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Minimum Wages and Insurance within the Firm*

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Abstract

Minimum wages alter the allocation of firm-idiosyncratic risk across workers. To establish this result, we focus on Italy, and leverage employer-employee data matched to firm balance sheets and hand-collected occupation-specific wage floors. We find a relatively larger pass-through of firm-specific productivity shocks into the wages of the high-paid workers employed by establishments intensive in minimum wage workers. We study the welfare implications of this fact using an incomplete-market model with heterogeneous firms and heterogeneous workers. The asymmetric pass-through uncovers a novel channel which tilts the welfare gains of removing minimum wages toward high-wage employees at the expense of low-paid workers.

JEL Codes: E24, E25, E64, J31, J38, J52.
Keywords: Firm-specific productivity shocks, pass-through, employer-employee data, skill complementarities, incomplete-market model.

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1 Introduction

Policy-makers are turning to minimum wage policies to cope with the aftermath of the Covid crisis. Although the effects of minimum wages have been extensively analyzed in the literature, these studies focus on how *changes* in the wage floors alter employment and wages.[1] However, little is known about how the *presence* of a minimum wage constraint alters the pass-through of firm-specific shocks into workers' wages. Since firm heterogeneity accounts for a sizable fraction of log-earnings variance (Abowd et al., 1999; Sorkin, 2018; Song et al., 2019), the interaction between minimum wages and the pass-through of firm-specific shocks could have a first-order effect on workers' earnings.

This paper argues that the pass-through of firm productivity shocks into wages – and thus the allocation of firm-idiosyncratic risk across workers – crucially depends on the presence of minimum wages. To establish this result, we focus on the case of Italy, an ideal laboratory for our study for four main reasons. First, we leverage employer-employee data from 1995 to 2015 matched to both firm balance sheets and novel hand-collected information on wages floors. These floors are set by collective contracts and act as *de-facto* minimum wages. With these sources of information, we can evaluate how firm-idiosyncratic shocks alter labor earnings over a total of 600,000 person-year observations. Second, since we observe the allocation of employees across firms' establishments, we estimate how firm productivity shocks imply a different pass-through *within* firms, depending on the establishments' incidence of minimum wages. Third, the wage floors vary across occupations. For instance, in 2015 a metalworker faced different occupation-specific wage floors ranging from €1,297.81 up to €2,333.17. This feature provides with substantial variation in the incidence of minimum wages across both workers and establishments. Fourth, the minimum wage is quantitatively relevant, as it accounts for 50% of the average wage and binds for roughly 12% of workers in our sample.

Our granular data are instrumental to identify the firm productivity shocks. In the baseline approach, we use firm balance sheet information and the control method of De Loecker and Warzynski (2012) to estimate the TFP shocks for each firm. Then, we plug-in the estimated shocks into a worker-level regression and evaluate how they affect workers' wages, as well as to what extent this pass-through depends on the establishment's share of minimum wage workers. In the spirit of Abowd et al. (1999), we saturate the regression with worker-establishment and time fixed effects to absorb any unobserved variation in labor earnings as well as in establishments' long-run efficiency levels.

Our main finding is that although negative firm productivity shocks reduce wages, this effect masks considerable heterogeneity. On the one hand, the wages of the workers that are close to the minima are unresponsive. While this lack of adjustment to negative shocks confirms that the floors act *de facto* as minima, wages close to the floors do not react even amidst

[1] See for instance Card and Krueger (1994), Neumark et al. (2004), Cengiz et al. (2019), Harasztosi and Lindner (2019), Clemens (2021), Manning (2021), Dustmann et al. (2022), and Engbom and Moser (2022).

positive shocks. However, this lack of wage adjustment among minimum wage workers is accompanied by changes at the extensive margin: productivity shocks alters job separations. On the other hand, TFP shocks do alter wages – with no effect on employment outcomes – of high-paid workers. Crucially, the magnitude of this channel increases with the share of minimum wage employees at the establishment level. Thus, the pass-through of productivity shocks into wages is concentrated among high-wage workers employed in minimum-wage-intensive establishments. We refer to the relatively sensitivity of the wage of high-paid workers in minimum-wage-intensive establishments to firm productivity shocks as the *asymmetric pass-through*.[2]

This asymmetric pass-through of productivity shocks carries through alternative specifications of firm-level labor-demand shocks. We ascertain the robustness of our results by replacing the TFP shocks with firm-specific labor-productivity shocks and export shocks. We derive the latter in a Bartik approach, by combining export data by province, sector, and destination country with firms' export status. All in all, our analysis confirms that minimum wages shape the asymmetric effects of firm-level shocks into labor earnings across workers.

To dig deeper into the asymmetric pass-through, we show that the relatively larger response of wages to TFP shocks for high-paid workers in minimum-wage-intensive establishments holds independently of some key worker and firm characteristics. More specifically, the asymmetric pass-through holds also above and beyond the role of workers' risk aversion and firms' markups, profit ratios, bankruptcy risk, uncertainty, and local labor-market employment shares. These results coupled with the fact that our evidence holds at the establishment level suggests that the asymmetric pass-through cannot be fully explained by worker-firm risk sharing (e.g., Ellul et al., 2018; Lamadon et al., 2022) and rent sharing (e.g., Card et al., 2014), or by firm monopsony power (e.g., Chan et al., 2021; Berger et al., 2022a).

We rationalize our empirical evidence through an incomplete-market economy with heterogeneous households and heterogeneous firms. The aim of the model is to provide a proof of concept that the asymmetric pass-through due to the wage floors generates heterogeneous welfare implications over the labor-earnings distribution.

We consider an economy which is populated by a continuum of households, who are ex-ante heterogeneous in their fixed labor skills, that we map into two occupations: blue collars and white collars. Households accumulate assets subject to a borrowing constraint. On the production side, a continuum of firms operate with decreasing returns to scale technologies. Firms are ex-ante heterogeneous in their fixed markups and face idiosyncratic productivity shocks. As in the data, firms hire workers subject to occupation-specific minimum wages. Importantly, firms' production function is characterized by complementarities in the labor

[2]Our definition of asymmetric pass-through is based on the differential effect of firm productivity shocks into wages across workers with different exposure to the bite of minimum wages. As such, our definition does not emphasize the differential wage sensitivity to positive and negative productivity shocks, as in Juhn et al. (2018) and Chan et al. (2021). Actually, we show that our asymmetric pass-through does not vary with the sign of the productivity shock.

supplied by workers with different skills, as in Krusell et al. (2000), Caselli and Coleman (2006), and Shao et al. (2021). This feature parsimoniously generates a pattern for labor demand such that firms hire workers with different skills (Iranzo et al., 2008).

In the model, the wage elasticity to firm productivity shocks crucially depends on the risk of rationing due to the wage floors: the workers whose marginal product of labor (MPL) is below the minima in the counterfactual full-employment economy (i.e., the economy without wage floors) could be laid off and become unemployed. In this setting, negative productivity shocks directly reduce workers' MPL, leading firms to shed some low-skill employees.

The asymmetric pass-through is then captured through an indirect technological channel, which hinges on the interplay between the rationing and the complementarities in firms' labor demand. Through this indirect channel, the wage floors amplify the wage sensitivity of high-skill workers, while muting that of low-skill employees. On the one hand, the increased rationing of low-skill workers triggered by negative productivity shocks exacerbates the drop in the MPL – and the wage – of high efficiency workers due to labor-demand complementarities *across* different skills. On the other hand, this rationing dampens the drop in the wage of those low-skill workers that are still employed, as their type has become relatively scarcer.

Consistently with the empirical evidence, the model predicts that high-skill workers experience a relatively larger wage pass-through of firm productivity shocks when employed by minimum-wage-intensive firms. Since these firms are more likely to lay off a substantial fraction of their low-skill labor force, the magnitude of the employment rationing leads to large variations in workers' MPL. Importantly, our technological channel can also rationalize the asymmetric pass-through amidst positive productivity shocks. In this case, the reduction in the rationing of low-skill workers further raises the wage of high-skill workers, while curtailing that of low-skill employees. Lastly, we corroborate the key role of the labor-demand complementarities: without them, the model counterfactually predicts that the wage sensitivity to productivity shocks barely depends on the firm-level incidence of minimum wages.

We discipline the quantitative analysis by calibrating the model to the main features of the Italian economy. First, the fixed heterogeneity in the total production-cost wedge matches the observed dispersion in markups across firms. We then set the process of firm-level productivity shocks such that the model is consistent with both the standard deviation and the autocorrelation of firm log-sales. Second, to discipline the variation in workers' skills, we proxy skills in the data with the workers' fixed effects estimated in a regression featuring firm-time fixed effects, in the spirit of Abowd et al. (1999). We discretize the workers' fixed effects over seven skill levels for blue collars and white collars. These levels are set such that the model matches the distribution of workers and wages across skill groups. Third, minimum wages differ across skills, depending on whether the worker is either a blue collar or a white collar. Finally, the model captures the relevance of the occupation-specific wage floors by matching the ratio between minimum and average wages for both blue collars and white collars.

Given the key role of labor-demand complementarities in our setting, we discipline this dimension by leveraging the equilibrium wage condition. The model implies that the mapping from skills to wages depends on the degree of skill substitutability. Specifically, the within-firm dispersion in the wage-to-skill ratio decreases with the elasticity of substitution across skills, so that in the limiting case of perfect substitutability, all workers within a firm feature the same wage-to-skill ratio. This condition implies that the elasticity of substitution across skills can be identified by the within-firm standard deviation of the wage-to-skill ratio. The model matches the within-firm dispersion of the wage-to-skill ratio computed in the data with an elasticity of substitution of 1.43, which is in line with the estimate of the aggregate long-run elasticity of Ciccone and Peri (2005). In addition, the insights of our calibration strategy allow us to provide empirical evidence directly supporting the key role of the labor-demand complementarities. In particular, we find that in the data the asymmetric pass-through of firm productivity shocks into the wages of high-paid workers holds only in those minimum-wage-intensive establishments with a sufficiently high dispersion of the wage-to-skill ratio.

Crucially, the model replicates not only qualitatively but also *quantitatively* the way in which the incidence of minimum wages at the worker and firm level shapes the pass-through of firm productivity shocks into labor earnings. For this reason, our economy is an ideal laboratory to study the welfare implications of removing minimum wages. We find substantial heterogeneity across the labor earnings distribution: the elimination of wage floors tilts the welfare gains toward high-skill white collars at the expense of low-skill blue collars. Blue collars are mostly worse off, with consumption equivalent welfare losses up to -0.3% for those low-skill workers employed in minimum-wage-intensive firms. Conversely, white collars benefit from the absence of wage floors, with welfare gains up to 0.3% for high-skill workers employed in firms intensive in minimum wage employees.[3] To put the magnitude of these numbers into context, the asymmetric pass-through due to the presence of minimum wages generates welfare implications that account for about one tenth of the welfare gains associated to the optimal minimum wage in the U.S., according to Berger et al. (2022a). Our analysis, thus, uncovers a novel channel through which removing minimum wages benefits relatively more high-paid workers at the cost of the employees at the low end of the wage distribution: the asymmetric pass-through of firm productivity shocks into earnings due to the presence of minimum wages.[4]

Our results offer a novel view on the insurance within the firm studied by Guiso et al. (2005), Lagakos and Ordoñez (2011), Ellul et al. (2018), Juhn et al. (2018), and Balke and Lamadon (2022), as we uncover a relatively lower amount of insurance provision toward high wage workers associated with firms with high shares of minimum wage employees. The minimum wage raises the insurance of the workers whose labor earnings are close to the wage

[3]We also leverage the distribution of workers' asset holdings to highlight that the welfare implications crucially depend on wealth. Specifically, the asymmetry in welfare gains is relatively larger for wealth-poor workers.

[4]Our approach computes welfare changes across workers without taking a stand on the aggregation required to derive a welfare-maximizing optimal wage floor. For a discussion of optimal minimum wages in a context in which the government values redistribution towards low-paid workers, see Allen (1987) and Lee and Saez (2012).

floors, at the cost of a greater volatility in the wages of high-paid workers. From this perspective, we provide direct evidence on the hypothesis of Friedrich et al. (2021), who argue that the lower pass-through of productivity shocks into low-skilled workers' wages could be due to minimum wage constraints.[5]

This paper closely relates to the literature that highlights the response of wages to firm-specific shocks (e.g., Kline et al., 2019; Chan et al., 2021; Howell and Brown, 2022). As in Chan et al. (2021), we use employer-employee data to study the heterogeneous effects of firm productivity shocks by controlling for differences in workers' labor quality. However, the focus – and main contribution – of our paper differs as we show that the pass-through crucially depends on the relevance of minimum wages at both the worker and establishment level.

We build on the work that studies the implications of minimum wages across the distribution of firms and workers (e.g., Dube et al., 2010; Sorkin, 2016; Cengiz et al., 2019; Berger et al., 2022b; Engbom and Moser, 2022). These studies derive the pass-through of changes in the minimum wage *per se* into earnings and profits. Instead, we take a complementary approach by considering the minimum wage as given and evaluating how its presence shapes the pass-through of firm-level productivity shocks into wages. In other words, rather than focusing on how changes in wage floors alter the wage *level*, we uncover how a given minimum wage affects the wage *cyclicality* with respect to firm-idiosyncratic risk.[6]

Minimum wage policies are often analyzed through the lens of frictional-market models (e.g., Flinn and Mullins, 2021; Engbom and Moser, 2022). In this paper, we consider a neoclassical model in which the asymmetric pass-through is due to a technological channel. The rationale of our choice is two-fold. First, we build a model with heterogeneity across both (multi-worker) firms and (risk-averse) households within an incomplete-market setting. These features are key to derive the welfare implications of the uneven pass-through across the wage distribution as well as across individuals employed by firms which differ in the share of minimum wage workers. Second, our approach is consistent with the fact that the asymmetric pass-through of firm-specific shocks into wages holds at the establishment level and does not vary with the firms' characteristics that could envisage a scope for worker-firm bargaining over risk sharing or rent sharing.

2 Empirical Evidence

2.1 Institutional Setting

To study the effect of the presence of minimum wages on the pass-through of firm productivity shocks into wages, we focus on the case of Italy. While there is no statutory minimum

[5]Our results contribute to the general wisdom that negotiated minima dampen the variation in wages at the cost of a larger variation in employment. We show that while this fact holds true for the workers whose wage is close to the minima, the contrary happens for high-paid employees: the minima do not influence their employment outcome, but generate additional volatility in their wages.

[6]A strand of the literature evaluates how minimum wages alter aggregate business cycles (e.g., Glover, 2019; Faia and Pezone, 2021).

wage in Italy, collective bargaining between major trade unions and employer federations set minimum floors which apply on average over a 2-3 year horizon to both unionized and non-unionized workers at the industry-wide level (Adamopoulou and Villanueva, 2022).[7,8] Collective contracts envisage nominal increases of the negotiated wage floors that typically take place every year.

Crucially for our analysis, there is close-to-full compliance with the wage floors: only less than 1% of wage observations are below the minimum in our sample of relatively large metal manufacturing firms. Our focus on the wage floors is further supported by the fact that collective bargaining at the firm level is rare, and during the period of our analysis could only envisage top-ups. In other words, the bargained wage floors act as *de facto* minimum wages.

An important feature of wage floors in Italy is that they vary across job titles ("livelli di inquadramento" in Italian) that are explicitly defined by the collective bargaining agreements. These titles are based not only on the specific content of each job task, but may depend also on the seniority and education of the worker (even after accounting for seniority bonuses). As such, the job titles can be thought of as occupations.[9] This structure is more granular than in the case of the U.S., in which the current federal minimum wage is $7.25 per hour and applies to all workers.

To put the variation of the minimum wage across occupations into context, in 2015 a metalworker was facing ten different wage floors: €1,297.81, €1,432.58, €1,588.63, €1,622.96, €1,657.28, €1,744.89, €1,902.42, €2,040.98, €2,278.56, and €2,333.17, respectively. In principle, the first seven floors applied to blue collars, white collars could be assigned to the first eight floors, while middle-managers faced the two highest floors. The existence of multiple wage floors by occupation gives us additional variability in the incidence of minimum wages across both workers and establishments.

2.2 Data

To carry out our analysis, we build a unique dataset at the worker-establishment-firm-year level by bringing together information from a firm-level survey, firm-level balance sheets, administrative employer-employee social security records, and hand-collected occupation-specific wage floors from collective contracts.

We start with a representative survey of Italian firms with at least 20 employees in the manufacturing sector, the "Indagine sugli investimenti delle imprese manifatturiere" (Inquiry into the investments of manufacturing firms; henceforth, INVIND). This survey covers around 4,000 firms, and contains detailed information on revenues, capital structure, as well as the usage of production factors. We complement this information with three additional data sources.

[7] Although there are no legal provisions for mandatory extensions, labor courts identify the "fair wage" level for workers using the wage floors defined by the corresponding sectoral collective contracts. Therefore, wage floors set in collective contracts act as minimum wages, with a close-to-universal coverage.

[8] Sectoral collective contracts are not a unique feature of Italy, as they also apply to most European countries, with the exception of the U.K.

[9] Yet, workers with the same occupation but different seniority or education may face distinct wage floors.

First, we get a complete picture of the sales and production inputs of each firm by complementing the INVIND information with the detailed balance sheets from the proprietary database CERVED. Second, we merge the firm-level data to a linked employer-employee database from the Italian National Social Security Institute (INPS). In this way, we observe the complete working histories for all workers employed by any establishment associated with each of the INVIND firms over the period 1995-2015.[10] Third, we add hand-collected data on negotiated minimum wages by occupation and year using the information on the collective contract covering each worker from the Social Security data. Unfortunately, we can perform this matching only for metalworkers. However, our sample of metalworkers allows us to study the pass-through of firm shocks into wages within an industry which in 2015 accounted for 46% of total manufacturing value added, and 41% of its overall employment. In addition, this industry is highly unionized, which guarantees the full enforceability of the collective contracts.

We compute daily wages by dividing gross annual earnings with the total number of days worked during the year.[11] Our wage measure includes the base wage and bonuses, without the possibility of distinguishing among each component. For this reason, we exclude from our analysis all managers, since these are the cases in which bonuses account for a sizable fraction of overall earnings.[12,13] Finally, we focus on metalworkers aged 20-64 with some labor-force attachment, by selecting those who have worked for at least 6 months in a year.

To ensure that our analysis on the role of the minimum wage is accurate, we use the information contained in the social security records to select workers covered by the main metalworking collective contract.[14] Specifically, we restrict the analysis to establishments with more than 90% of their workforce covered by the main metalworking collective contract. This restriction reduces our sample of firms by only 5%, and guarantees a sound minimum wage constraint at the establishment level. The final sample contains around 600,000 person-establishment-year observations over the period 1995-2015.[15]

2.3 The Incidence of Minimum Wages

We use the information on the wage floors to derive a measure of minimum wage incidence at both the worker and establishment level. To do so, we use the details of the collective contract information to assign each worker to its corresponding wage floor, following the procedure in Adamopoulou and Villanueva (2022). This allows us to pin down the distance of each worker's salary from its occupation-specific floor (also accounting for seniority bonuses).

[10]Our data allow us to track this sample of metalworkers also if they move to non-INVIND firms.

[11]We exclude outliers by winsorizing wages in the top-1% and bottom-1% of the wage distribution.

[12]We also provide further evidence on the fact that bonuses do not drive our results, by estimating the baseline regression on a restricted sample that either includes only blue collars or excludes the workers at the top of the wage distribution. In this way, we focus only on the workers for which bonuses are negligible.

[13]Table B.4 of the Online Appendix shows that the asymmetric pass-through holds also in the case we include managers in our final sample.

[14]There are three collective contracts in the Italian metalworking industry: the main one that applies to the workers of our sample, and two smaller ones that cover workers in SMEs and artisans.

[15]Table A.1 presents some descriptive statistics at the firm, establishment, and worker level.

Since we observe the entire workforce of each establishment in our sample, we can derive the relevance of wage floors also at the establishment level. We use these measures in the worker-level regressions to estimate how the pass-through of firm-specific shocks into wages depends on the minimum wage exposure of both workers and establishments.

We start by computing the worker minimum wage cushion as

$$\text{Worker MinW Cushion}_{i,o,e,f,t} = \frac{\text{Wage}_{i,o,e,f,t} - \underline{W}_{o,t}}{\underline{W}_{o,t}}, \tag{1}$$

which is the distance of the salary of worker i with occupation o employed in establishment e of firm f in year t, $\text{Wage}_{i,o,e,f,t}$, from its relevant occupation-specific wage floor, $\underline{W}_{o,t}$. A lower cushion implies a relatively higher incidence of minimum wages at the individual level.

The individual cushions are pivotal to derive the establishment minimum wage bite as

$$\text{Establishment MinW Bite}_{e,f,t} = \frac{\sum_{i \in \mathcal{N}_{e,f,t}} \mathbb{I}_{\{\text{Worker MinW Cushion}_{i,o,e,f,t} < 20\%\}}}{\sum_{i \in \mathcal{N}_{e,f,t}}} \tag{2}$$

which describes the incidence of workers close to the minimum wage in establishment e of firm f in year t. We denote the total number of employees in a given establishment by $\mathcal{N}_{e,f,t}$, and consider workers to be close the minimum wage if they feature a cushion up to 20%, that is, if the workers' wage is at most 20% above their relevant wage floor.[16] A higher bite implies that an establishment features relatively more workers whose salary is close to the minima.

2.4 Estimation of the Firm-Level Productivity Shocks

Our empirical analysis aims at uncovering the pass-through of exogenous variation in firm labor demand on workers' wages. Our baseline labor-demand shift is given by firm-specific TFP shocks, given the prominence of these innovations in both empirical and theoretical work. We also consider alternative specifications for the firm-level shocks. In this way, we ascertain that our findings do not hinge on a single source of variation but rather can be generalized to different labor-demand shifters. To do so, we perform robustness checks using either firm-specific labor-productivity shocks or firm-specific export shocks. We provide the details of the derivation of these two alternative shocks in Appendix B.1. The three shocks are computed at the firm level due to the lack of balance sheet information at the establishment level.

To construct the series of firm productivity shocks, we estimate a firm-level Solow residual by positing a Cobb Douglas revenue production function, and use the control function approach of De Loecker and Warzynski (2012) and Ackerberg et al. (2015).[17] We posit that the Hicks-neutral productivity shocks follow a first-order Markov process, and assume that intermediates are optimally chosen in response to observed productivity to back out this unobserved process. Since the construction of the TFP shocks series is based on inputs' growth rates, it also requires the use of lagged values for the instruments. As a result, the TFP shock cannot be computed for the first two years of the dataset, that is, 1995 and 1996. This ap-

[16] While the baseline cutoff is 20%, Appendix B shows that our findings are robust to changes in this threshold.

[17] Capital is set as pre-determined so that it does not correlate with contemporaneous productivity shocks.

proach leads to the estimation of a series of firm-specific TFP shocks spanning from 1997 until 2015. Importantly, while our model considers firms' production function with complementarities across workers of different skills, the estimation procedure abstracts from this feature and impose skill perfect substitutability. In this way, we do not plug into the estimated productivity shocks the implications that labor-demand complementarities *per se* have on wage elasticities.[18]

We then validate our series of firm-specific productivity shocks – together with the labor-productivity and export shocks – by showing in Table B.1 of Appendix B.2 that these shocks do alter the average wage per employee at the firm level. However, since the firm-level results capture not only the individual pass-through, but also potential within-firm heterogeneity as well as compositional effects, the next section leverages employer-employee data to identify the pass-through at the worker level.

2.5 Worker-level Analysis

This section shows that the pass-through of firm shocks into wages is concentrated in high-paid workers employed by minimum-wage-intensive establishments. To uncover this fact, we leverage the employer-employee data and characterize how the pass-through jointly depends on the incidence of minimum wages at both the worker and establishment levels. Our baseline worker-level regression is the following:

$$\begin{aligned} \Delta \log \text{Wage}_{i,o,e,f,t} &= \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \\ &\dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \mathbf{X'}_{e,f,t}\gamma + \alpha_{i,e} + \alpha_t + \epsilon_{i,o,e,f,t}, \end{aligned} \tag{3}$$

where $\Delta \log \text{Wage}_{i,o,e,f,t}$ is the log-change of the daily wage of worker i with occupation o employed by establishment e of firm f in year t. For the baseline series of firm productivity shocks, $\text{Shock}_{f,t}$, we consider either a dummy variable that equals 1 if firm f experiences a negative TFP shock in year t and 0 otherwise, or the series of firm TFP shocks in its continuous (both negative and positive) values. The term $\text{Establishment MinW Bite}_{e,f,t-1}$ denotes the lagged bite of minimum wages of establishment e associated with firm f.[19]

We also include time-varying firm and establishment covariates. At the firm level, the regression controls for size (measured as the logarithm of the number of employees and the logarithm of total assets), sales (measured as the logarithm of turnover), markups (estimated jointly with the process of firm TFP shocks as described in the previous section), and the profit-to-asset ratio. At the establishment level, we control for the local-labor-market employment share (proxied at the 2-digit-sector-region level), the share of blue collars and white collars, as well as the share of each occupation that is associated with a different wage floor.[20].

[18] Section 4.2.2 shows that the magnitude of the model-implied pass-through of firm productivity shocks into labor earnings is the same when using the actual productivity shocks or when backing the shocks out exactly as in the data, notwithstanding the presence of the firm labor-demand complementarities in our economy.

[19] Standard errors are derived with INVIND survey weights and a two-way clustering by workers and firms.

[20] These controls ensure that the pass-through of firm productivity into wages does not capture any difference in the hierarchical organizational structure across establishments, and thus avoid the concern that the shocks

Table 1: The worker-level wage pass-through of firm-specific TFP shocks.

Dependent variable:	Δ log Wage$_{i,o,e,f,t}$			
	Negative Shocks		Continuous Shocks	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.010	-0.001	0.016	0.004
	(0.006)	(0.003)	(0.018)	(0.015)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$	0.010	-0.033*	0.010	0.107*
	(0.014)	(0.017)	(0.042)	(0.054)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	19,039	517,746	19,039	517,746

Note: The table reports the estimates of worker-level regressions on annual data from 1997 to 2015. In all regressions, the dependent variable is the daily wage growth of worker i with occupation o employed in the establishment e associated with firm f in year t. The variable Shock$_{f,t}$ denotes either a dummy variable for all the negative realizations of firm TFP shocks in Columns (1) and (2), or the series of firm TFP shocks in its continuous values in Columns (3) and (4). Firm shocks are interacted with the lagged value of the establishment minimum wage bite, Establishment MinW Bite$_{e,f,t-1}$. We also control for the establishment bite in isolation. Columns (1) and (3) estimate the regression for workers whose minimum wage cushion is below 20%, and Columns (2) and (4) focus on workers whose cushion is above 20%. All regressions include year and worker-establishment fixed effects. Robust standard errors clustered at the firm and worker level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

Regression (3) includes workers' age dummies (specified over 5-year age groups), worker-establishment fixed effects, $\alpha_{i,e}$, and year fixed effects, α_t, which control for time-invariant unobserved heterogeneity as well as any common time variation across establishments. From this perspective, the variation in the incidence of minimum wages across establishments and our set of fixed effects allow us to identify how the pass-through of wages to firm shocks depends on the establishments' exposure to minimum wages which holds above and beyond differences in firms' long-run productivity levels.

Our coefficient of interest is β_3, which is associated with the interaction between the firm-specific shock and the establishment-level incidence of minimum wages. A larger coefficient in absolute value implies that the pass-through is relatively larger in those establishments with relatively more workers close to the wage floors. To evaluate also the relevance of the incidence of minimum wages at the individual level, we estimate regression (3) for two samples: one for the workers who are close to the minimum wage, defined as all workers whose minimum wage cushion, Worker MinW Cushion$_{i,e,f,t}$, is below 20%, and one for the workers who are way above the wage floors, defined as all workers with a cushion above 20%.

Table 1 presents the effect of a negative TFP shock on workers' wage growth, distinguishing between the workers close to the minima, in Column (1), and those far from it, in Column (2). The direct pass-through of firm shocks into wages is negative but not statistically significant, confirming that the floors act as *de facto* minimum wages for low-cushion workers.

could be intrinsically related to the division of labor or the relevance of minimum wages (Haanwinckel, 2020)

Table 2: The blue-collar worker-level wage pass-through of firm-specific TFP shocks.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$			
	Negative Shocks		Continuous Shocks	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.007	0.002	0.012	-0.014
	(0.007)	(0.003)	(0.023)	(0.009)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$	0.008	-0.044**	0.014	0.147***
	(0.017)	(0.020)	(0.051)	(0.049)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	12,454	320,678	12,454	320,678

Note: The table reports panel-regression estimates as in Table 1 focusing only on blue-collar workers.

The incidence of minimum wages at the establishment level plays a key role for high-cushion workers: the wage of high-paid workers drops relatively more amidst a negative TFP shock when they are employed by minimum-wage-intensive establishments. Instead, the wage response of workers close to the minima does not vary with the interaction of the TFP shock with the establishments' bite. These results establish the existence of an asymmetric pass-through of firm shocks: amidst firm negative productivity shocks, the wage adjustment is concentrated among those high-paid workers who are employed by high-bite establishments.

Importantly, the asymmetric pass-through holds not only for the negative realizations of the firm TFP shocks, but also for the series of TFP shocks in its continuous values. Columns (3) and (4) of Table 1 confirm the lack of wage adjustment for workers close to the floors and the relatively larger wage elasticity for high-cushion workers in high-bite firms, respectively, when considering jointly both the negative and the positive innovations to firm productivity. These results highlight that low-cushion workers are fully shielded from any variation in firm risk, since the lack of wage adjustment holds not only downwards, but also upwards.

Since we observe only daily wages, our asymmetric pass-through could be driven by the variation in total hours worked as well as in bonuses. To address this concern, we focus on a workforce which is more homogeneous across establishments and run the regression (3) on a sample of blue collars.[21] We report the results of this exercise in Table 2.

Focusing on blue-collar workers increases the size and precision of our estimates, without altering the qualitative patterns derived in Table 1. Once again, we find that the wage of those workers close to the floors does not react to the firm productivity shocks, as the pass-through is concentrated among high wage workers in minimum-wage-intensive establishments. This is true for both the case of negative TFP shocks, reported in Columns (1) and (2), as well as for the case of the continuous TFP innovations, in Columns (3) and (4). The

[21] This restriction does not slash the variation in wage floors, since they also change within blue collars, as described in Section 2.1.

asymmetric pass-through is not only highly statistically significant, but also highly economically relevant: a one standard-deviation increase in the establishment minimum wage bite reduces the wage growth of high-paid workers amidst firm negative productivity shocks by 0.3 percentage points, which accounts for 10% of the average wage growth in our sample.

2.6 Robustness Checks

We perform a comprehensive battery of robustness checks to corroborate how the incidence of wage floors at the worker and establishment levels shape the asymmetric pass-through of firm specific shocks into wages. Appendix B.3 validates our findings over seven key dimensions.

First, Tables B.2 and B.3 reveal that the economic and statistical significance of the pass-through in the wage of high-paid workers employed in minimum-wage-intensive establishments does not change in case we consider the two alternative specifications for the negative firm labor-demand shocks, that is, the labor-productivity shocks or the export shocks. This result holds for both the case of using a dummy variable which equals one for the negative realizations of either shock, or the series of the two shocks in their continuous values.

Second, Table B.5 reports that the magnitude of the asymmetric pass-through to negative productivity innovations does not change in case we consider either TFP shocks adjusted for variable utilization derived as in Basu et al. (2006), or a series of firm productivity shock in which we explicitly control for heterogeneity in workers' labor inputs across firms, by absorbing from firms' labor inputs the estimated worker fixed effects. This latter case – together with the lack of a correlation between firm productivity shocks and the establishment level minimum-wage bite – confirms that the shocks we recover are not biased towards certain skill groups. In addition, we estimate the wage pass-through of large negative TFP shocks as in Juhn et al. (2018), as well as the transitory and permanent innovations to firm productivity, which are identified as in Blundell et al. (2008).

Third, Table B.6 shows that the asymmetric pass-through to negative productivity shocks holds also in the case in which both the worker cushion and the establishment bite cutoff values are set to 25% or 30%, rather than 20% as in the baseline.

Fourth, Table B.7 shows that our results on the effects of firm negative TFP shocks are robust to substituting the year fixed effects with 2-digit sector-year fixed effects, province-year fixed effects, or 2-digit sector-province-year fixed effects.

Fifth, Table B.8 digs deeper on the role of workers' characteristics, and shows that the asymmetric pass-through of firm negative TFP shocks holds irrespectively of workers' age as well as if we exclude either the workers at the very top of the wage distribution, or workers with temporary contracts, or workers in short time work (furlough) schemes.

Sixth, we study to what extent the asymmetric pass-through of firm negative TFP shocks depends on firms' characteristics other than the incidence of minimum wages. Table B.9 shows that our main finding holds independently not only of firms' TFP levels – which confirms that saturating the worker-level regression with worker-establishment fixed effects uncovers the pass-through of productivity shocks above and beyond firms' long-run efficiency levels – but also of firms' age, markups, profit ratios, and local labor-market employment shares. This evidence coupled with the fact that the asymmetric pass-through of firm-specific productivity shocks into wages holds at the establishment level suggests that the asymmetric pass-through cannot be fully explained by either worker-firm rent sharing (Card et al., 2014), or firm monopsony power (e.g., Chan et al., 2021; Berger et al., 2022a).

Finally, we show that the asymmetric pass-through is not due to worker-firm risk sharing (e.g., Ellul et al., 2018; Lamadon et al., 2022). Table B.10 establishes this result, by reporting that the relatively higher elasticity of high-cushion workers in high-bite establishments holds above and beyond differences in workers' risk aversion, as well as firm heterogeneity in the volatility of TFP shocks, the degree of cash needs, and bankruptcy risk. We derive a measure of risk aversion in a similar spirit as Guiso et al. (2005), by leveraging a question in the SHIW in which respondents report their own risk-return trade-off. We then impute the risk aversion for the workers of our sample via a matching procedure on common observables in both datasets. The cash needs are derived through a question from the INVIND survey, in which firms report the fraction of trade credit claims which has been deferred over the agreed expiration date. Finally, we proxy firms' bankruptcy risk with the Altman (1968)'s Z-score.

2.7 The Job-separation and Labor-earnings Pass-through

How does the asymmetric pass-through of firm shocks into workers' wages affect employment outcomes? This section provides direct evidence on how the heterogeneous wage elasticities to firm shocks are mirrored by an asymmetric pass-through of firm shocks in job separations.

We run a similar analysis to regression (3) with the only difference that the dependent variable is now Job Separation$_{i,o,e,f,t}$, which is a dummy variable that equals one if blue collar i with occupation o employed in establishment e separates from firm f by the end of year t:

$$\begin{aligned}\text{Job Separation}_{i,o,e,f,t} &= \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \\ &\dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \mathbf{X'}_{e,f,t}\gamma + \alpha_{i,e} + \alpha_t + \epsilon_{i,o,e,f,t}.\end{aligned} \tag{4}$$

Columns (1) and (2) of Table 3 report the results of this exercise, showing that high-cushion workers do not experience any job separation amidst a negative firm TFP shock, even if they are employed by minimum-wage-intensive establishments. Instead, the job separations are concentrated among those low-cushion workers employed by high-bite establishments. Thus, although the wage adjustment associated to changes in firm labor demand is concentrated among high-paid workers in minimum-wage-intensive establishments, these companies modify relatively more their low-cushion workforce.[22]

Altogether, our evidence on the asymmetric pass-through of wages and employment outcomes contributes to the general wisdom that bargained minima dampen the variation in

[22] Our analysis uncovers how the presence of a given minimum wage alters employment outcomes following a firm-specific shock. For studies showing how changes in the minimum wage *per se* lead to limited employment losses, see Cengiz et al. (2019), Harasztosi and Lindner (2019), and Dustmann et al. (2022).

Table 3: The blue-collar job-separation and labor earnings pass-through of negative firm-specific TFP shocks.

Dependent variable:	Job Separation$_{i,o,e,f,t}$		$\Delta \log$ Labor Earnings$_{i,o,e,f,t}$	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.019**	0.001	0.034	0.006
	(0.009)	(0.002)	(0.039)	(0.009)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$	0.047**	0.013	-0.045	-0.121*
	(0.020)	(0.023)	(0.097)	(0.070)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	No
Observations	11,803	263,260	32,476	422,361

Note: The table reports panel-regression estimates as in Table 2 with the difference being that in Columns (1) and (2) the dependent variable is a dummy variable that equals one if blue-collar worker i with occupation o employed in the establishment e associated with firm f is laid off in year t, and in Columns (3) and (4) is the log-change in labor earnings of a blue-collar worker i employed with occupation o in the establishment e associated with firm f in year t.

wages at the cost of a larger employment variation. While this fact holds true for the low-cushion workers, the opposite applies to high-cushion workers: the minima do not influence their employment, but generate additional wage volatility. Then, the natural question is whether the variation in job separations outweighs the wage changes so that low-wage workers bear the bulk of the adjustment amidst firm shocks. We show that this is not the case by estimating a regression in which the dependent variable is the log change in workers' labor earnings:

$$\Delta \log \text{Earnings}_{i,o,e,f,t} = \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \qquad (5)$$
$$\dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \mathbf{X'}_{e,f,t}\gamma + \alpha_{i,e} + \alpha_t + \epsilon_{i,o,e,f,t}.$$

where $\Delta \log \text{Earnings}_{i,o,e,f,t}$ combines the change in wages with that in employment, such that $\log \text{Earnings}_{i,o,e,f,t} = 0$ if worker i is laid off at time t and has not found a new job.

Columns (3) and (4) of Table 3 report the results of this exercise, and highlight that notwithstanding the increased probability of losing a job for low-wage workers, the adjustment in labor earnings amidst firm TFP shocks is still concentrated among those high-paid workers employed by high-bite establishments.

2.8 Summary of the Stylized Facts

To sum up, our empirical analysis reveals that minimum wages shape the pass-through of firm-specific labor-demand shocks into wages. On the one hand, low-cushion workers experience no variation in wages, but face a relatively larger variation in the probability of losing their job. On the other hand, workers whose salary is way above the wage floors – but are employed by high-bite establishments – experience a relatively higher wage sensitivity, and no change in employment outcomes. The same pattern holds true also when looking at labor earnings, highlighting that high-paid workers are relatively more exposed to firm shocks. All in all, these results uncover the key role of the incidence of minimum wages at both the individual and establishment level in understanding the worker-level implications of firm shocks.

3 Model

This section proposes a model to rationalize the way in which the minimum wage shapes the asymmetric pass-through of the firm productivity shocks into wages. The ultimate aim is to provide a proof of concept that the asymmetric pass-through generates heterogeneous welfare implications across the labor-earnings distribution. To do so, we build a neoclassical model in which the asymmetric pass-through is due to a technological channel that hinges on the different degree of complementarity across workers with different skill levels. The rationale of our choice is three-fold. First, it allows us to build a model with heterogeneity across both (multi-worker) firms and (risk-averse) households within an incomplete-market setting. These features are key to derive the welfare implications of the differences in the pass-through across the wage distribution as well as across individuals employed in establishments with different shares of minimum wage workers. Second, our approach is consistent with the fact that the asymmetric pass-through of firm-specific shocks into wages holds at the establishment level and does not vary with firms' characteristics that could envisage a scope for worker-firm bargaining over rent sharing. Finally, we use the insights into the way in which labor-demand complementarities operate in our economy to provide empirical evidence backing the role of this key modeling feature in shaping the asymmetric pass-through.

Our economy is populated by a continuum of households, who are ex-ante heterogeneous in their fixed labor skills, that we map into occupations. Workers accumulate assets subject to a borrowing constraint. The production side consists of a continuum of firms operating with decreasing returns to scale technologies, as in Hopenhayn (1992). Firms are ex-ante heterogeneous in their fixed markups, which we capture through wedges in total production cost, and face persistent idiosyncratic productivity shocks. As in the data, firms hire workers subject to occupation-specific minimum wages. The effect of firm productivity shocks on workers' wages – combined with the borrowing constraint – makes households bear an uninsurable persistent idiosyncratic labor-earnings risk, in the spirit of Aiyagari (1994).

3.1 Firms

The production side of the economy consists of a continuum of firms of unit measure.[23] Firms are characterized by an idiosyncratic time-varying TFP level, z, and an idiosyncratic fixed markup, captured by τ. The former is a discrete random variable following an arbitrary stationary stochastic process with transition matrix $\Gamma_z(z, z')$. We denote the discrete set of possible values of z by $\mathbb{Z} = \{z_1, \ldots, z_{N_z}\}$. The variable τ, that denotes firm markup, is fixed for each firm and take N_τ levels within the set $\mathbb{T} = \{\tau_1, \ldots, \tau_{N_\tau}\}$. We capture firms' markups as

[23]We interpret each firm as the model counterpart of the establishments in our empirical analysis.

exogenous wedges that apply to firms' total production costs.[24] Firms produce the final good of the economy, Y, with the technology

$$Y = z(K^{\alpha}L^{1-\alpha})^{\eta}, \tag{6}$$

where K denotes capital, and L is labor. Finally, the span-of-control parameter η is assumed to be less than 1, such that the technology features decreasing returns to scale.

As in Krusell et al. (2000), Caselli and Coleman (2006), and Shao et al. (2021), firms' labor consists of an aggregator that allows for imperfect substitutability between workers of different skills. Formally, firms' effective labor aggregates the supply of different skills as follows

$$L = \left(\sum_{i=1}^{N_x} [x_i \mu(x_i)]^{\rho} \right)^{\frac{1}{\rho}}, \tag{7}$$

where $\mu(x)$ is the firm-specific measure of workers with skills x. These skills are fixed and heterogeneous across workers, and can take N_x levels within the set $\mathbb{X} = \{x_1, \ldots, x_{N_x}\}$. We then map skills into occupations $o(x)$. Specifically, we consider a set of occupations $\mathbb{O} = \{\text{bc}, \text{wc}\}$, such that workers can be either blue collars, bc, or white collars, wc. We then assign the first $N_{x,1}$ values of workers' skills to blue collars, and the next $N_{x,2}$ values to white collars, such that $N_{x,1} + N_{x,2} = N_x$. Thus, the skills for blue collars take value within the subset $\mathbb{X}_1 = \{x_1, \ldots, x_{N_{x,1}}\}$, and the skills for white collars take value within the subset $\mathbb{X}_2 = \{x_{N_{x,1}+1}, \ldots, x_{N_x}\}$. Hereafter, we refer to both workers' skills x and occupations o as individual state variables, even though the latter depends entirely on the former.

The parameter ρ of Equation (7) is the key factor determining the degree of complementarities in firm labor demand: workers of different skill levels are perfect substitutes if $\rho = 1$, and imperfect substitutable as long as $\rho < 1$. This labor aggregation follows the specifications in Ciccone and Peri (2005) and Caselli and Coleman (2006) for the aggregate production functions for economies with different skill groups of workers.[25] In this setting, workers are perfectly substitutable within each skill level, and imperfectly substitutable across skills.

We assume that there is anonymity in firms and workers conditional on z, τ, and x. Workers who are going to work in a (z, τ)-firm in a period are pooled together and drawn randomly into firms. This rules out firms' dynamic considerations when attracting workers, so that firms decide on the measure of workers from each skill independently of the past. In addition, upon the values of a (x, o, z, τ)-tuple, the worker is fully mobile between firms of productivity z

[24] The relevance of the heterogeneity in markups is twofold. First, it breaks the one-to-one mapping between firms' TFP and minimum wage bite. Without the variation in markups, the model would counterfactually imply that the minimum wage relevance at the firm level uniquely depends on its productivity. Instead, Section 2.6 has shown that the asymmetric pass-through holds independently of firms' productivity levels. Second, markups heterogeneity generates variation in wages that goes above and beyond that implied by the dispersion in firms' TFP. Without the variation in markups, the pass-through implied by the model could be biased upwards as it would derive the response of wages with respect to changes to their sole determinant, firms' productivity.

[25] Our labor aggregation captures the complementarities between skill groups within firms, rather than countries or sectors, in the spirit of Rosen (1978) and Kremer and Maskin (1996). This feature parsimoniously generates a pattern for labor demand such that firms hire workers with different skill levels, see Iranzo et al. (2008).

and markup τ. This implies that the wage for a given skill x in occupation o is the same for each (z, τ)-firm. We denote this wage by $w(x, o, z, \tau)$.[26]

Firms' profit-maximization problem is static: firms choose how much capital to rent, the measure of workers of each skill level, $\{\mu(x_i)\}_{i=1}^{N_x}$, and their output, as follows,

$$\pi(z, \tau) = \max_{K, \{\mu(x_i)\}_{i=1}^{N_x}, Y} \quad Y - (1-\tau)[(r+\delta)K - \sum_{i=1}^{N_x} w(x_i, o, z, \tau)\mu(x_i)] \tag{8}$$

$$\text{s.t.} \quad Y = z\left[K^{\alpha}\left\{\left(\sum_{i=1}^{N_x}(x_i\mu(x_i))^{\rho}\right)^{\frac{1}{\rho}}\right\}^{1-\alpha}\right]^{\eta}. \tag{9}$$

As in the data, firms face occupation-specific minimum wage constraints

$$w(x, o, z, \tau) \geq \underline{w}(o), \qquad \forall x, z, \tau, \tag{10}$$

which impose the same wage floor $\underline{w}(o)$ for workers with occupation o independently of their skills x, as well as the productivity, z, and markup τ, of the firm at which they are employed.[27]

3.2 Workers

The economy is populated by a continuum of households of unit measure. Households have standard CRRA preferences in consumption, so that life-time utility equals

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}, \tag{11}$$

where γ captures the degree of risk aversion, and β is the time discount factor.

Workers are endowed with a fixed skill level, x, whose properties are described above. The variation in skills make households ex-ante heterogeneous. In addition, workers face a source of idiosyncratic uncertainty: with probability $1-s$, workers are obliged to work in their employer of last period. In this case, their wage varies with the realizations of the productivity shocks of their employer, moving along the same TFP-ladder of their firm, which is governed by the transition matrix Γ_z. Instead, with probability s, workers receive the opportunity to decide on which firm-level productivity and markup to work for.[28]

Conditional on the own labor skill, x, and occupation, o, as well as firm characteristics, z and τ, workers face a probability $U(x, o, z, \tau)$ of not being hired due to the rationing implied by the presence of the minimum wage constraints. If households are not hired, they receive an exogenous unemployment income, b, that is assumed uniform within the economy. If they are hired, they receive the wage rate $w(x, o, z, \tau)$. Although the function $U(x, o, z, \tau)$

[26]This would also be the implication of a take-it-or-leave-it offer from the worker to the firm in each period.

[27]In this setting, the firm problem does not need to explicitly take into account the existence of the minimum wage constraints. Since firms take wages as given, the restriction imposed by the minimum wage emerges in equilibrium, but without appearing explicitly in any agent optimization problem.

[28]If we set idiosyncratic probability s to one, workers would change firms in every period and there would not be a well-defined notion of the pass-through of firm productivity shocks into wages. The quantitative analysis disciplines this modeling feature by matching the turnover of workers across firms.

is endogenous, workers take it as given. The unemployment spell of a worker, conditional on x, o, z, and τ, is independently drawn over time. The dependence of workers' wages on firm TFP and the possibility of being unemployed generates a source of idiosyncratic labor-earnings risk for the households.

Workers can accumulate a risk-free asset, a, but cannot have negative positions due to the presence of a borrowing constraint. In addition, workers hold infinitesimal shares of each firm in the economy. In each period, the profits are uniformly rebated back to all workers. We denote this flow of profit with Π. Consequently, we can define the value function $V(a, x, o)$ associated with a worker with asset holdings a, skill level x, and occupation o, starting a period with the opportunity to decide on which firm to work for, as:

$$V(a, x, o) = \max_{(z,\tau)\in\mathbb{Z}\times\mathbb{T}} V^m(a, x, o, z, \tau). \tag{12}$$

When maximizing the value function in Equation (12), workers consider the value associated with matching to each particular firm, $V^m(a, x, o, z, \tau)$. Specifically, when deciding to match to a particular firm with TFP level z and markup level τ, workers take into account that with a probability that depends on both the worker efficiency level and the firm productivity and markup levels, $U(x, o, z, \tau)$, they will end up unemployed (i.e., $u = 1$), and with the remaining probability, $1 - U(x, o, z, \tau)$, the match becomes active (i.e., $u = 0$). Thus, the function $V^m(a, x, o, z, \tau)$ averages the values associated with each employment status, weighted by the respective probabilities, as follows:

$$\begin{aligned} V^m(a, x, o, z, \tau) =& \left[1 - U(x, o, z, \tau)\right] \tilde{V}(a, x, o, z, \tau \mid u = 0) \\ &+ U(x, o, z, \tau)\tilde{V}(a, x, o, z, \tau \mid u = 1), \end{aligned} \tag{13}$$

where $\tilde{V}(a, x, o, z, \tau; u)$ denotes the value function conditional on the unemployment realization in the current period. The latter is characterized as follows:

$$\tilde{V}(a, x, o, z, \tau; u) = \max_{a'\geq 0} \frac{c^{1-\gamma}}{1-\gamma} + \beta E\Big\{sV(a', x, o) + (1 - s)E_{z'|z}\left[V^m(a', x, o, z', \tau)\right]\Big\} \tag{14}$$

$$\text{s.t. } c = (1 - u)w(x, o, z, \tau) + ub + a(1 + r) - a' + \Pi \tag{15}$$

$$a \geq 0. \tag{16}$$

Equation (14) takes into account that, in the next period, with probability $1 - s$ workers keep being attached to the current firm at which they are employed, and thus are associated with the continuation expected value $E_{z'|z}\left[V^m(a', x, o, z', \tau)\right]$, that depends on the transition of firm productivity shocks. With the remaining probability s, workers can reset their occupational choice, which yields the value of $V(a', x, o)$. Equation (15) is the budget constraint, and posits that workers finance their consumption expenditures with either their labor earnings, $w(x, o, z, \tau)$, in case they are hired by a firm, or their unemployment benefit b, and also receives the net proceeds from the risk-free assets, $a(1 + r) - a'$, as well as firms' profits, Π.

Finally, Equation (16) is the borrowing constraint on the holdings of the risk-free asset.[29]

The only reason for a positive unemployment rate in this model is the presence of the occupation-specific minimum wage constraints, which ration the employment of those workers whose marginal product of labor is below the wage floors $\underline{w}(o)$. The next section shows how the presence of the minimum wage alters the wage sensitivity to firm TFP shocks of high-cushion employees by affecting the rationing of low-cushion workers.

3.3 The Role of Complementarities in Firm Labor Demand

This section provides an analytical characterization of the way in which the labor rationing implied by the presence of the minimum wage interacts with the complementarities in firm labor demand to determine the wage elasticity to firm TFP. To do so, we combine the first order conditions of a firm with productivity z and markup τ with the labor market clearing condition, and obtain the wage which ensures that a firm is indifferent between hiring or not a worker of skill level x and occupation o, given the rest of the workers in the firm:

$$w(x,o,z,\tau) = (1-\alpha)\eta \left(\frac{\alpha\eta}{r+\delta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} \left(\frac{z}{1-\tau}\right)^{\frac{1}{1-\alpha\eta}} L^{\star}(z,\tau)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}-\rho} x^{\rho} \mu^{\star}(x,o,z,\tau)^{\rho-1}, \quad (17)$$

where $L^{\star}(z,\tau) = \left(\sum_{i=1}^{N_x} (x_i \mu^{\star}(x_i,o,z,\tau))^{\rho}\right)^{\frac{1}{\rho}}$ is the optimal effective labor aggregation for a type (z,τ) firm, $\mu^{\star}(x,o,z,\tau) = [1-U(x,o,z,\tau)] \sum_{a'} \lambda(a,x,o,z,\tau)/\Phi(z,\tau)$ represents the labor supply of efficiency x and occupation o optimally absorbed by a firm with productivity z and markup τ, and $\Phi(z,\tau)$ is the ergodic distribution of firm level productivity and markup.

To the extent that low-skill blue collars and white collars earn relatively lower wages, they are closer to their occupation-specific minimum wage.[30] Conjecturing this property, we denote the skill level within each occupation that yields the equilibrium wage in a firm with productivity z to equal the minimum wage – given firms' markups τ – as $\underline{x}(o,z|\tau)$. Below this level there is rationing, i.e. workers' MPL is below the occupation-specific wage floor. Importantly, since in our calibration the distance between the average wage and the minimum wage is larger for white collars than for blue collars, as in the data, changes in firm productivity generate a relatively larger rationing of low-skill workers within blue collars.

Suppose that a firm receives a negative TFP shock, so that its productivity level decreases from z to $z' < z$. In this case, the skill level threshold rises, that is, $\underline{x}(o,z'|\tau) > \underline{x}(o,z|\tau)$, which implies that there are relatively more low-skill workers within each occupation falling below the threshold. Consequently, the rationing increases, while at the same time those low skill workers who are still employed become relatively scarcer.

The complementarities across skills in firm labor demand modulate how the changes in rationing at the lower end of the skill distribution affect the wage elasticity with respect to firm TFP shocks for all the workers whose skill level is above their occupation-specific threshold,

[29]We refer to Appendix C for the definition of the stationary equilibrium of the model.

[30]This happens if the ergodic density function of x within occupations decreases in x, as in our calibration.

that is, $x > \underline{x}(o, z'|\tau)$. To see how the wages of a given skill x and occupation o change with the mass of workers in all the remaining skill levels, which we denote by $\hat{x}$, we take the following derivative of the wage function $w(x, o, z, \tau)$:

$$\frac{dw(x, o, z, \tau)}{d\mu(\hat{x}, o, z, \tau)} = \left[\frac{(1-\alpha)\eta}{1-\alpha\eta} - \rho\right] \Xi\left(x, o, z, \tau\right), \tag{18}$$

where $\Xi\left(x, o, z, \tau\right)$ is a non-negative convolution of variables and parameters,[31] The derivative in Equation (18) is positive if and only if

$$\rho < \frac{(1-\alpha)\eta}{1-\alpha\eta}. \tag{19}$$

This condition is not satisfied under full substitutability across skills, that is, when $\rho = 1$. In that case, the rationing at the lower end of the wage distribution raises the remuneration of high-paid employees.[32] Consequently, the additional rationing amidst negative productivity shocks mutes the wage sensitivity of high-skill workers. Instead, if the degree of imperfect substitutability across workers with different skill levels is sufficiently low, the derivative in Equation 18 becomes positive: the rationing of low-skill employees reduces the wages of high-skill workers. In other words, imperfect substitutability allows the rationing of low-skill employees upon negative TFP shocks to amplify the drop in the wages of high-paid employees.

4 Quantitative Analysis with the Model

This section shows that the quantitative implications of our model are in line with the asymmetric pass-through of firm productivity shocks into wages estimated in the data, and isolates the channels that account for it. We discipline this analysis by calibrating the model to the main features of the Italian metalworking sector, including s the dispersion and persistence of log-sales – as well as the dispersion of markups – across firms, the dispersion of wages across workers' skills, and the relevance of minimum wages by occupation, defined as the ratio between minimum and average wages at the occupation level. We use the model as a laboratory to study how the asymmetric wage pass-through maps into heterogeneous welfare effects of removing minimum wages along the labor earnings (and wealth) distribution.

4.1 Calibration

We calibrate the model to the Italian metalworking industry at the annual frequency. We start by first describing the parameter values that are defined following the standard in the literature, and then explain the calibration of the rest of the parameters which are set to match features of the data. Table 4 shows how the model compares to data with respect to the targeted moments.[33]

[31]Specifically, $\Xi\left(x, o, z, \tau\right) = (1-\alpha)\eta \left(\frac{z(\alpha\eta)^{\alpha\eta}}{(r+\delta)(1+\tau)}\right)^{\frac{1}{1-\alpha\eta}} L^{\star}(z, \tau)^{\frac{(1-\alpha)\eta}{1-\alpha\eta} - 2\rho} x^{\rho} \hat{x}^{\rho} \left[\frac{\mu^{\star}(x, o, z, \tau)}{\mu^{\star}(\hat{x}, o, z, \tau)}\right]^{\rho-1} > 0.$

[32]The rationing of low-skill workers raises the MPL of all remaining employees due to firms' decreasing-return-to-scale technologies.

[33]Table C.11 in Appendix C.3 reports the entire set of values assigned to the parameters of the model.

We calibrate the parameters governing the standard features of the model to values widely used in the literature. In particular, we set the risk aversion, γ, to 1.5, and the discount rate, β, to 0.94. The capital share in the production function, α, is set to equal 0.33, and we set the span-of-control, η, to 0.85. The capital depreciation rate, δ, equals 0.06.

Table 4: Targeted moments, data vs. model.

Moment	Data	Model
Within-firm standard deviation of wage-to-skill ratio	0.25	0.25
Autocorrelation of log-sales	0.99	0.97
Standard deviation of log-sales	1.80	1.77
Standard deviation of markups	0.124	0.124
Minimum wage / average wage – blue collars	0.66	0.71
Minimum wage / average wage – white collars	0.50	0.55
Replacement rate	40%	40%

Note: The table compares the model implications on the set of targeted moments with the data. The model statistics are computed using the stationary distributions of workers and firms. The within-firm standard deviation of the wage-to-skill ratio is computed in the model as standard deviation of the difference between log-wages and the logarithm of x^ρ across all workers in each firm, and then by averaging across firms. In the data, we compute this statistics as the difference between log-wages and the logarithm of workers' fixed effects estimated in a regression with firm-year fixed effects. Sales are computed in the model as output, Y, and in the data as revenues. Markups in the model correspond to the total production-cost wedge τ, while the empirical counterpart comes from the estimation of firm TFP shocks. The replacement rate in the data is taken from the OECD, and in the model it is the ratio of parameter b to the average wage.

We calibrate the workers' probability of having an option to choose a new firm productivity and markup, s, to match the fraction of metalworkers changing firms in Italy, estimated at 10%.[34] Then, we turn to the parametrization of workers' skill levels x. To do so, we leverage the employer-employee dimension of our data, and estimate workers' fixed effects within a regression featuring firm-time fixed effects, in the spirit of Abowd et al. (1999). We discretize the estimated workers' fixed effects over 7 groups for both blue collars and white collars, and map the value of each of these total 14 groups into 14 different levels for workers' skill x. We set the value of each skill such that the model matches the distribution of both workers and average wages across skill groups, after normalizing the average wage of the lowest skill level within the blue collar group to unity.[35]

Regarding the cross-section of firms, we calibrate the heterogeneity in markups and productivity. We start by setting the variation of the total production-cost wedges, τ, in the model to replicate that of markups in the data. For the empirical counterpart, we use the distribution of markups across firms that we estimate when recovering firm productivity shocks, as discussed in Section 2.4. This approach yields a standard deviation of the total production-cost wedges which equals $\sigma_\tau = 0.124$. With respect to the firm productivity process, we construct

[34] In the model, workers change firms only to work in a company with distinct TFP and markup levels. Accordingly, we target the fact that workers move to firms with different TFP and markup levels every period with a 10% probability.

[35] Figures C.1a and C.1b in Appendix C.3 illustrate how the model replicates exactly the distribution and the average wage across skill groups observed in the data.

the transition matrix for the discrete Markov chain governing the dynamics of firm TFP, Γ_z, to resemble an AR(1) process with persistence parameter π_z and standard deviation for the innovations σ_z. We do so following the Tauchen (1986) algorithm, which gives us two parameters for the calibration. We set these parameters targeting the autocorrelation and standard deviation of log-sales in our sample of metal manufacturing firms.

We consider two minimum wage constraints, one for blue collars and one for white collars. While in the data wage floors vary also within occupations, they do so through dimensions which are absent in the model, such as seniority and education. To calibrate these two minimum wage constraints, we replicate the ratio between the average wage and the (average) wage floor for both blue collars and white collars, $\underline{w}(\text{bc})$ and $\underline{w}(\text{wc})$, which equal 66% and 50%, respectively. To set the amount of unemployment benefits, OECD data show that for a worker earning 67% of the average wage in the economy, the income if unemployed in the next two quarters equals 60% of the current income. Since the unemployment income is uniform in our model, we replicate this statistic by calibrating the unemployment income parameter b to equal 40% of the average worker labor earnings.

The model does not only match this set of targeted moments, but is also consistent with an additional number of key dimensions on both the cross-section of firms and the distribution of wealth across workers. Table C.12 in Appendix C.3 shows how the model compares with the data over this set of untargeted moments.

4.1.1 The calibration of the labor-demand complementarities across skills

We turn to the calibration of the complementarities across skills in firm labor demand, which is the key dimension that regulates how the rationing due to the minimum wages at the lower end of the skill distribution alters the wages of high-skill workers. To discipline this feature, we leverage the specification of the equilibrium wage derived in Equation (17). This condition implies that wages do not depend only on skills, but also on the elasticity of substitution across skills. As long as skills are imperfect substitutes, the within-firm dispersion in the wage-to-skill ratio decreases with the elasticity of substitution across skills. In the limiting case in which $\rho = 1$, when skills are perfectly substitutes, Equation (17) collapses to

$$w(x, o, z, \tau) = (1-\alpha)\eta \left(\frac{\alpha\eta}{r+\delta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} \left(\frac{z}{1-\tau}\right)^{\frac{1}{1-\alpha\eta}} L^{\star}(z,\tau)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}-1} x.$$

In this case, the ratio of the wage to skills, $w(x, o, z, \tau)/x$, is constant across workers within the same firm, as it only depends on firm-specific parameters and characteristics, such as its productivity and markup levels. In other words, the standard deviation of the wage-to-skill ratio within firms is zero. This condition implies that the within-firm standard deviation of the wage-to-skill ratio identifies the elasticity of substitution across skills.

To measure empirically the within-firm dispersion of the wage-to-skill ratio, we leverage the employer-employee dimension of our data, and estimate workers' fixed effects in a regression saturated with firm-time fixed effects, in the spirit of Abowd et al. (1999). Then, we compute the average within-firm standard deviation of the difference between log-wages and the logarithm of the workers' fixed effects. In the model, we replicate the same approach using the standard deviation of the difference between log-wages and the logarithm of workers' fixed skill component, which equals x^ρ, as highlighted by Equation (17). This procedure identifies a substitutability parameter of $\rho = 0.3$. This value implies an elasticity of substitution between skills of 1.43, which is in line with the values estimated in the literature, such as the elasticity of 1.5 between aggregate skill groups documented by Ciccone and Peri (2005). Moreover, the economy with $\rho = 0.3$ also accounts for an additional moment that hinges on the degree of the labor-demand complementarities: the economy-wide standard deviation of the wage-to-skill ratio. Indeed, this moment equals 0.268 in the baseline model and 0.258 in the data.

Table 5: Identification of ρ, data vs. model.

Moment	Data	Model			
		$\rho = 0.1$	$\rho = 0.3$	$\rho = 0.6$	$\rho = 1$
Within-firm standard deviation of the wage-to-skill ratio	0.246	0.328	0.249	0.147	0.004
Standard deviation of the wage-to-skill ratio	0.258	0.401	0.268	0.156	0.057
Standard deviation of log-wages	0.340	0.336	0.258	0.255	0.248

Note: This table compares the implications of the baseline model with the degree of complementarity equal to $\rho = 0.3$ to three alternative specifications, which span the potential values of the elasticity of substitution across skills. For each alternative, we recalibrate only the levels of the occupation-specific minimum wage ($\underline{w}$(bc) and $\underline{w}$(bc)) and the levels of the $x-$grid to match both the ratio between the average wage and the minimum wage for each occupation, as well as the relative wages for each skill groups, as we do in the baseline calibration. We keep the rest of the parameters unaltered. We compute in the model the within-firm standard deviation of the wage-to-skill ratio by dividing wages with x^ρ in each firm, and then take the average across firms. This moment is calculated in the data by dividing wages with the estimated workers' fixed effects recovered from a worker-level regression which features firm-time fixed effects.

To further corroborate the identification of the degree of the labor-demand complementarities, we study how the average within-firm standard deviation of the wage-to-skill ratio varies with the value of the parameter ρ. In particular, we consider the baseline economy with $\rho = 0.3$, which implies an elasticity of substitution of 1.43, to three alternative specifications which span the entire range of the degree of complementarities: a first economy with $\rho = 0.1$, which implies an elasticity of substitution of 1.11; a second economy with $\rho = 0.6$, which implies an elasticity of substitution of 2.5; and a third economy with $\rho = 1$, which implies an infinite elasticity of substitution. Table 5 confirms that the within-firm standard deviation of the wage-to-skill ratio decreases with the elasticity of substitution, ranging from 0.328 for the economy with $\rho = 0.1$, down to virtually zero for the economy with $\rho = 1$.

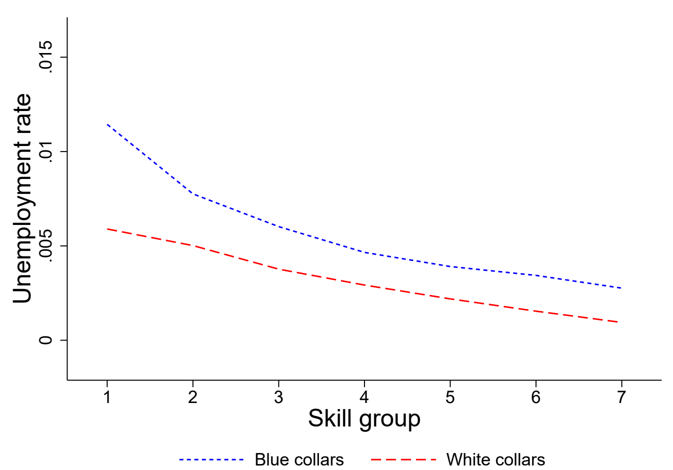
Table 5 evaluates the implications of the model vis-à-vis also a third moment that is directly influenced by the value of the degree of substitutability across skills: the economy-wide standard deviation of log-wages. While in this case the economy with the lowest elasticity of substitution (i.e., $\rho = 0.1$) gives a standard deviation of log-wages relatively closer to the data, this is because our model by construction abstracts from many of the determinants that can explain the observed dispersion in remuneration across workers. From this perspective, our model featuring only heterogeneity across firms in TFP and markups can already account for 58% of the variance of log-wages.[36]

4.2 Quantitative Results

4.2.1 Employment rationing due to the minimum wages

We start the inspection of the model predictions by showing how the minimum wages shape the rationing of low-skills workers. Since we calibrate the variation of skills x to guarantee that wages increase with skills within each occupation, the wage floors bind relatively more at low values of x, in line with the data. Thus, low-skill workers face a relatively higher unemployment rate as it is more likely that their MPL is below the minima. Figure 1 shows that, within each occupation, moving from the lowest to the highest skill level halves the probability of being unemployed. In addition, the rationing is relatively lower for white collars. Indeed, while the minimum wage of blue collars accounts for 66% of their average wage, this statistics is just 50% for white collars. This different incidence in the wage floors explains why the unemployment rate of blue collars is around one-third higher than that of white collars.

Figure 1: Unemployment rate across skills.



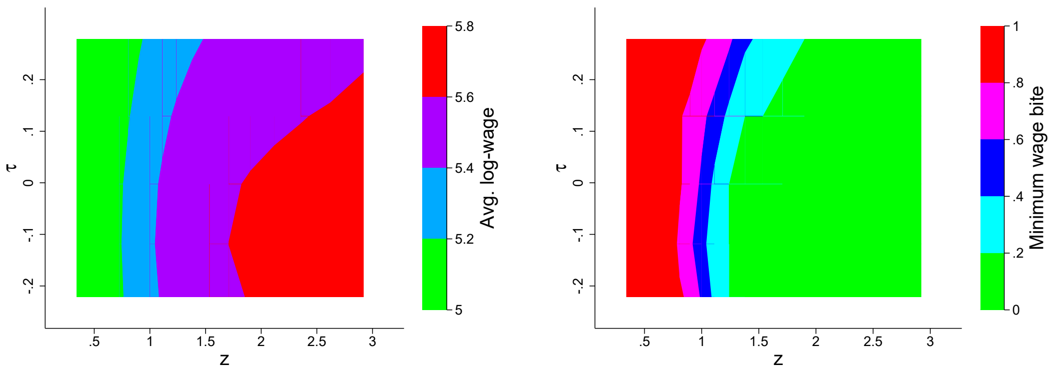
Note: The figure plots the unemployment rate across skill groups, x for blue collars (blue short dashed line) and white collars (red long dashed line).

To understand how the rationing varies across firm characteristics, we start by reporting in Panel (a) of Figure 2 the heat map of wages as a function of firm productivity z and markup, τ. The panel shows that wages are relatively higher in high-TFP and in low-markup companies (i.e., high-z and low-τ firms). This relationship then implies that firms' minimum wage bite depends negatively on productivity and positively on markups: Panel (b) shows that the relatively lower wages in firms with low TFP and high markups raise the incidence of the wage floors. Consequently, workers are more likely to be laid off by firms at the lower

[36]Matching the economy-wide standard deviation of log-wages would back out a stronger degree of labor-demand complementarities. For this reason, we opt for the conservative choice of $\rho = 0.3$.

Figure 2: The effect of firm productivity and markup on wages and the minimum wage bite.

(a) Wage | (b) Minimum Wage Bite



Note: The figures plot how firms' average log-wage (in Panel a) and firms' minimum wage bite (in Panel b) vary with productivity z and markup τ.

end of the productivity distribution and at the higher end of the markup distribution. Thus, negative TFP shocks amplify the rationing of low-skill workers, even more so in firms with low productivity and/or high markups.

4.2.2 The asymmetric pass-through of firm shocks into wages

What are the model implications regarding the way in which the incidence of minimum wages at the worker and firm level shapes the pass-through of firm productivity shocks into wages? To answer this question, we construct a measure of wage elasticity to firm TFP, as follows:

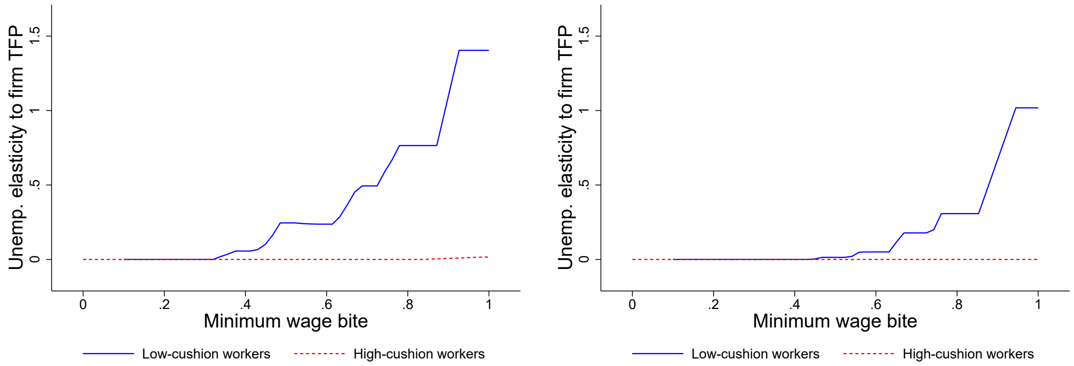
$$\frac{\log w(x, o, z_k, \tau) - \log w(x, o, z_{k-1}, \tau)}{\log z_k - \log z_{k-1}}. \tag{20}$$

Equation (20) computes the ratio between the change in log-wages associated with a change in firm log-productivity, by considering two consecutive values of firm TFP levels in our grid points, indexed by k and $k-1$, keeping constant workers' skills and occupations, as well as firms' markup levels. In the spirit of our empirical analysis, we compute the wage elasticity to TFP shocks in Equation (20) for two groups of workers: those whose minimum wage cushion is at most 20% (i.e., workers that are close to the minimum wage), and those whose cushion is above 20% (i.e., workers that are far from the minimum wage). We then compute these two measures for each value of firms' minimum wage bite, that is, the firm-level fraction of low-cushion workers.

How does the model generate the asymmetric pass-through? The answer lies in the way in which minimum wages modulate the rationing of low-skill workers in response to firm productivity shocks. In the model, the effect of firm-specific productivity shocks on wages crucially depends on the risk of rationing implied by the presence of wage floors: the workers whose MPL is below the minimum wage in the counterfactual full-employment economy (i.e., the economy with no wage floors) could be laid off and become unemployed. In this setting, negative productivity shocks directly reduce the MPL of all workers, leading firms to shed some low-skill employees. These dynamics can be observed in Figure 3, which report the job-loss elasticity of low-cushion and high-cushion workers in firms' response to productivity shocks as a function of the incidence of minimum wages at the firm level. Following a negative TFP shock, low-cushion workers are likely to get unemployed and the probability of lay-off is increasing with the firm level bite. This is in line with the empirical evidence of Table 3.

Figure 3: Unemployment elasticity to firm-level TFP shocks.

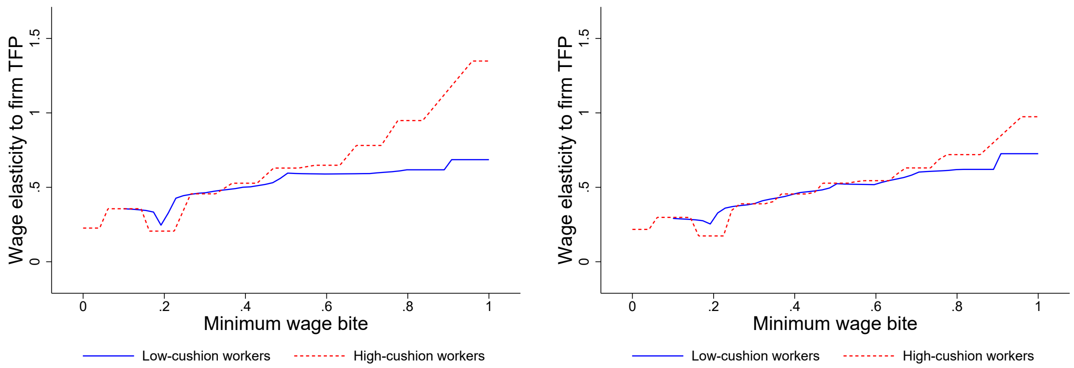
(a) Negative TFP shock (b) Positive TFP shock



Note: The figures plot how the worker-level unemployment elasticity to firm-level TFP shocks varies with the minimum wage bite of the firm in which the worker is employed at. The wage elasticity is computed as described in Equation (20). Panel (a) focuses on the unemployment elasticity to negative TFP shocks, and Panel (b) focuses on the unemployment elasticity to positive TFP shocks. The blue solid lines are for the low-cushion workers (i.e., the workers whose wage is within 20% above the minimum wage) and the red dashed lines are for high-cushion workers (i.e., the workers whose wage is at least 20% above the minimum wage).

Figure 4: Wage elasticity to firm-level TFP shocks.

(a) Negative TFP shock (b) Positive TFP shock



Note: The figures plot a worker-level elasticity to firm productivity shocks, as in Figure 3, with the difference that in this case we report the change in wages rather than in unemployment.

Figure 4 shows how the wage elasticities vary with firms' minimum wage bite by distinguishing between low-cushion and high-cushion workers. Panel (a) reports the wage elasticities with respect to negative TFP shocks, while Panel (b) focuses on positive TFP shocks. The figure shows that the model is consistent with our empirical evidence over three dimensions. First, the wages of low-cushion workers tend to be less responsive to the realizations of negative productivity shocks, irrespectively of firms' minimum wage bite. Second, firms' bite crucially determines the wage elasticity of high-cushion workers amidst negative productivity shocks. In this case, the pass-through becomes substantial at sufficiently high levels of the bite, that is, in those firms which are highly intensive in minimum wage workers. Third, while the wage of low-cushion workers reacts amidst positive productivity shocks, the magnitude of this change is still below that of high-cushion workers, especially so in high-bite firms.

Table 6: The blue-collar labor earnings pass-through of negative (mis-specified) TFP shocks.

Dependent variable:	Δ log Labor Earnings$_{i,o,e,f,t}$			
	Data		Model	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.034	0.006	-0.050	-0.038
	(0.039)	(0.009)		
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$	-0.045	-0.121*	-0.086	-0.148
	(0.097)	(0.070)		
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	No

Note: The table compares the blue-collar labor-earnings elasticities to negative firm TFP shocks estimated in the data, as in Columns (3) and (4) of Table 3, with those recovered through the lens of the model by assuming that the elasticity of substitution across skills is infinite.

The asymmetric pass-through of firm shocks due to wage floors is then captured through an indirect channel, which hinges on the interplay between the rationing and the complementarities in firms' labor demand. This indirect effect provides a technological channel through which the presence of minimum wages amplifies the wage sensitivity of high-skill workers, while muting that of low-skill employees. On the one hand, the rationing of low-skill workers implied by negative productivity shocks exacerbates the drop in the MPL – and thus the wage – of high efficiency workers due to labor-demand complementarities *across* different skills. On the other hand, this rationing dampens the drop in the wage of those low-skill workers that are still employed, as their type has become relatively scarcer.

While the model can qualitatively replicate the empirical patterns on the effects of firm productivity shocks on workers' wages and probability to become unemployed as a function of the incidence of minimum wages at both the worker and firm level, Figures 3 and 4 do not clearly demonstrate how the model performs quantitatively vis-à-vis the data in terms of the *magnitude* of the asymmetric pass-through. Since we want to use the model as a laboratory to study how the welfare effects of this differential pass-through vary over the labor-earnings distribution, we need to ensure that the model is quantitatively consistent with the response of labor earnings to firm productivity shocks. To do so, we take the model simulated data and closely follow the empirical approach of regression (5), by estimating how the effects of negative productivity shocks into labor earnings vary across low-cushion and high-cushion workers, as a function of firms' minimum wage bites.[37,38]

Table 6 shows that the model is successfully consistent with the pass-through of negative productivity shocks into labor earnings as estimated in the data. On the one hand, the model predicts a relatively stronger pass-through of TFP shocks into the earnings of low-cushion workers in minimum-wage-intensive firms. However, this can be explained by the fact that the model does not feature any firing cost, and thus it naturally overestimates the earnings drop amidst negative TFP innovations. On the other hand, the earnings response of high-cushion workers crucially depends on firms' minimum wage bite, so that the higher the incidence of minimum wage workers at the firm level, the larger the drop in labor earnings for high-cushion employees. What is key in these results is the magnitude of the interaction term between the productivity shock and firms' minimum wage bite associated to high-cushion workers: the model implied value of -0.148 is close to our data estimate of -0.121. From this perspective, the model accounts not only qualitatively but also quantitatively for the way in which the asymmetric pass-through of firm productivity shocks into wages and job losses depends on the incidence of the wage floors.

4.2.3 The role of complementarities

What is the role of complementarities in firm labor demand in shaping the asymmetric pass-through of the firm productivity shocks? This section isolates the role of this key modeling feature by focusing on the wage elasticity of high-cushion workers. To do so, we replicate the analysis of Figure 4 and compare how the wage elasticity to firm negative TFP shocks varies with firms' minimum wage bite both in the baseline model and in an alternative calibration in which skills are perfectly substitutable, that is, an economy with $\rho = 1$.[39]

The results of this exercise in Figure 5 show that while in the baseline economy the wage elasticity of high-cushion workers to firm productivity shocks increases with firms' minimum wage bite, in the alternative economy which abstracts from the labor-demand complementarities, the wage elasticity of high-cushion workers barely changes with the firm-level incidence of the wage floors.[40] In other words, the labor-demand complementarities across skills are the essential feature that allows the model to be consistent with our empirical evidence.

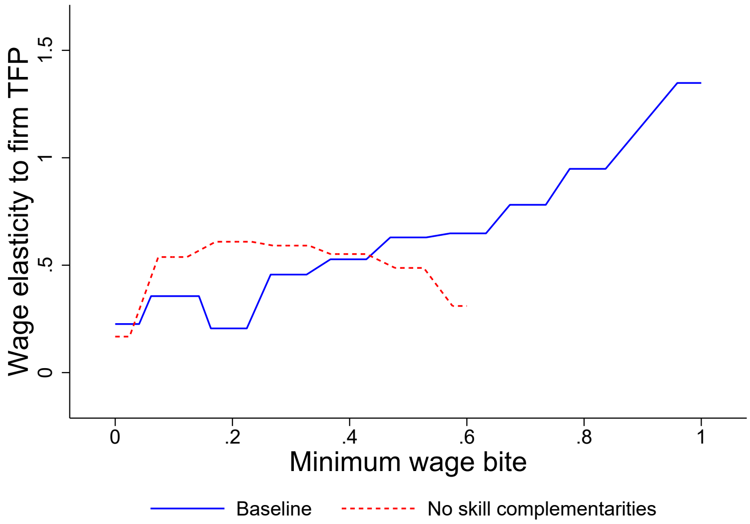
[37] The regressions on model simulated data do not include year fixed effects because the model is stationary and does not feature any aggregate uncertainty.

[38] We run this exercise as in our empirical analysis: although our model economy features production functions with complementarities in labor demand, we back out a series of productivity shocks by assuming that the elasticity of substitution across skills is infinite. In the model, the actual TFP shocks and those derived under the assumption of full substitutability across workers' skills are perfectly correlated. Consequently, there is no bias in estimating the wage elasticity with the mis-specified series of firm productivity shocks.

[39] We calibrate the alternative economy so that (i) the minimum wages lead to the same unemployment across occupations, (ii) the unemployment benefit maintains the ratio of unemployment income to the average wage; and (iii) the dispersion of skills across workers maintains the dispersion of log-wages.

[40] These dynamics can also be observed in Figure C.2 in Appendix C.4, which reports the distribution of the wage elasticity to firm TFP shocks for both blue collar and white collar high-cushion workers. The density curves show that the economy with no complementarities in firm labor demand generates pass-through levels which are substantially lower than in the baseline model.

Figure 5: Wage elasticity to firm TFP shocks, the minimum wage, and the complementarities.



Note: The figures plot the wage elasticity to firm-level negative TFP shocks as in Figure 4. In this case, we focus only on high-cushion workers (i.e., the workers whose wage is 20% above the minimum wage). The blue solid line denotes the wage elasticity implied by the baseline model, and the dashed red line is the wage elasticity of the alternative economy with full substitutability across workers' skills.

We then leverage the insights derived in our calibration strategy on the identification of the labor-demand complementarities to provide direct evidence on the role of this key modeling feature in the asymmetric pass-through of firm productivity shocks into the wages of high-cushion workers. Since the elasticity of substitution across skills maps directly into the dispersion of the wage-to-skill ratio, we use the variation in this measure across establishments in the data to verify that the pass-through increases with the degree of the complementarities. Specifically, we compute the standard deviation of the wage-to-skill ratio for each establishment, and estimate regression (3) for high-cushion blue collars by splitting the sample in the workers employed by establishments with either below-average or above-average dispersion in the ratio. In this way, we can test directly whether the magnitude of the asymmetric pass-through increases with the degree of the labor-demand complementarities.

We report the estimates of this exercise in Table 7. The results show that the pass-through of firm productivity shocks into the wages of high-cushion workers is relatively larger in those high-bite establishments featuring a high standard deviation of the wage-to-skill ratio. Specifically, the size of the pass-through in those high-bite establishments with large standard deviations of the wage-to-skill ratio is five times as large as the wage elasticity in the establishments with a relatively lower dispersion in workers' remuneration for the case of the negative productivity shocks, and twice as large for the case of the continuous productivity shocks. Consequently, the data support the model predictions on the fact that the asymmetric pass-through holds only as long as there is a sufficiently low elasticity of substitution across workers' skills (i.e., a sufficiently high degree of the labor-demand complementarity).

Table 7: Labor-demand complementarities and the wage elasticities of high-cushion workers.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$			
	Within-Establishment Standard Deviation of the Wage-to-Skill Ratio			
	Low	High	Low	High
	Negative Shocks		Continuous Shocks	
Worker MinW Cushion$_{i,o,e,f,t} > 20\%$	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.001	0.006	-0.022	-0.010
	(0.004)	(0.004)	(0.014)	(0.013)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$	-0.018	-0.103**	0.122***	0.238**
	(0.022)	(0.046)	(0.055)	(0.112)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	172,321	136,859	172,321	136,859

Note: The table reports panel-regression estimates as in Table 2 focusing on a sample of only high-cushion workers, that is, those workers whose minimum wage cushion is above 20%. Columns (1) and (3) focus on a sample of establishments with below-average within-establishment standard deviation of the wage-to-skill ratio, and Columns (2) and (4) focus on the establishments with above-average within-establishment standard deviation of the wage-to-skill ratio. The wage-to-skill ratio is derived by dividing raw wages with the workers' fixed effects estimated in a regression featuring firm-year fixed effects, in the spirit of Abowd et al. (1999).

4.3 Welfare Implications

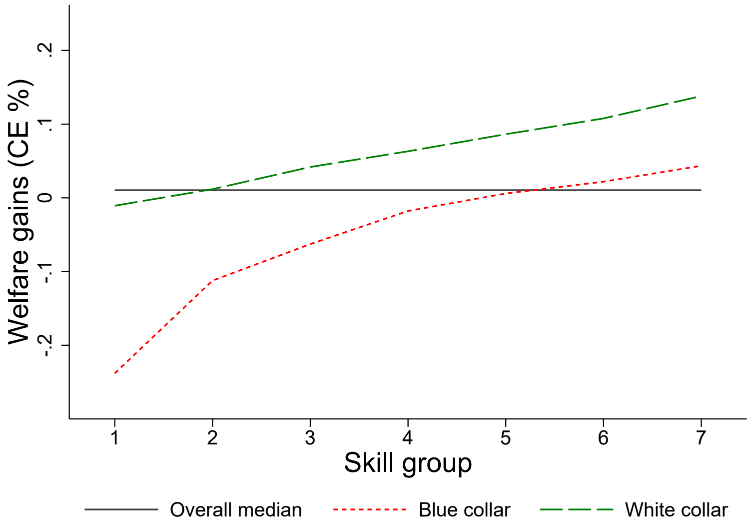
Since our model has implications for the way in which the wage floors shape the asymmetric wage elasticity of firm-level TFP shocks across workers, we leverage it as an ideal laboratory for quantifying the welfare gains and losses due to the presence of the minimum wage. Importantly, our analysis does not aim at deriving an optimal level for the minimum wage, as we take no stand on how to aggregate the different welfare changes across households. Rather, we report how welfare changes over the wage distribution if we remove the minimum wage constraint.[41] This section provides a proof of concept that the asymmetric pass-through due to the wage floors generates heterogeneous welfare implications over the labor-earnings (and wealth) distribution.

To highlight how the asymmetric pass-through of firm-level TFP shocks into wages alters households' welfare, we compute for each individual worker the gains or losses they experience by moving from the baseline economy to one without the minimum wage.[42] We refer to the latter version of the model, the one that abstracts from the wage floors, as the "Counterfactual" economy. Then, we compare how the welfare changes are distributed among the entire population of workers, as well as on the sample of either only blue collars or white collars. We report the results of this exercise in Figure 6.

[41] For a discussion on the optimality of minimum wages in a context in which the government values redistribution toward low wage workers, see Allen (1987) and Lee and Saez (2012).

[42] Specifically, we compute the consumption equivalence term, e.g. the constant rate of change imposed on workers' lifetime consumption to bring them to the value they would achieve without minimum wages.

Figure 6: Welfare gains/losses from removing the minimum wage.



Note: The figures report the welfare gains and losses from removing the minimum wage constraint for each point of the wage distribution. The gains/losses are computed in consumption equivalence terms. We use the distribution of the baseline economy to weigh these states. The continuous line reports the overall median welfare gain, whereas the short-dashed line and the long-dashed line report the welfare gains for the median blue collar and the median white collar, respectively.

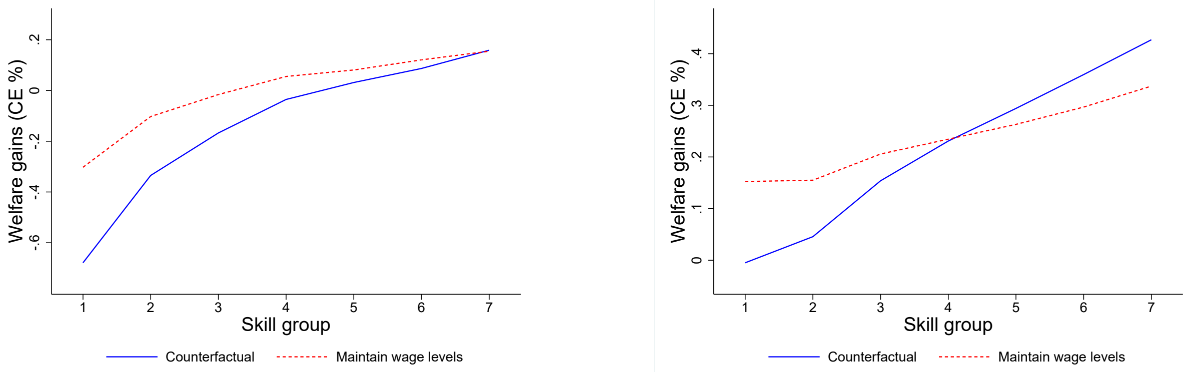
The figure shows that the median welfare change caused by removing the minimum wage is close to zero. However, the lack of welfare changes at the median level masks substantial heterogeneity. For both blue collars and white collars, we find welfare losses at the lower end of the skill distribution, and welfare gains at the higher end. The welfare changes of blue collars are tilted towards negative values: low-skill blue collars losing as much as -0.2% in lifetime consumption equivalence terms from the removal of minimum wages, while high-skill collars experience small gains. On the other hand, white collars are mostly better off: low-skill white collars experience a negligible loss from the absence of wage floors, whereas high-skill blue collars gain up to 0.15% in lifetime consumption equivalence terms.

These patterns become even more pronounced when looking at the welfare implications of the workers associated with high-bite firms. Indeed, our empirical evidence shows that the wage elasticity of high-paid workers is substantially large when they are employed in establishments with a large fraction of minimum-wage workers. Thus, focusing on the blue collars and white collars employed in high-bite firms allows us to uncover the full extent of the welfare effects of the asymmetric pass-through due to the wage floors.

Panel (a) of Figure 7 shows the welfare implications of removing the minimum wages for blue collars, as a function of their skill group. Panel (b) shows the analogous pattern for white collars. We find that low-skill blue collars lose substantially from the removal of the wage floors, as their welfare losses amount up to -0.7% in lifetime consumption equivalence terms. These substantially larger welfare losses for low-skill blue collars are mirrored by the sizable

Figure 7: Welfare gains/losses from removing the minimum wage: The role of high-bite firms.

(a) Blue collars (b) White collars



Note: The figures report the welfare gains and losses from removing minimum wages as in Figure 6, isolating the role of workers' wealth. Low and high wealth refer to the gains for workers in top and bottom wealth decile of their skill group-occupation, respectively.

welfare benefits of high-skill white collars, who can gain up to 0.4%. These asymmetric effects of removing the minimum wage are related to the way in which the wage floors alter the pass-through of firm TFP shocks into workers' wages: while low-skill blue-collar workers benefit from a muted volatility in their wages, high-skill white-collar workers bear the burden of the amplification in their wage sensitivities.

A potential threat to our approach is the fact that the comparison of the "Counterfactual" economy with no wage floor to our baseline model yields welfare implications that do not only capture the effect of the minimum wages on the firm productivity pass-through – and thus the *volatility* of wages – across workers, but also the direct effect of minimum wages on the *level* of earnings. To address this concern, we consider a third economy with no wage floors as in the "Counterfactual" case, but with the crucial difference that we recalibrate workers' skill levels x such that workers in each skill group earn the same wage as under the baseline model. We refer to this case as the "Maintain wage levels" economy. In this way, comparing this third economy to the baseline model allows us to derive welfare implications that isolate the role of the volatility effect stemming from the interaction between the pass-through of firm TFP into wages and the presence of minimum wages.

The dashed lines in Figure 7 then report the welfare implications of removing the wage floors in the "Maintain wage levels" economy. We find that the volatility effect of the asymmetric pass-through accounts for half of the overall welfare changes on both ends of the skill distribution. On the one hand, the welfare loss of -0.35% for low-skill blue collars solely stems from the fact that they bear a higher volatility of wages. On the other hand, high-skill white collars gain up to -0.3%, since their wage elasticity shrinks absent the wage floors. Thus, although the asymmetric pass-through into wages alters the volatility of workers' wages, its welfare implications are of a first-order relevance.

To put the magnitude of the welfare changes into context, we compare the model implications with the welfare changes associated to the optimal minimum wage. Berger et al. (2022a) find that the utilitarian social welfare change from varying in the U.S. the level of the minimum wage from zero up to \$15.12 per hour equals 3.04% in lifetime consumption equivalence terms. From this perspective, the asymmetric pass-through due to minimum wages generates welfare losses for low-skill blue-collars – and welfare gains for high-skill white collars – in high-bite firms equal (in absolute terms) 10% of the welfare change implied by the optimal level of the minimum wage.

Finally, Appendix C.5 corroborates further the welfare implications of the asymmetric pass-through by leveraging the distribution of asset holdings across households. Specifically, Figure C.3 shows that the welfare implications crucially vary with households' wealth, such that low-skill workers are substantially worse off – and, equivalently, high-skill workers are relatively better off – if they hold low asset positions. This is because the variation in the wage pass-through of firm productivity shocks generated by the presence of minimum wages maps relatively more into consumption if workers' wealth is low. In other words, when workers have low assets and cannot insure well their consumption stream, the welfare implications of the asymmetric pass-through are relatively larger.

All in all, the asymmetric pass-through of firm TFP shocks into wages generates a novel channel that tilts the benefits from removing the minimum wage toward high-paid – albeit wealth-poor – workers at the expense of wealth-poor low-paid employees. Although the losses from removing the minimum wage among the latter group of workers is relatively larger, the welfare gains at the higher end of the wage distribution are also not negligible.

5 Conclusions

This paper documents that minimum wages shape the allocation of firm-idiosyncratic risk across workers: the pass-through of firm-level labor-demand shocks is entirely concentrated in the earnings of high wage individuals employed by establishments intensive in minimum wage workers. Instead, we find a lack of wage adjustment for the workers whose salary is close to the minima. Importantly, this lack of adjustment does not characterize only the response to negative shocks, but also that to positive productivity shocks. Overall, our evidence provides a novel dimension of the mechanism through which minimum wages shift the cyclicality of wages with respect to firm shocks away from low-paid workers and toward the employees at the high end of the earnings distribution.

We build an incomplete-market economy with heterogeneous households and firms to provide a proof-of-concept that the asymmetric pass-through due to the wage floors generates heterogeneous welfare implications across workers. We account for the way in which minimum wages modulate the pass-through of firm productivity shocks into wages through firms' labor-demand complementarities across skills. The model shows that the asymmetric pass-through tilts the benefits of removing minimum wages toward high-paid workers at the expense of low-paid workers. The heterogeneity in the welfare effects is substantially amplified when comparing wealth-poor individuals. These results highlight a novel channel through which minimum wages asymmetrically affect welfare over the wage distribution by altering the cyclicality of wages with respect to firm-idiosyncratic risk.

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Online Appendix to: “Minimum Wages and the Insurance within the Firm”

A Descriptive Statistics

Table A.1 reports some descriptive statistics of our data sample, by showing the mean and the standard deviation of a selected set of variables, computed at the firm, establishment, and worker level. Panel A reports firm-level information on the average monthly wage, the firm size in terms of employees, log total assets, log turnover, markups, the profit-to-asset ratio, the employment share in the local labor market defined as the combination of 2-digit sectors and regions, age, and the estimated firm idiosyncratic TFP level as well as the series of TFP shocks. Panel B shows the establishment-level information on the minimum wage bite and the share of blue-collar workers. Finally, Panel C reports worker-level information on daily wages, the minimum wage cushion, the age, the probability of losing a job, as well as the share of blue-collar, permanent, and furlough workers.

Table A.1: Summary statistics.

Variable	Mean	Standard Deviation
Panel A: Firm-level Variables		
Average Monthly Wage (in Euros)	2,277.8	601.6
Employment	156.5	530.0
Log Total Assets	7.88	1.47
Log Turnover	10.11	1.35
TFP Level	1.21	1.75
TFP Shock	1.07	20.42
Markups	1.19	0.73
Profits to Assets Ratio	0.44	7.55
Age	32.46	16.39
Panel B: Establishment-level Variables		
Minimum Wage Bite	0.12	0.15
Employment Share in Local Labor Market	0.64	0.40
Share of Blue Collars	0.61	0.20
Share of White Collars	0.34	0.19
Panel C: Worker-level Variables		
Average Daily Wage (in Euros)	93.00	34.93
Minimum Wage Cushion	0.50	0.26
Probability of Losing a Job	0.03	0.17
Share of Blue-collar Workers	0.63	0.48
Share of Permanent Workers	0.98	0.12
Share of Part-time Workers	0.04	0.19
Share of Workers in Furlough	0.18	0.38
Age	41.18	9.10

B More on the Empirical Results

B.1 The Alternative Firm-Specific Labor-Demand Shocks

In our empirical analysis, we study how wages react to firm productivity shocks. However, we evaluate the robustness of our findings to two alternative measures that capture exogenous shifts in firm labor demand. In particular, we consider firm-specific labor productivity shocks and firm-specific export shocks.

The firm-specific labor-productivity shock trades off a weaker exogeneity with a much more flexible specification. To back out this series, we compute the difference between the log-change of firms' sales with the log change of firms' total number of employees,

$$\Delta \text{Labor Productivity}_{f,t} = \Delta[\log(\text{Real Sales}_{f,t}) - \log(\text{Employees}_{f,t})]. \tag{B.1}$$

The firm-specific export shock is derived as a Bartik-like shift-share variable, in the spirit of Mayer et al. (2021) and Aghion et al. (2018). In particular, we obtain data from the Italian National Statistical Institute on the exports from each Italian province p and each sector s to each destination country d in 1995. We complement it with information from the BACI-CEPII database, that collects yearly information on imports to each country-sector pair over the period 1995-2015. For each sector, we then construct a province-sector proxy of foreign demand, $\text{Foreign Demand}_{s,p,t}$, as:

$$\text{Foreign Demand}_{s,p,t} = \sum_{d} \frac{\text{Real Exports}_{s,p,d,1995}}{\sum_{p} \text{Real Exports}_{s,p,d,1995}} * \text{Real Imports}^{-IT}_{s,p,d,t}, \tag{B.2}$$

where $\text{Real Exports}_{s,p,d,1995}$ are total exports of sector s from the Italian province p to destination country d in 1995, and $\text{Real Imports}^{-IT}_{s,p,d,t}$ are total imports to d – excluding the imports from Italy – in year t. By factoring out Italy's own imports, we rule out the possibility that the changes in foreign demand are driven by variation in the supply-side of the Italian economy. To then attribute the province-sector foreign demand to each firm i, we use firms' lagged revenue share of exports, $\frac{\text{Real Exports}_{f,t-1}}{\text{Real Sales}_{f,t-1}}$, and obtain the firm-level trade shifter:

$$\Delta \tilde{Z}_{f,t} = \frac{\text{Real Exports}_{f,t-1}}{\text{Real Sales}_{f,t-1}} * \frac{\Delta \text{Foreign Demand}_{s,p,t}}{\text{Foreign Demand}_{s,p,t-1}}. \tag{B.3}$$

Finally, we define the firm-specific export shock by averaging the values of the variable $\Delta \tilde{Z}_{f,t}$ over three years to capture the dynamics and slow-moving behavior of trade flows,

$$\text{Export Shock}_{f,t} = \frac{1}{3} \sum_{\tau=1}^{3} \Delta \tilde{Z}_{f,t-\tau}. \tag{B.4}$$

As we mention in Section 2.4, these two shocks – as well as the firm-level productivity shocks – are computed at the firm level as we have no balance sheet information at the establishment level.

B.2 Firm-level Pass-through of Firm Shocks into Wages

To validate our three series of firm-specific labor-demand shocks, we show that they do affect wage dynamics at the firm level. More specifically, we run the following panel regression for firm f in year t:

$$\Delta \log \text{Wage}_{f,t} = \beta \text{Shock}_{f,t} + \mathbf{X'_{f,t-1}}\gamma + \alpha_f + \delta_{p,s,t} + \epsilon_{f,t}, \tag{B.5}$$

where $\Delta \log \text{Wage}_{f,t}$ is the log-change at the firm level of workers' average monthly wage, $\text{Shock}_{f,t}$ is one of the three firm-specific shocks, $\mathbf{X_{f,t-1}}$ is a set of lagged firm controls that include firm size (measured as both the logarithm of the number of employees and the logarithm of total assets), sales (measured as the logarithm of turnover), markups (estimated when recovering the process of firm TFP shocks as described in the previous section), the profit-to-asset ratio, the employment share in the local labor markets (proxied at the 2-digit-sector-region level), the share of blue collars and white collars, as well as the share of each occupation that is associated with a different wage floor. The variable α_f is a set of firm fixed effects, and $\delta_{p,s,t}$ is a set of province-sector-year fixed effects, where p denotes the province in which firm f is located, and s denotes its sector of operation.

We consider two series for the firm-specific productivity shocks, $\text{Shock}_{f,t}$. The first one is a dummy variable that captures all the negative realizations of the firm TFP shocks. However, we also consider the series of firm TFP shocks in continuous values, thus encompassing both negative and positive shocks. We follow this dual approach also for the labor-productivity shocks and the export shocks.

Table B.1 reports the results of the estimation of regression (B.5). Column (1) shows that wage growth is lower by around 1.3 percentage points in firms that experienced a negative TFP shock. A similar result holds true also in Column (2), which shows that the continuous TFP shocks are positively associated with changes in firm wages. These results are confirmed for the case of the export shocks, and even strengthened – in terms of both economic and statistical significance – when using the labor-productivity shocks. This analysis confirms that firm labor-demand shocks alter the average wage per employee.

Table B.1: The firm-level wage pass-through of firm-specific productivity shocks.

Dependent variable:	Δ log Wage$_{f,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
TFP Shock$_{f,t}$	-0.013*					
(negative dummy)	(0.006)					
TFP Shock$_{f,t}$		0.010*				
(continuous values)		(0.006)				
Labor-Productivity Shock$_{f,t}$			-0.043***			
(negative dummy)			(0.001)			
Labor-Productivity Shock$_{f,t}$				0.002***		
(continuous values)				(0.001)		
Export Shock$_{f,t}$					-0.011*	
(negative dummy)					(0.006)	
Export Shock$_{f,t}$						0.013*
(continuous values)						(0.008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Province-Sector-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2511	2511	2511	2511	1634	1634

Note: The table reports the estimates of panel regressions across firms on annual data from 1997 to 2015. In all regressions, the dependent variable is the growth rate at the firm level of the average monthly wage per employee, and the key independent variable is a series of firm-specific labor-demand shocks. In Columns (1), (3), and (5), we consider a dummy variable for the negative realizations of the TFP shocks, labor-productivity shocks, and export shocks, respectively. In Columns (2), (4), and (6), we consider the three shocks in continuous values. All regressions include firm and province-sector-year fixed effects, as well as one-year lagged control for firm size (as both the logarithm of the number of employees and the logarithm of total assets), the share of blue collars, and firm sales (as the logarithm of turnover). Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10%, respectively.

B.3 Robustness Checks

This section provides a comprehensive battery of robustness checks on the pass-through of firm-specific labor-demand shocks on wages at the worker level. We start by ascertaining the validity of our results to alternative specifications for the firm-level labor-demand shocks. We complement the analysis of Section 2.5, which has relied on firm TFP shocks, by estimating regression (3) using either firm-specific labor-productivity shocks, or firm-specific export shocks. Again, we consider both the negative dummy variables for each shock, thus capturing only the negative innovations, and the series in their continuous values, thus encompassing both the negative and positive innovations. We report the results of these two cases in Tables B.2 and B.3, respectively.

Next, we show in Table B.4 that the asymmetric pass-through holds also in the case we include managers in the final panel, independently of whether we consider the negative or the continuous firm productivity shocks.

Then, Table B.5 reports that the magnitude of the asymmetric pass-through does not change in case we consider either the continuous values of the TFP shocks adjusted for variable utilization derived as in Basu et al. (2006), in which we use firms' reported utilization of their production inputs, which comes with a value between 0 and 1 in the INVIND survey, or the continuous values of a series of firm productivity shock in which we explicitly control for heterogeneity in workers' labor inputs across firms. We do so as in Chan et al. (2021), that is, by absorbing from firms' labor inputs the estimated worker fixed effects, which are recovered in a worker-level regression in the spirit of Abowd et al. (1999). In this case, the number of observations drops because we can only identify the worker fixed effects for the sub-sample of movers. In addition, we estimate the wage pass-through of large negative TFP shocks as in Juhn et al. (2018), as well as the transitory and permanent innovations to firm productivity, which are identified as in Blundell et al. (2008).

The baseline analysis in Section 2.5 has characterized the role of the incidence of minimum wages at the worker level by estimating the regression (3) on two samples of workers, one whose minimum wage cushion is up to 20%, and one with a cushion above 20%, as well as considering the 20% cutoff value to compute the minimum-wage bite at the establishment level. Table B.6 confirms the empirical evidence of Table 2 in case we consider either 25% or 30% as the threshold values for the worker cushion and the establishment bite.

We also show that the baseline results are robust to saturating the regression with more granular fixed effects. For instance, Table B.7 reports that the pass-through of firm TFP shocks into the wages of high-cushion workers holds in case we substitute the year fixed effects with 2 digit sector-year fixed effects, with province fixed effects, or with the combination of both, that is, 2 digit sector-province-year fixed effects. If anything, the magnitude of the pass-through increases when using the relatively more granular sector-province-year fixed effects.

Next, we study the role of some key workers' characteristics in shaping the pass-through of the firm-specific shocks into the wages of high-paid workers. We do so over four dimensions. First, we split the samples by workers' age: one with all the employees whose age is between 20 and 41, and one with those employees whose age is above 41. We find that the relatively larger pass-through applies almost indistinguishably to the two groups of workers. Second, we exclude the workers at the top 20% of the wage distribution, to provide further evidence that bonuses or heterogeneity in job performance at the top end of the wage distribution (Juhn et al., 2018) are not driving our result. Third, we exclude all those workers who have been subject to furlough policies. Fourth, to rule out any consideration due to the duality of the Italian labor market, we exclude all workers with a temporary contract and focus exclusively on the employees with a permanent position. We report all these cases in Table B.8.

We also evaluate the role of firms' characteristics. Table B.9 reports the wage elasticity of high-cushion workers by splitting the firms into two samples depending each time on one key firm characteristics. Columns (1) and (2) consider the wage elasticity in a sample of firms with low TFP levels and high TFP levels, respectively. These productivity levels are estimated in the data when recovering the series of firm productivity shocks, as discussed in Section 2.4. We find that the pass-through to high-cushion workers in high-bite firms holds in both samples, which gives further support to our empirical strategy, in which the presence of the worker-establishment fixed effects allows us to identify the effect of firm productivity shocks into wages above and beyond firms' long-run efficiency levels. We then consider few characteristics that proxy for firms' financial conditions. Columns (3) and (4) consider the wage elasticity in a sample of low-markup and high-markup, respectively. These markups are estimated jointly with the productivity levels when recovering the firm productivity shocks. Columns (5) and (6) evaluate how the pass-through relates to firms' profits-to-asset ratio, and Columns (7) and (8) analyze the role of firms' age. In all these cases, the magnitude of the pass-through is fairly constant across samples, thus revealing that this phenomenon cannot be fully explained by worker-firm rent sharing (e.g., Card et al., 2014). For the last characteristics, we consider firms' monopsony power. Specifically, Columns (9) and (10) study whether the pass-through depends on firms' employment share in their local labor market of operation, which is defined at the 2 digit sector-region level. While the magnitude of the pass-through decreases with firms' local monopsony power, in line with Chan et al. (2021) and Berger et al. (2022a), we find that the wage elasticity keeps being statistically significant in the sample of firms with high employment shares in their local labor markets. Consequently, the asymmetric pass-through holds above and beyond firms' monopsony power.

Finally, we study the role of risk-sharing in shaping the asymmetric pass-through (Guiso et al., 2005; Ellul et al., 2018; Lamadon et al., 2022), and find that our results hold above and beyond any risk consideration. Table B.10 establishes this result by looking at four dimensions. The first one is workers' risk aversion. In the spirit of Guiso et al. (2005), we leverage a question of the SHIW which asks whether workers manage their financial investments either (i) to aim at very high gains, even though this implies that a substantial part of the invested capital could be likely lost, or (ii) to aim at a good gain, while facing a discrete degree of safety for the invested capital, or (iii) to aim at a discrete gain, while facing a good degree of safety for the invested capital, or (iv) to aim a low gain, with no risk for the invested capital. Following closely Guiso et al. (2005), we impute the risk aversion of all the workers in our sample through a matching procedure based on the observable characteristics that appear both in our dataset and in the SHIW. We then define lowly risk-averse workers all those one who are associated to answers (i)-(iii), while answer (iv) defines highly risk-averse workers. Second, we consider firm uncertainty and proxy it with the time-series volatility of firm TFP shocks. We define that a firm has a low volatility if the standard deviation of its TFP shocks is below the median value in our sample. As a third dimension, we consider firm bankruptcy risk, and measure it with Altman (1968)'s Z-score. We then consider discretize the score in 9 points, so that the firms with high bankruptcy risk are those in the highest two buckets. The last dimension we consider is firm cash needs. We measure them by exploiting a question in the INVIND survey, in which firms have to report the fraction of their trade credit claims that have been deferred over the agreed expiration date. The answer to this question then measures the amount of liquid resources that firms could have got should their customers have paid them on due time. We then define low cash-need firms as those who have reported a fraction of deferred trade credit claims which is below the median value in our sample. Table B.10 shows that the asymmetric pass-through of firm negative productivity shocks into the wages of high-cushion workers holds always above and beyond variation in these four ways of capturing risk considerations.

Table B.2: The blue-collar worker-level wage pass-through of firm-specific labor productivity shocks.

Dependent variable:	Δ log $\text{Wage}_{i,o,e,f,t}$			
	Negative Shocks		Continuous Shocks	
Worker MinW $\text{Cushion}_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
$\text{Shock}_{f,t}$	-0.022***	-0.012***	0.075**	0.060***
	(0.007)	(0.003)	(0.024)	(0.012)
$\text{Shock}_{f,t}$ × Establishment MinW $\text{Bite}_{e,f,t-1}$	0.023	-0.039**	-0.084	0.166*
	(0.021)	(0.018)	(0.072)	(0.085)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	13,080	345,774	13,080	345,774

Note: The table reports panel-regression estimates as in Table 2 with the difference that in this case the series of firm-specific labor-demand shocks, $\text{Shock}_{f,t}$, is either a dummy variable for all the negative realizations of firm labor-productivity shocks in Columns (1) and (2), or the series of firm labor-productivity shocks in its continuous values in Columns (3) and (4).

Table B.3: The blue-collar worker-level wage pass-through of firm-specific export shocks.

Dependent variable:	Δ log $\text{Wage}_{i,o,e,f,t}$			
	Negative Shocks		Continuous Shocks	
Worker MinW $\text{Cushion}_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
$\text{Shock}_{f,t}$	-0.005	0.006*	0.011	-0.006
	(0.010)	(0.004)	(0.013)	(0.010)
$\text{Shock}_{f,t}$ × Establishment MinW $\text{Bite}_{e,f,t-1}$	0.030	-0.042*	-0.056	0.216**
	(0.024)	(0.023)	(0.039)	(0.109)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	5,991	190,508	5,991	190,508

Note: The table reports panel-regression estimates as in Table 2 with the difference that in this case the series of firm-specific labor-demand shocks, $\text{Shock}_{f,t}$, is either a dummy variable for all the negative realizations of firm export shocks in Columns (1) and (2), or the series of firm export shocks in its continuous values in Columns (3) and (4).

Table B.4: The worker-level wage pass-through of firm-specific TFP shocks: Including managers.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$			
	Negative Shocks		Continuous Shocks	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.009	-0.002	0.016	0.003
	(0.006)	(0.003)	(0.018)	(0.015)
Shock$_{f,t}$ × Establishment MinW Bite$_{e,f,t-1}$	0.010	-0.030*	0.011	0.104**
	(0.014)	(0.017)	(0.042)	(0.053)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	19,105	541,646	19,105	541,646

Note: The table reports panel-regression estimates as in Table 1 with the difference that in this case managers are also included in the sample.

Table B.5: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks: Alternative TFP shocks.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$									
	Shocks Adjusted Variable Utilization		Shocks Adjusted Labor Inputs		Large Shocks		Transitory Shocks		Permanent Shocks	
Worker MinW Cushion$_{i,o,e,f,t}$:	0-20%	>20%	0-20%	>20%	0-20%	>20%	0-20%	>20%	0-20%	>20%
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock$_{f,t}$	-0.091***	0.041**	0.129*	0.055**	-0.009	0.001	0.017	0.000	0.014	0.023***
	(0.026)	(0.017)	(0.037)	(0.023)	(0.010)	(0.003)	(0.017)	(0.011)	(0.017)	(0.007)
Shock$_{f,t}$ × Establishment MinW Bite$_{e,f,t-1}$	-0.159*	0.231**	-0.138*	0.264*	0.004	-0.046**	0.004	0.117**	-0.009	-0.043
	(0.067)	(0.114)	(0.074)	(0.140)	(0.021)	(0.016)	(0.045)	(0.057)	(0.044)	(0.040)
Worker-Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,951	310,623	10,528	169,498	12,454	320,678	10,791	262,379	10,791	262,379

Note: The table reports panel-regression estimates as in Table 2 with the difference that in this case the series of firm-specific labor-demand shocks, Shock$_{f,t}$, is either the continuous realizations of firm productivity shocks adjusted for firms' reported variable utilization of production inputs, in Columns (1) and (2), or the continuous realizations of firm productivity shocks adjusted for heterogeneity in workers' inputs, by absorbing from firm labor the workers' fixed effects estimated in a regression in the spirit of Abowd et al. (1999), or a dummy variable for all the large negative realizations of firm productivity shocks, defined as those innovations above the median of all negative TFP shocks, in Columns (5) and (6), or a dummy variable for all the transitory realizations of firm productivity shocks considered in its continuous values, and estimated as in Blundell et al. (2008), in Columns (7) and (8), or a dummy variable for all the permanent realizations of firm productivity shocks considered in its continuous values, and estimated as in Blundell et al. (2008), in Columns (9) and (10),

Table B.6: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks: The role of workers' cushion and establishments' bite cutoff values.

Dependent variable:	Δ log Wage$_{i,o,e,f,t}$			
Worker MinW Cushion$_{i,o,e,f,t}$:	0-25%	>25%	0-30%	>30%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.001	0.3	0.002	0.003
	(0.007)	(0.003)	(0.006)	(0.004)
Shock$_{f,t}\times$	-0.002	-0.037**	-0.004	-0.030*
Establishment MinW Bite$_{e,f,t-1}$	(0.014)	(0.019)	(0.011)	(0.018)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	21,762	309,153	35,785	293,105

Note: The table reports panel-regression estimates as in Table 2 with the difference that the cutoff values for both workers' cushion and establishments' bite are set to 25% in Columns (1) and (2), and 30% in Columns (3) and (4).

Table B.7: The blue-collar worker-level wage pass-through of firm-specific TFP shocks: The role of fixed effects.

Dependent variable:	Δ log Wage$_{i,o,e,f,t}$			
	Baseline	Sector-Year FE	Province-Year FE	Sector-Province Year FE
Worker MinW Cushion$_{i,o,e,f,t} > 20\%$	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.002	0.002	0.003	0.011
	(0.003)	(0.003)	(0.003)	(0.010)
Shock$_{f,t}\times$	-0.044**	-0.043**	-0.042**	-0.139*
Establishment MinW Bite$_{e,f,t-1}$	(0.020)	(0.020)	(0.021)	(0.060)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	No	No
Sector-Year FE	No	Yes	No	No
Province-Year FE	No	No	Yes	No
Sector-Province-Year FE	No	No	No	Yes
Observations	320,678	320,678	320,498	317,344

Note: The table reports in Column (1) the baseline panel-regression estimate of Table 2 for high-cushion workers, that is, those workers whose minimum wage cushion is above 20%. Column (2) substitutes the year fixed effects with 2 digit sector-year fixed effects, Column (3) substitutes the year fixed effects with province-year fixed effects, and Column (4) considers sector-province-year fixed effects.

Table B.8: The blue-collar worker-level wage pass-through of negative firm-specific TFP shocks: The role of key worker characteristics.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$				
	Young Workers	Old Workers	Excluding Top 20%	Excluding Furlough	Permanent Workers
Worker MinW Cushion$_{i,o,e,f,t}$:>20%	(1)	(2)	(3)	(4)	(5)
Shock$_{f,t}$	0.004	0.000	0.003	0.002	0.2
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Shock$_{f,t}\times$	-0.055**	-0.041*	-0.047**	-0.035**	-0.044**
Establishment MinW Bite$_{e,f,t-1}$	(0.022)	(0.022)	(0.019)	(0.016)	(0.020)
Worker-Establishment FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	165,422	150,293	279,946	219,664	315,431

Note: The table reports panel-regression estimates as in Column (2) of Table 2 and studies the role of some key worker characteristics. Columns (1) and (2) split the sample by the age of the workers, such that Column (1) is estimated on a sample of young employees, whose age is between 20 and 41 years old, Column (2) focuses on a sample of old employees, whose wage is above 41 years old, Column (3) excludes the workers whose wage is in the top 20% of the sample, Column (4) excludes the workers who have been subject to furlough policies, and Column (5) excludes workers with temporary contracts.

Table B.9: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks: The role of key firm characteristics.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$									
	TFP Level		Markups		Profits/Assets Ratio		Age		Empl. Share in Local Labor Market	
	Low	High	Low	High	Low	High	Low	High	Low	High
Worker MinW Cushion$_{i,o,e,f,t} > 20\%$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Shock$_{f,t}$	0.000	0.005	0.002	-0.001	0.007	0.003	0.008	0.000	-0.004	0.004
	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.007)	(0.003)	(0.006)	(0.003)
Shock$_{f,t}\times$	-0.046*	-0.060*	-0.044*	-0.051*	-0.051**	-0.062**	-0.062**	-0.041*	-0.063*	-0.046*
Establishment MinW Bite$_{e,f,t-1}$	(0.026)	(0.033)	(0.026)	(0.025)	(0.026)	(0.031)	(0.031)	(0.024)	(0.029)	(0.024)
Worker-Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	167,690	111,527	243,384	69,464	140,410	149,593	100,374	223,028	62,044	250,791

Note: The table reports panel-regression estimates as in Column (2) of Table 2 and studies the role of some key firm characteristics. Columns (1) and (2) estimate the regressions for the samples of firms with low and high productivity levels, Columns (3) and (4) estimate the regressions for the samples of firms with low and high markup levels, Columns (5) and (6) estimate the regressions for the samples of firms with low and high profit ratios, Columns (7) and (8) estimate the regressions for the samples of young and old firms, and Columns (9) and (10) estimate the regressions for the samples of firms with low and high local labor-market employment shares, respectively. The local labor market is defined at the 2 digit sector-region level.

Table B.10: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks: The role of risk.

Dependent variable:	$\Delta \log \text{Wage}_{i,o,e,f,t}$							
	Worker Risk Aversion		Firm Uncertainty		Firm Bankruptcy Risk		Firm Cash Needs	
	Low	High	Low	High	Low	High	Low	High
Worker MinW Cushion$_{i,o,e,f,t} > 20\%$	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Shock$_{f,t}$	0.001	0.002	0.003	0.000	0.001	0.017**	-0.001	0.003
	(0.003)	(0.003)	(0.005)	(0.003)	(0.004)	(0.007)	(0.003)	(0.004)
Shock$_{f,t}\times$	-0.035*	-0.056**	-0.052*	-0.039*	-0.052**	-0.074*	-0.044*	-0.055*
Establishment MinW Bite$_{e,f,t-1}$	(0.020)	(0.024)	(0.031)	(0.023)	(0.024)	(0.042)	(0.026)	(0.055)
Worker-Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	146,122	138,818	112,570	208,108	255,286	12,871	151,343	157,194

Note: The table reports panel-regression estimates as in Column (2) of Table 2 and studies the role of risk. Columns (1) and (2) estimate the regressions for low and high risk-averse workers, respectively, where risk aversion is derived from a question in the SHIW survey about households' financial investment attitude. Columns (3) and (4) estimate the regressions for low and high volatile firms, respectively, where volatility is the time-series standard deviation of firm TFP shocks, and firms are split in two groups of low and high volatility around the median value of the TFP shock standard deviation. Columns (5) and (6) estimate the regressions for firms with low and bankruptcy risk, respectively. Bankruptcy risk is measured using Altman's Z-score. High risk firms are those featuring a score that defines a firm to be in financial distress. Columns (7) and (8) estimate the regressions for firms with low and high cash needs, respectively. Cash needs are derived from a question in the INVIND survey in which firms report the fraction of trade credit claims which have been referred over the due expiration date. We define low cash-need firms as all those reporting a fraction which is below the median value in the sample.

C More on the Model

C.1 Convexifying the Workers' Problem

The firm matching problem is non-convex, as workers can choose between a discrete set of different labor markets, characterized by TFP, z, and the inverse of markup, τ. To convexify this problem, we assume that – in addition to the wages offered by different groups of firms – a worker's occupational choice is affected by taste shocks for working for each of these groups. In particular, in the beginning of each period, a worker realizes a vector of taste shocks $\boldsymbol{\epsilon}$. Each component of this vector corresponds to a different additional level of firm TFP and markup, adding to the original value of the match. Technically, these shocks facilitate the model solution by convexifying the maximization problem of workers over different jobs. The policy functions that are otherwise discrete in nature become continuous probabilities before the realization of these shocks. This smooths out the value functions and facilitates the convergence of the model's numerical solution.[43] Nevertheless, these shocks are relevant beyond the technical aspect. As discussed in Card et al. (2018), they make firms imperfect substitutes from the workers' point of view, adding motives for workers to sort into firms beyond the differences in the wages they are offered.

The presence of the taste shocks implies that the value function $V(a, x, o, \boldsymbol{\epsilon})$ of a worker with asset level a, skills x, occupation o, and taste shock vector $\boldsymbol{\epsilon}$, starting a period with the opportunity to decide on which firm to work for is:

$$V(a, x, o, \boldsymbol{\epsilon}) = \max_{(z,\tau)\in\mathbb{Z}\times\mathbb{T}} \{V^m(a, x, o, z, \tau) + \epsilon_{z,\tau}\}, \tag{C.6}$$

where $V^m(a, x, o, z, \tau)$ denotes the value that workers with skill level x, occupation o, and asset holdings x receive from matching to a firm with productivity level z and markup τ, as defined in Equation (13).

In the calibration, we posit that the ϵ-shocks capturing the taste of workers for working in different productivity firms follow a Generalized Extreme Value distribution:

$$F(\boldsymbol{\epsilon}) = \exp\left[-\left(\sum_{k=1}^{K} \exp\left(-\frac{\epsilon_k}{\pi_\epsilon \sigma_\epsilon}\right)\right)^{\pi_\epsilon}\right].$$

We set the parameter π_ϵ, which captures the correlation between the shocks for the different productivity levels, to 1, and then calibrate σ_ϵ to the smallest value that achieves the convergence of the workers' problem, which is 0.015. Importantly, the quantitative implications of the model on the asymmetric pass-through of firm-specific shocks into wages – and the associated welfare changes in removing the minimum wage constraint – do not vary with the value of σ_ϵ.

[43] These shocks have been used in many different contexts in economic research for the same motive, see for instance Iskhakov et al. (2017) for an overview.

C.2 Definition of Equilibrium

This section reports the definition of a stationary general equilibrium (SGE) for the model. We start by introducing some notation: we denote the wealth policy function as $A(a, x, o, z, \tau; u)$, and the firm-matching policy function as $M(a, x, o, z, \tau, \boldsymbol{\epsilon})$. This latter policy depends on the realization of the $\boldsymbol{\epsilon}$ vector, and thus implies a probability of choosing each occupation before the realization of the $\boldsymbol{\epsilon}$-shocks. We denote this probability vector by $\mathbf{M}(a, x, o, z, \tau)$.

The SGE is a set of policy functions $A(a, x, o, z, \tau; u)$, $\mathbf{M}(a, x, o, z, \tau)$ for the workers, factor demands $K^\star(z, \tau)$ and $\mu^\star(x, o, z, \tau)$, firms' profit function $\pi(z, \tau)$, a probability distribution of workers $\lambda(a, x, o, z, \tau)$, an interest rate r, a wage function $w(x, o, z, \tau)$, an unemployment probability function $U(x, o, z, \tau)$, and total profits received by workers, Π, such that:

- The policy functions $A(a, x, o, z, \tau; u)$ and $\mathbf{M}(a, x, o, z, \tau)$ solve the worker problem (14) for each (a, x, o, z, τ) given the prices, the unemployment probability function, and total profits.

- Firms' demand choices $K^\star(z, \tau)$ and $\mu^\star(x, o, z, \tau)$ solve their static profit maximization for each z and τ given the prices.

- The profits received by households are consistent with the profits of each firm, given the prices:
$$\Pi = \sum_{l=1}^{N_\tau} \sum_{j=1}^{N_z} \pi(z_j, \tau_l) \phi(z_j, \tau_l)$$

- The wages satisfy the minimum wage constraint: $w(x, o, z, \tau) \geq \underline{w}(o)$, $\forall x, z, \tau$.

- The labor demand for each worker efficiency and firm productivity pair is equal to the number of workers who supply labor and are not unemployed in the corresponding market:
$$\Phi(z, \tau)\mu^\star(x, o, z, \tau) = [1 - U(x, o, z, \tau)] \sum_a \lambda(a, o, x, z, \tau), \forall x, o, z, \tau \tag{C.7}$$
with $U(x, o, z, \tau) \geq 0$. Moreover, $U(x, o, z, \tau) > 0$ if and only if $w(x, o, z, \tau) = \underline{w}(o)$.

- The asset market clears:
$$\sum_{l=1}^{N_\tau} \sum_{j=1}^{N_z} \Phi(z_j, \tau_l) K^\star(z_j, \tau_l) = \sum_{l=1}^{N_\tau} \sum_{j=1}^{N_z} \sum_{i=1}^{N_x} \sum_{k=1}^{2} \sum_a \lambda(a, x_i, o_k, z_j, \tau_l) a.$$

- Workers' asset positions satisfy the borrowing constraint, $a \geq 0$.

- The distribution across worker states is time-invariant: $\lambda(a', x, z', \tau) =$

$$\sum_{l=1}^{N_\tau}\sum_{j=1}^{N_z}\sum_{i=1}^{N_x}\sum_{k=1}^{2}\sum_{a}\lambda(a, x_i, o_k, z_j, \tau_l) \times \sum_{u=0}^{1}\Big\{\left(uU(x, o, z, \tau) + (1-u)\left[1 - U(x, o, z, \tau)\right]\right)\times$$
$$\times\, \mathbb{I}_{\{A(a,x,o,z,\tau;u)=a'\}}\left[\Big(1-s\Big)\Gamma_z(z, z') + s\mathbf{M}(a', x, o, z', \tau')\right]\Big\}. \tag{C.8}$$

C.3 More on the Calibration

Table C.11 reports the details on the entire set of calibrated parameters. Panel (a) refers to the set of parameters that are externally calibrated, that is, whose value is defined according to the standard used in the literature. Then, Panel (b) shows the set of parameters that are internally calibrated, that is, whose value is define to match a specific data moment. The panel shows not only the value for each parameter, but also reports the moment (and its value) associated to each of them.

Table C.11: Parameters.

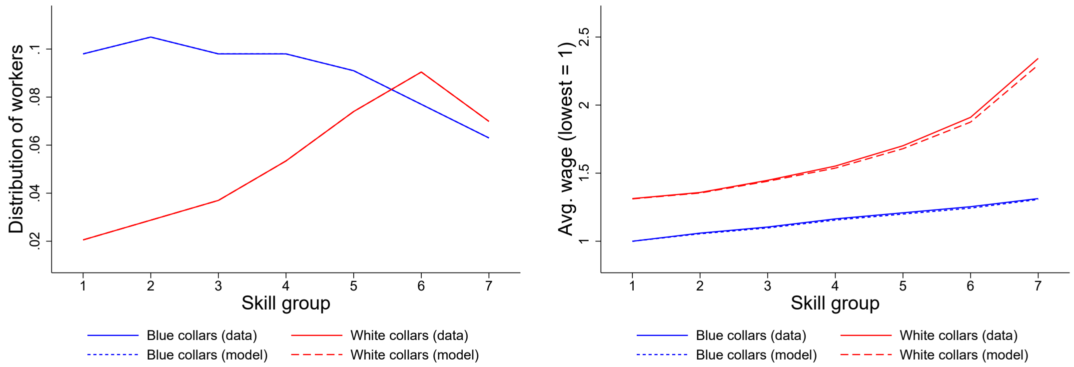
Parameter	Value	Description/Target
Panel A: Calibrated outside of the simulations		
γ	1.5	Risk aversion
β	0.94	Discount factor
α	0.33	Capital share
η	0.85	Span of control
δ	0.06	Capital depreciation
r	0.05	Risk-free interest rate
Panel B: Calibrated targeting moments		
ρ	0.3	Within-firm standard deviation wages-to-skill ratio $= 0.25$
π_z	0.96	Autocorrelation of log-sales $= 0.99$
σ_z	0.10	Standard deviation of log-sales $= 1.8$
σ_τ	0.124	Standard deviation of markups $= 0.124$
$\underline{w}$(bc)	155	Minimum wage/ average wage - blue collars $= 0.66$
$\underline{w}$(wc)	184	Minimum wage/ average wage - white collars $= 0.50$
b	113	Replacement rate $= 40\%$
s	0.10	Probability of changing firms $= 0.10$

Note: Panel A reports the parameters that are set before solving the model (i.e., the parameters that are calibrated outside the model). Panel B reports the parameters that are set to match specific targets with the model solution (i.e., the parameters that are calibrated within the model).

Figure C.1 reports the graph describing the calibration of workers skills. In particular, Panel (a) shows that the model can exactly replicate the distribution of workers across skills as derived in the data. Indeed, the continuous line, which denote the model implications on the skill distributions for blue collars (blue line) and white collars (red line) are perfectly on the top of the respective dashed lines, which indicate the patterns of the density of workers across skills in the data. To empirically measure workers' skills, we refer to the workers' fixed effects estimated in a regression that features firm-year fixed effects.

Figure C.1: Calibration of workers' skills.

(a) Distribution of skills | (b) Wages across skills



Note: The left panel plots the distribution of skills x in the baseline model calibration (solid line) and in the data (dashed line). We measure skills in the data with the estimated workers' fixed effects in a regression featuring firm-year fixed effects, in the spirit of Abowd et al. (1999). The figure shows the distribution of skills separately for blue and white collar workers. The right panel does the same for the wages, normalized by the lowest skill group within blue collars.

C.3.1 Model performance with untargeted moments

Table C.12 compares the model implications on a set of key untargeted moments with respect to the data. While we have calibrated the model only to match the dispersion – and the persistence – of log-sales and markups across firms, our economy can also almost perfectly account for the auto-correlation of firms' log-employment, and explain 86% of the dispersion of log-employment across firms. In addition, our calibrated model is consistent with the patterns of the wage gap when comparing firms in the top and bottom quartile of either sales or employment. These results give further credence on the capacity of the model to replicate the cross-sectional distribution of Italian metalworking firms.

The welfare consequences of the asymmetric pass-through crucially depend on the model implications on both the magnitude of the wage elasticities to firm productivity shocks, and workers' wealth levels. Indeed, the latter defines the extent to which workers can self-insure against the variability in their labor earnings. Although the model is calibrated to match the distribution of wages across workers' skills for both blue collars and white collars, the economy replicates also the distribution of wealth across Italian manufacturing workers. In particular, we compare the ratios of the 25th, 75th, 90th, and 99th percentiles with respect to the median both in the model and in the data. The empirical counterpart of workers' wealth distribution comes from information of the Survey on Household Income and Wealth, by focusing only on the wealth of manufacturing workers, and excluding the self-employed. Table C.12 shows that our economy accounts well for most percentiles of the wealth distribution, while over-estimating the asset holdings at its lower end. Consequently, our model provides a lower bound for the welfare changes due to the asymmetric pass-through for wealth-poor workers.

Finally, the fact that white collars earn higher wages than blue collars and are relatively less subject to the rationing implied by the minimum wage bears implications also for the wealth distribution. This is especially the case when comparing wealth-rich workers across occupations: in the model the 95th wealth percentile for white collars is roughly twice as large as that of blue collars. Workers' wealth strongly covaries with firms' TFP, with a correlation of about 0.4.

Table C.12: Non-targeted moments, data vs. model.

Moment	Data	Model
Panel A. Firm heterogeneity		
Autocorrelation of log-employment	0.99	0.96
Standard deviation of log-employment	1.49	1.61
Autocorrelation of of log-wage	0.94	0.98
Standard deviation of log-wage	0.34	0.26
Top-bottom 25% sales, wage gap	45%	52%
Top-bottom 25% employment, wage gap	33%	51%
Panel B. Wealth distribution		
P99/P50	10.2	10.0
P90/P50	4.3	4.3
P75/P50	2.5	2.3
P25/P50	0.04	0.3

Note: The model statistics are computed using the stationary distributions of workers and firms. Sales in the data are computed as revenues, and in the model as output. Employment in the data and in the model is the number of workers. Top-bottom wage gap is the rate of change in average wages from bottom to top decile or quartile of firms in sales and employment. Wealth in the data is from the Survey on Household Income and Wealth. We report the ratios of 99th, 90th, 75th and 25th percentiles of wealth relative to the median.

C.4 More on the Quantitative Results

Section 4.2.3 shows that the complementarities across workers' skills in firms' labor demand are the key feature that allows our model to account for the asymmetric pass-through of firm productivity shocks into wages. Indeed, Figure 5 reveals that if we abstract from the labor-demand complementarities, that is, if we set the parameter $\rho = 1$ so that the elasticity of substitution across skills is infinite, then the model counterfactually implies that the wage elasticity of high-cushion workers does not vary with firms' minimum wage bite.

To provide further evidence on the key role played by the labor-demand complementarities, Figure C.2 reports the distribution of the wage elasticity to firm TFP shocks for both blue collar and white collar high-cushion workers. The density curves show that the economy with no complementarities in firm labor demand generates pass-through levels which are substantially lower than in the baseline model. In other words, a sufficiently low elasticity of substitution across workers' skills is crucial for letting the model to capture the way in which the minimum wages shape the wage elasticity to firm productivity shocks.

Figure C.2: The distribution of the Wage elasticity to firm-level TFP shocks.

(a) Blue collars

(b) White collars

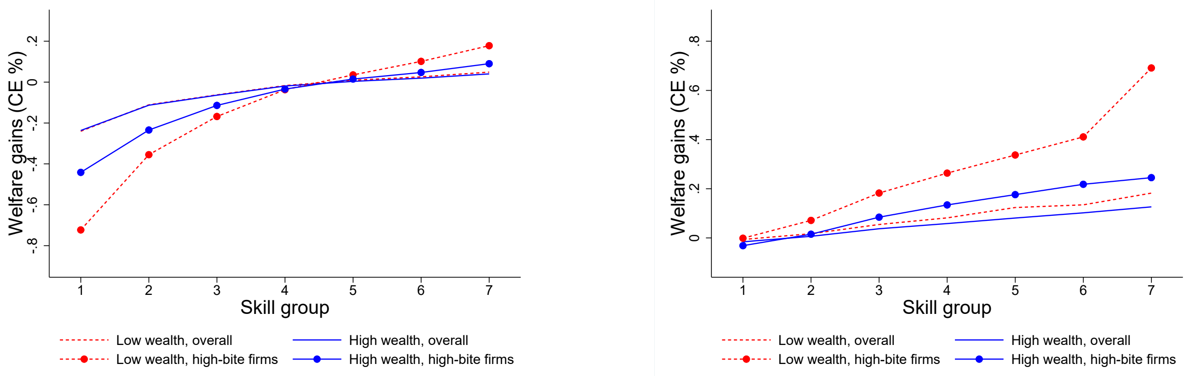
Note: The figures plot the Kernel densities of the wage elasticity with respect to TFP described in Equation (20). We use negative TFP shocks (i.e., an innovation which is one standard deviation below the mean) and only workers with high cushion (i.e., whose wage is at least 20% above the minimum wage). The left (right) panel is for the blue (white) collar workers. Blue solid lines in each figure correspond to the baseline model, and the red dashed lines correspond to the alternative calibration without complementarities.

C.5 Welfare Implications: The Role of Wealth

We then leverage the distribution of asset holdings across households to highlight how the welfare implications vary with wealth. To do so, Figure C.3 reports the welfare changes for blue collars and white collars by differentiating between those in the lower end of the wealth distribution and those in the higher end of asset holdings. Specifically, we consider the households in the bottom and top deciles of the wealth distribution. The graphs show that the welfare changes crucially depend on workers' wealth positions: within the blue collars, the welfare losses for those employed in high-bite firms can be twice as large when comparing workers with low wealth levels vis-á-vis wealth-rich ones. Similarly, the welfare gains from removing the minimum wages for white collars are substantially larger if workers have low asset positions. This is due to the fact that the variation in the wage pass-through of firm productivity shocks generated by the presence of minimum wages maps relatively more into consumption if workers' wealth is low. In other words, when workers have low assets and cannot insure well their consumption stream, the welfare implications of the asymmetric pass-through are relatively larger. These dynamics explain why the model implies that the welfare losses for the median blue collar in high-bite firms are in absolute value twice as large as the welfare gains of the analogous median white collar.

Figure C.3: Welfare gains/losses from removing the minimum wage: The role of wealth.

(a) Blue collars (b) White collars



Note: The figures report the welfare gains and losses from removing minimum wages as in Figure 6, isolating the role of workers' wealth. Low and high wealth refer to the gains for workers in top and bottom wealth decile of their skill group-occupation, respectively.