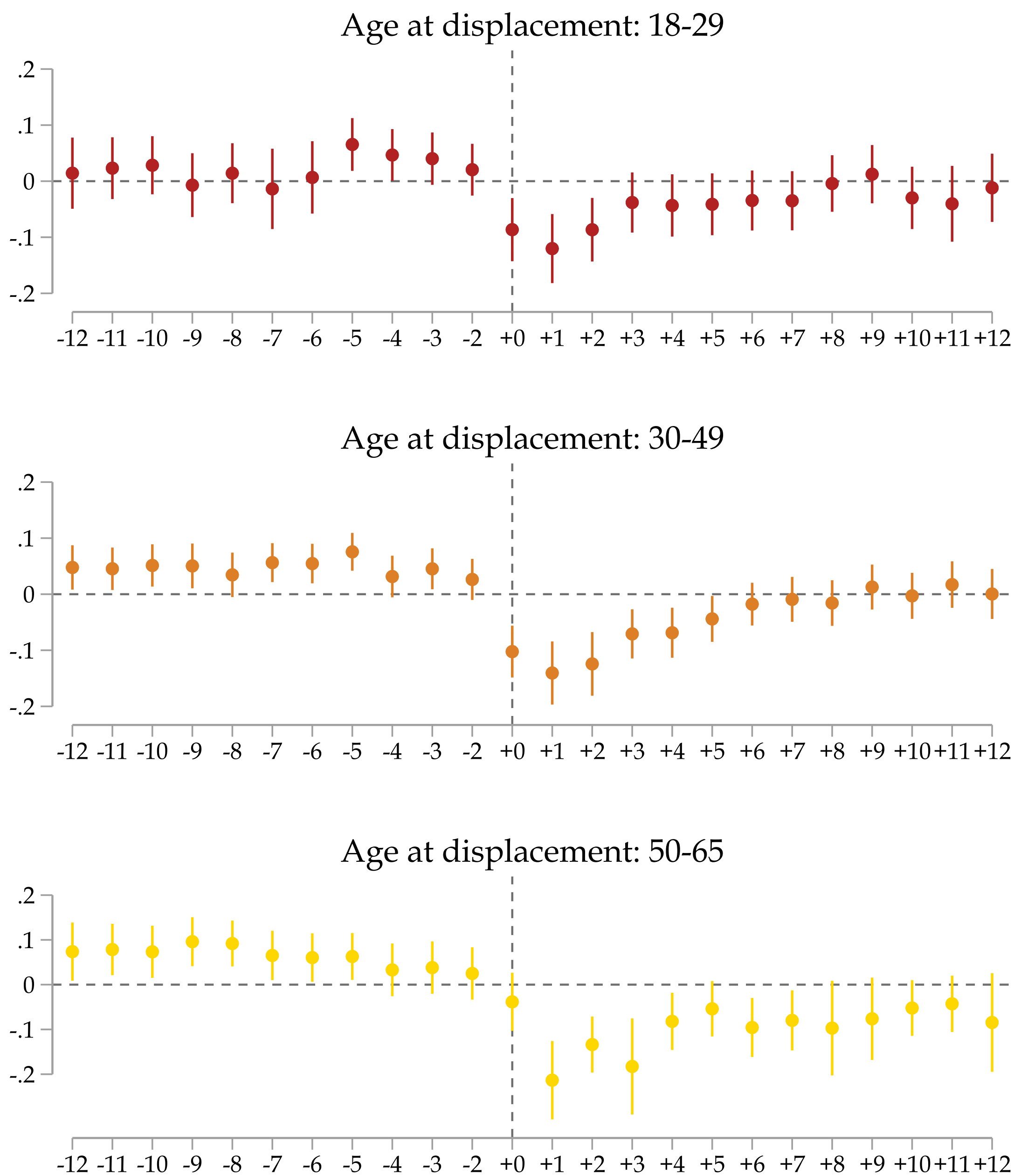
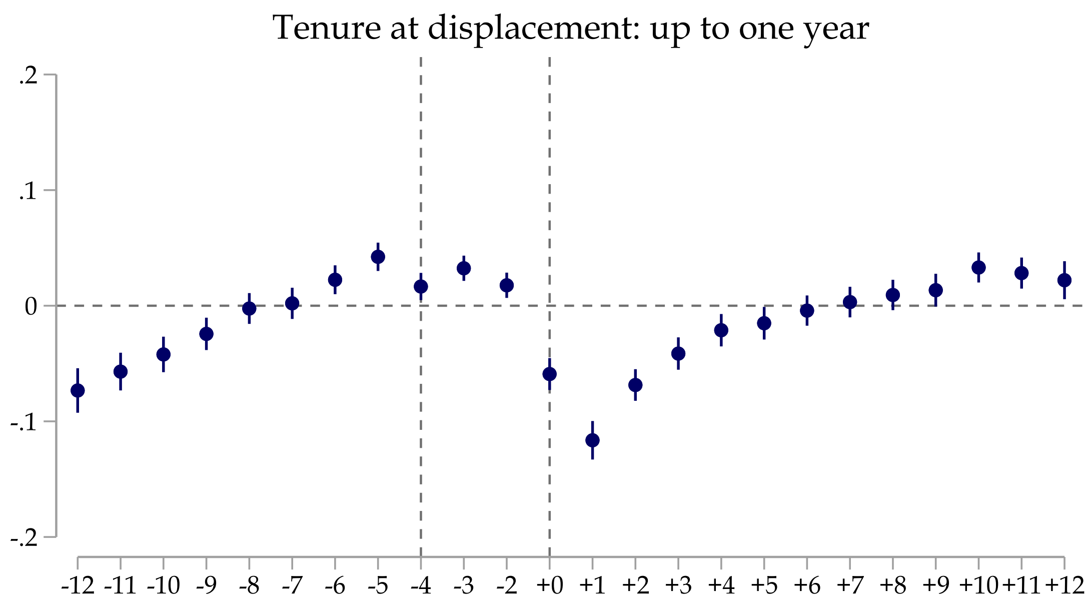


Figure 7: Earnings effects of displacement by tenure



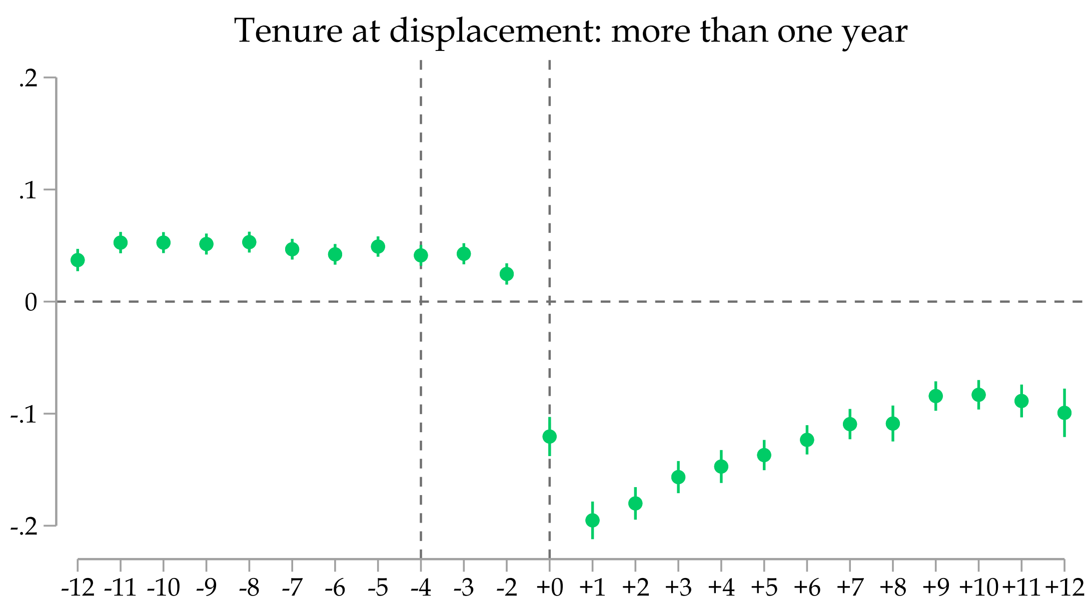
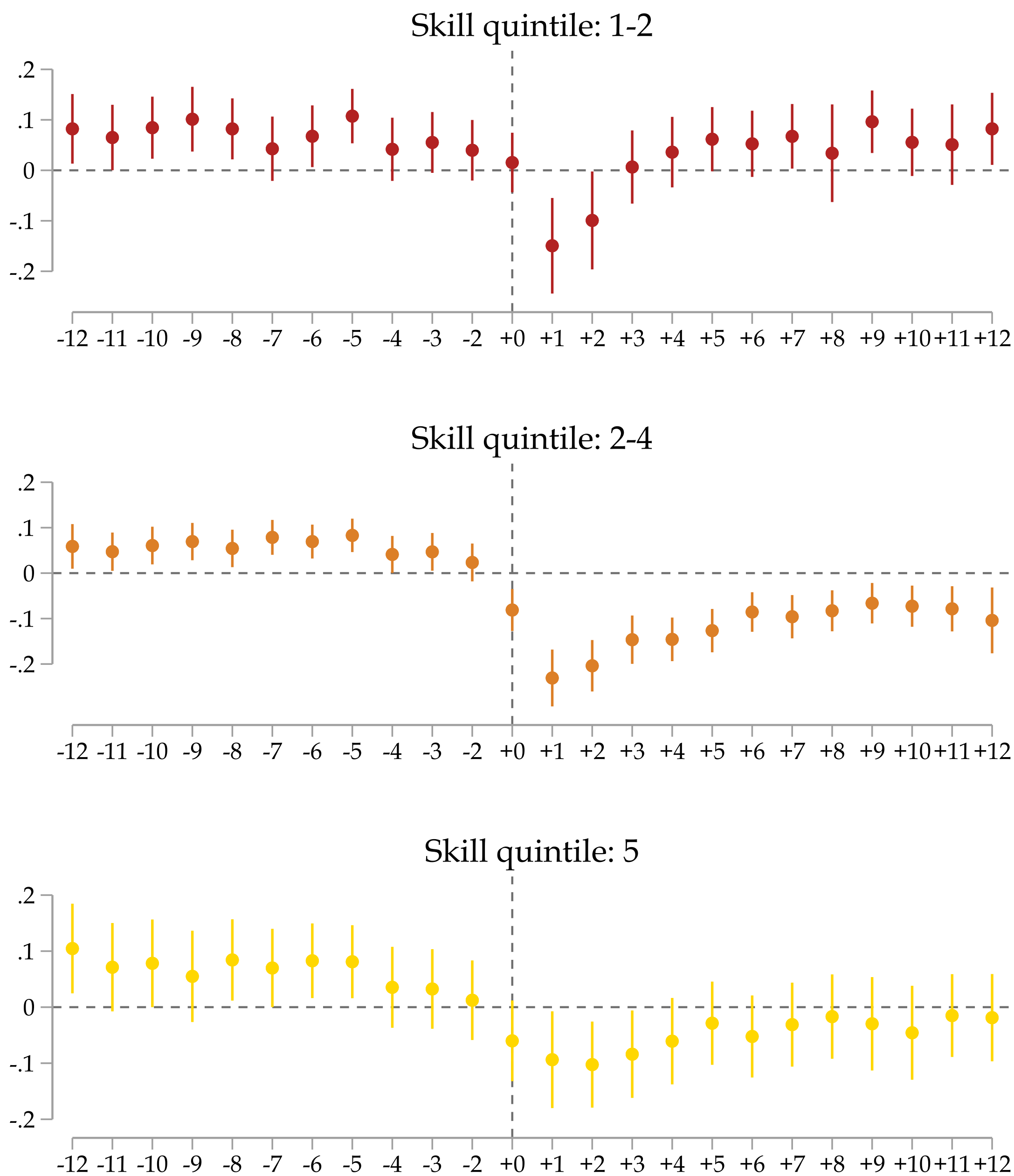


Figure 8: Earnings effects of displacement by skills



5 Conclusions

This paper contributes to the growing literature that studies the effect of idiosyncratic firm shocks on the earnings risk faced by workers. We contribute to this literature in several dimensions. First, we expand the scope of the literature, typically focused in developed economies, by using a use a matched employer-employee census between 2007 and 2019 for Chile, a developing economy with a significant degree of earnings inequality and job mobility. Second, we show that the passthrough of firm shocks to earnings can vary significantly with labor market conditions, and the downward risks faced by workers are countercyclical. Finally, we show that responses along the extensive margin of employment are very significant, as negative shocks increase the probability of separation, which can have significant earnings costs for certain types of workers. This suggests that looking at the earnings of workers that leave the firm after a negative shock can provide a more precise assessment of how firms transfer risks to workers.

References

Abowd, John M, Francis Kramarz, and David N Margolis, "High Wage Workers and High Wage Firms," *Economic Journal*, 1994, *126* (593), F1–F30.

Ackerberg, Daniel A, Kevin Caves, and Garth Frazer, "Identification properties of recent production function estimators," *Econometrica*, 2015, *83* (6), 2411–2451.

Albagli, Elias, Alejandra Chovar, Emiliano Luttini, Alberto Naudon, and Matias Tapia, "Labor market flows: Evidence for Chile using microdata from administrative tax records," *Latin American Journal of Central Banking (previously Monetaria)*, 2023, *4* (4).

_ , Alvaro Castillo, Antonio Martner, and Matias Tapia, "Sudden Unemployment," 2024.

_ , Gabriela Contreras, Matias Tapia, and Juan Wlasiuk, "Earnings cyclicality of new and continuing jobs: The role of tenure and transition length," *Labour Economics*, 2022, *78*.

Carlsson, Mikael, Julián Messina, and Oskar Nordström Skans, "Firm-Level Shocks and Labor Flows," *The Economic Journal*, 2021, *131* (634), 598–623.

Carneiro, Pedro and Rita Ginja, "Partial Insurance and Investments in Children," *Economic Journal*, 2016, *126* (596), F66–F95.

Central Bank of Chile, "Mercado Laboral: Hechos Estilizados e Implicancias Macroeconomicas (Labor Market; Stylized Facts and Macroeconomic Implications)," Technical Report 2018.

Chan, Mons, Sergio Salgado, and Ming Xu, "Heterogeneous Passthrough from TFP to Wages," *Available at SSRN 3538503*, 2023.

Couch, Kenneth A and Dana W Placzek, "Earnings losses of displaced workers revisited," *American Economic Review*, 2010, *100* (1), 572–89.

Flaaen, Aaron, Matthew D Shapiro, and Isaac Sorkin, "Reconsidering the consequences of worker displacements: Firm versus worker perspective," *American Economic Journal: Macroeconomics*, 2019, *11* (2), 193–227.

Gottschalk, Peter and Robert Moffitt, "The Growth of Earnings Instability in the U.S. Labor Market," *Brookings Papers on Economic Activity*, 1994, *1994* (2), 217–272.

Guiso, Luigi, Luigi Pistaferri, and Fabiano Schivardi, "Insurance within the Firm," *Journal of Political Economy*, 2005, *113* (5), 1054–1087.

Haider, Steven, "Earnings Instability and Earnings Inequality of Males in the United States: 1967-1991," *Journal of Labor Economics*, 2001, *19* (4), 799–836.

Haltiwanger, John C, Henry Hyatt, Lisa Kahn, and Lisa. McEntarfer, "Cyclical Job Ladders by Firm Size and Firm Wage," *American Economic Journal: Macroeconomics*, 2018, *10* (2), 52–85.

Jacobson, Louis, Robert LaLonde, and Daniel Sullivan, "Earnings Losses of Displaced Workers," *American Economic Review*, 1993, *83* (4), 685–709.

Juhn, Chinhui, Kristin McCue, Holly Monti, and Brooks Pierce, "Firm performance and the volatility of worker earnings," *Journal of Labor Economics*, 2018, *36* (S1), S99–S131.

Katz, Lawrence and David Autor, "Changes in the Wage Structure and Earnings Inequality," *Handbook of Labor Economics*, 1999, *3*, 1463–1555.

Krolikowski, Pawel, "Job Ladders and Earnings of Displaced Workers," *American Economic Journal: Macroeconomics*, 2017, *9* (2), 1–31.

Lamadon, Thibaut, Magne Mogstad, and Bradley Setzler, "Imperfect Competition, Compensating Differentials, and Rent Sharing in the US Labor Market," *American Economic Review*, 2022, *112* (1), 169–212.

Levahri, D. and Y Weiss, "The Effect of Risk on Investment in Human Capital," *American Economic Review*, 1974, *65*, 950–963.

Schwerdt, Guido, "Labor turnover before plant closure: "Leaving the sinking ship" vs. "Captain throwing ballast overboard"," *Labour Economics*, 2011, *18* (1), 93–101.

6 Appendix A

Table 10: Earnings evolution by categories

Category	Number of workers	Mean monthly real wage (USD 2015)	Number of workers	Mean monthly real wage (USD 2015)
	2007		**2018**	
Panel A				
Age [25, 40]	551,941	$ 952	509,338	$ 1,330
Age [36, 55]	160,905	$ 1,209	145,260	$ 1,850
Age [56, 65]	281,600	$ 1,276	410,264	$ 1,704
Panel B				
High Tenure	709,560	$ 1,211	819,702	$ 1,683
Low Tenure	284,886	$ 773	245,160	$ 1,084
Panel C				
Quintile 1	209,146	$ 536	232,374	$ 891
Quintile 2	210,699	$ 746	216,218	$ 1,234
Quintile 3	197,635	$ 947	213,624	$ 1,435
Quintile 4	192,044	$ 1,186	212,239	$ 1,642
Quintile 5	184,922	$ 2,136	190,407	$ 2,711

Note: the figures includes workers in our sample, that is, men, stayers, with incomes above the minimum wage. We also restrict our analysis to firms with more than 5 workers.

7 Appendix B

7.1 Instrumental variables

Table 11: Earnings effects of sales shocks: IV estimates

	All sectors		Manufacture	
	OLS	IV	OLS	IV
Sales shock	0.057***	0.052***	0.073***	0.069***
	(0.002)	(0.005)	(0.004)	(0.008)
N	9,909,494	9,909,494	2,194,732	2,194,732
Adjusted R2	0.052	0.052	0.066	0.066

Note: We control for age, age^2, tenure, tenure^2, and number of workers in the firm. We also use year, industry, and year-industry fixed effects. The instrument is a long-term shock (3 years)

Table 12: Earnings effects of sales shocks: Firm size

	(1)	(2)	(3)	(4)	(5)
	5-20	21-50	51-150	151-1000	1000+
Sales shock	0.046***	0.053***	0.056***	0.056***	0.041***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.005)
Positive Sales shock	0.047***	0.054***	0.054***	0.052***	0.034***
	(0.001)	(0.002)	(0.002)	(0.003)	(0.008)
Negative Sales shock	0.044***	0.052***	0.058***	0.062***	0.052***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.013)
N	819,264	1,061,014	1,647,370	3,708,714	3,961,359
Adjusted R2	0.044	0.057	0.068	0.075	0.068

Note: We control for age, age^2, tenure, tenure^2. We also use year, industry, and year-industry fixed effects.

Table 13: Earnings effects of sales shocks: Firm productivity

	(1) Q1	(2) Q2	(3) Q3	(4) Q4	(5) Q5
Sales shock	0.046***	0.051***	0.055***	0.052***	0.050***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
Positive Sales shock	0.039***	0.044***	0.053***	0.044***	0.048***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)
Negative Sales shock	0.057***	0.062***	0.059***	0.065***	0.055***
	(0.008)	(0.006)	(0.008)	(0.005)	(0.009)
N	2,732,464	1,915,389	1,554,134	1,693,574	3,302,909
Adjusted R2	0.070	0.069	0.070	0.064	0.068

Note: We control for age, age^2, tenure, $tenure^2$. We also use year, industry, and year-industry fixed effects.

Documentos de Trabajo **Banco Central de Chile**	**Working Papers** **Central Bank of Chile**
NÚMEROS ANTERIORES	PAST ISSUES
La serie de Documentos de Trabajo en versión PDF puede obtenerse gratis en la dirección electrónica: www.bcentral.cl/esp/estpub/estudios/dtbc. Existe la posibilidad de solicitar una copia impresa con un costo de Ch$500 si es dentro de Chile y US$12 si es fuera de Chile. Las solicitudes se pueden hacer por fax: +56 2 26702231 o a través del correo electrónico: bcch@bcentral.cl.	Working Papers in PDF format can be downloaded free of charge from: www.bcentral.cl/eng/stdpub/studies/workingpaper. Printed versions can be ordered individually for US$12 per copy (for order inside Chile the charge is Ch$500.) Orders can be placed by fax: +56 2 26702231 or by email: bcch@bcentral.cl.

DTBC – 1010
Firm Shocks, Workers Earnings and the Extensive Margin
Álvaro Castillo, Ana Sofía León, Antonio Martner, Matías Tapia

DTBC – 1009
Trade Policy and Reallocation: Multinational vs. Single-Country Linkages in the Tire Industry
Brian Pustilnik

DTBC – 1008
The finances of Chilean households during the pandemic: an assessment from the 2021 Household Financial Survey Enzo Cerletti, Magdalena Cortina, Alejandra Inzunza, Felipe Martínez, Patricio Toro

DTBC – 1007
UIP Deviations: Insights from Event Studies
Elias Albagli, Luis Ceballos, Sebastian Claro, Damian Romero

DTBC – 1006
Input price dispersion across buyers and misallocation Ariel Burstein, Javier Cravino, Marco Rojas

DTBC – 1005
The Role of Parental Altruism in Parents Consumption, College Financial Support, and Outcomes in Higher Education
Agustín Díaz Casanueva

DTBC – 1004

Indebtedness and labor risk sorting across consumer lender types: evidence from Chile

Carlos Madeira

DTBC – 1003

Central Bank Independence at Low Interest Rates

Benjamín García, Arsenios Skaperda

DTBC – 1002

Altas temperaturas y escasez de lluvia: el impacto del cambio climático en la actividad económica de Chile

María Teresa Reszczynski Zúñiga

DTBC – 1001

The Effect of Cognitive Skills on Fertility Timing

Agustín Díaz

DTBC – 1000

Time-Varying Expenditure Shares and Macroeconomic Dynamics

Benjamín García, Mario Giarda, Carlos Lizama, Damián Romero

DTBC – 999

Relationship Lending: Characteristics and Real Effects Miguel Acosta-Henao, Sangeeta Pratap, Manuel Taboada

DTBC – 998

International Sourcing during COVID-19: How did Chilean firms fare?

Jennifer Peña, Elvira Prades

DTBC – 997

A Preliminary Assessment of the Economic Effects of Climate Change in Chile

Felipe Beltrán, Luigi Durand, Mario González-Frugone, Javier Moreno

DOCUMENTOS DE TRABAJO Marzo 2024