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JEL Classification: E24, E25, E64, J31, J38, J52

Keywords: Firm-specific shocks, Pass-Through, Minimum Wages, Linked employer-employee data, General Equilibrium, complementarities

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1 Introduction

Policy-makers in several advanced economies 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 tend to focus on how *changes* in the wage floors alter employment and wages, both at the aggregate level as well as across the labor earnings distribution.[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-specific labor-demand 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, which represents an ideal laboratory for our study for two main reasons. First, we can leverage employer-employee data over the period 1995-2015 matched to both firm balance sheets and novel hand-collected information on occupation-specific wage floors. These floors are set by collective contracts, and act as *de-facto* minimum wages.[2] By using these multiple sources of information, we can evaluate how firm-idiosyncratic shocks alter the labor earnings over a total of 600,000 person-establishment-year observations. Second, the minimum wage is quantitatively relevant, as it corresponds on average to 55% of the sector-occupation wage and binds for roughly 10% of all workers in our sample.

Our granular data are instrumental to identify the firm-specific labor-demand shocks. Our baseline approach uses firm balance sheet information and the control method of De Loecker and Warzynski (2012) to estimate firm-level idiosyncratic productivity shocks. Then, we plug-in the estimated shocks into a worker-level regression and evaluate how the productivity shocks 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 determinant of labor earnings. Importantly, the worker-establishment fixed effects allow us to control for establishments' average efficiency levels. In this way, we can evaluate how productivity shocks affect wages above and beyond differences in firms' long-run productivity levels.

Our main finding is that although negative firm-level labor-demand shocks reduce wages,

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

[2] The U.S. federal minimum wage is $7.25 per hour and applies to all workers. Instead, in Italy the minimum wage varies across occupations. For instance, in 2013 a metalworker was facing seven different occupation-specific wage floors, ranging from €1,234.44 up to €2,094.48.

this effect masks considerable heterogeneity in the pass-through of firm productivity into workers' earnings. On the one hand, the wages that are close to the floors are unresponsive to firm shocks. While this lack of adjustment to negative shocks confirms that the floors act *de facto* as minima, these wages do not react even amidst positive shocks. However, for workers close to the floors, the lack of wage adjustment is coupled with changes at the extensive margin: negative (positive) productivity shocks generate job losses (gains). 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 who are employed in minimum-wage-intensive establishments.

This main result carries through alternative specifications of the firm-level labor-demand shocks. We ascertain the robustness of our empirical analysis by replacing the TFP shocks with either firm-specific labor productivity shocks or firm-specific export shocks. We derive the latter variable via a Bartik approach, by combining export data by province, sector, and destination country – as well as the yearly import-export matrix of world trade – with firms' (lagged) export status. All in all, our analysis provides corroborating evidence on how minimum wages shape the asymmetric pass-through of firm-level shocks into labor earnings across workers.

We then rationalize the empirical evidence on how minimum wages shape the response of wages to firm-specific labor-demand shocks through a general-equilibrium 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.

Specifically, the model economy is populated by a continuum of households, who are ex-post heterogeneous in consumption and wealth due to an uninsurable idiosyncratic labor-earnings risk, as in Aiyagari (1994). The production side consists of a continuum of ex-ante identical firms with decreasing returns to scale technologies. As in Hopenhayn (1992), the presence of idiosyncratic productivity shocks leads to a non-degenerate firms' distribution. Firms hire workers subject to a minimum-wage constraint. Importantly, firms' production function is characterized by complementarities in the labor supplied by workers with different efficiency levels, 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 efficiency levels (Iranzo et al., 2008).

The model provides a technological rationale to the asymmetric pass-through of firm-specific shocks due to the presence of wage floors, as the key feature that accounts for this fact is the interaction between the complementarity across workers with different efficiencies in firms' labor demand and the rationing implied by the minimum wage. In the model, the workers whose marginal product of labor (MPL) is below the minimum wage in the counterfactual full-employment economy (i.e., the economy with no wage floors) face the risk of rationing, and could end up being unemployed. When a firm is hit by a negative productivity shock, the MPL of all workers goes down, leading the firm to shed some low-efficiency employees. Due to the labor-demand complementarity *across* different efficiency levels, this additional rationing decreases further the MPL – and thus the wage – of high-efficiency workers. However, this rationing dampens the drop in the wage of those low-efficiency workers that are still employed, as their type has become relatively scarcer.

Our technological channel then implies that the wages of high-efficiency workers are relatively more sensitive to changes in firm productivity. Consistently with the empirical evidence, the model predicts that the largest pass-through of productivity shocks into wages is associated with those high-efficiency workers who are employed in firms intensive in low-efficiency workers, since in this case the magnitude of the rationing is amplified. Importantly, the same mechanism happens amidst positive productivity shocks, and thus allows the technological channel to explain the asymmetric pass-through in these circumstances. Lastly, if we abstract from the complementarities in labor demand, the model counterfactually predicts that the presence of minimum wages dampens the sensitivity of high wage workers when employed in minimum-wage-intensive firms.

We discipline the quantitative analysis by calibrating the model to match the main features of the Italian economy, including the process of firm-level productivity shocks, the process of worker-level labor earnings, as well as the relevance of the minimum wage. We set the degree of the labor-demand complementarity across efficiency levels to the value estimated by Ciccone and Peri (2005).

We then study the welfare implications of removing the minimum wage. We find that the median welfare change is close to zero throughout the labor-earnings distribution. However, this result conceals a large heterogeneity: removing the minimum wage substantially tilts the welfare gains toward high-paid households, at the expense of low-wage workers. In particular, the largest welfare losses are concentrated among wealth-poor low-efficiency workers who are employed by firms with relatively more minimum-wage contracts. These losses are mirrored by welfare gains among those high-paid – albeit low-wealth – workers hired by minimum-wage-intensive firms. Thus, the asymmetric pass-through of firm shocks into earnings due to the presence of wage floors generates a novel channel through which the removal of the minimum wages benefits relatively more high-paid workers at the cost of the employees at the low end of the wage distribution.[3]

[3]Our analysis compares the welfare gains and losses over the wage distribution without taking a stand on the aggregation required to derive a welfare-maximizing optimal wage floor. For a discussion on the optimality of minimum wages in a context in which the government values redistribution toward low wage workers, see

Our findings offer a novel view on the insurance within the firm highlighted by Guiso et al. (2005), Ellul et al. (2018), and Lagakos and Ordoñez (2011), as we uncover a relatively lower amount of insurance provision toward high wage workers associated with firms with high shares of minimum-wage employees. Thus, the presence of the minimum wage raises the insurance of the workers whose labor earnings are around the wage 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.[4]

This paper is closely related to the strand of the literature that studies the response of wages to firm-specific shocks (e.g., Kline et al., 2019; Howell and Brown, 2020; Chan et al., 2021). As in Chan et al. (2021), we leverage employer-employee data to study the heterogeneous effects of firm productivity shocks by controlling for differences in workers' labor quality. However, the focus – and thus the main contribution – of our paper differs as we show that the pass-through crucially depends on the relevance of minimum wages both at the worker level and at the establishment level.

Our paper builds on the body of 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., 2021; Engbom and Moser, 2021). 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 evaluate how its presence shapes the pass-through of firm-level 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.[5]

Minimum wage policies are often analyzed through the lens of frictional-market models (e.g., Flinn, 2010; Flinn and Mullins, 2019; Engbom and Moser, 2021). 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 can 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 by firms which differ in the

Allen (1987) and Lee and Saez (2012).

[4]Our results also contribute to the general wisdom that negotiated minima dampen the variation in wages at the cost of a larger variation of employment. We show that while this fact holds true for the workers whose wage is closer 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.

[5]A strand of the literature evaluates how minimum wages – as well as the more general concept of downward wage rigidity – alter business-cycle dynamics, but it abstracts from any distributional implications (e.g., Erceg et al., 2000; Schmitt-Grohé and Uribe, 2016; Glover, 2019; Faia and Pezone, 2020).

share of minimum-wage workers. Second, the fact that the asymmetric pass-through of firm-specific shocks into wages holds at the establishment level suggests that this phenomenon cannot be fully explained by worker-firm bargaining.

2 Empirical evidence

2.1 Institutional setting

To study the effect of the presence of minimum wages on the responsiveness of wages to labor-demand shocks, we focus on the case of Italy. Similarly to other European countries, the Italian labor market is characterized by duality and collective bargaining (Boeri and Garibaldi, 2007). While there is no statutory minimum wage in Italy, collective bargaining between unions and employer federations set *de facto* minimum wages at the sectoral level, and involve both unionized and non-unionized workers (Brandolini et al., 2007; Adamopoulou and Villanueva, 2020).[6] Unlike the U.S. in which the current federal minimum wage is $7.25 per hour and applies to all workers, in Italy the minimum wage varies across occupations. For instance, in 2013 a metalworker was facing seven different occupation-specific wage floors, ranging from €1,234.44 up to €2,094.48.[7]

Our focus on the sector-occupation wage floors is supported by the fact that collective bargaining at the firm level is rare, and can only envisage top-ups. 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 large metal manufacturing firms.

2.2 Data

To carry out our analysis, we build a unique source of data 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 wage floors from collective contracts.

More specifically, we exploit 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. First, we use detailed income statement and balance sheet information from the proprietary database CERVED, to have a complete picture of the sales and production inputs of each firm. Second, we merge the firm-level data to a linked employer-employee

[6] 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.

[7] These occupation-specific wage floors are set over a 2-3 year horizon via collective contract renewals at the sectoral level. Collective contracts envisage nominal increases of the negotiated wage floors that typically take place every year.

database from the Italian National Social Security Institute. In this way, we observe the complete working histories for all the individuals who were employed by any establishment associated with each of the INVIND firms over the period 1995-2015. Third, we introduce the information on minimum wages by adding hand-collected data on negotiated wages of metalworkers by occupation and year. To do so, we use the information on the collective contract that covers each worker from the Social Security data.

We then restrict the analysis to workers aged 20-64 with some attachment to the labor force, by focusing on the individuals who have worked for at least six months in a given year. Our wage measure includes the base wage, bonuses, and top-ups, without the possibility of distinguishing among each component.[8] We compute daily wages by dividing gross annual earnings with the total number of days worked during the year.[9]

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.[10] Specifically, we restrict the analysis to firms with more than 90% of their workforce covered by the main collective contract. This restriction reduces our sample of firms by only 5%, and guarantees that the minimum-wage constraint that we consider is the relevant one at the establishment level. In addition, we also exclude managers from the analysis. The final sample contains around 600,000 person-establishment-year observations over the period 1998-2015.

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 level and the establishment level. To do so, we use the details of the collective contract information to assign to each worker its corresponding wage floor, following the procedure in Adamopoulou and Villanueva (2020). This allows us to pin down the distance of each worker's salary from its occupation-specific floor (also accounting for seniority bonuses). We can derive the relevance of wage floors at the establishment level because we observe the entire workforce of each establishment in our sample.

With all this information, we compute the worker minimum-wage cushion as

$$\text{Worker MinW Cushion}_{i,e,f,t} = \frac{W_{i,e,f,t} - \bar{W}_t}{\bar{W}_t}, \tag{1}$$

which describes the distance of the salary of worker i employed in establishment e associated to firm f in year t, $W_{i,e,f,t}$, from its relevant wage floor, $\bar{W}_t$. A lower cushion value then captures a relatively higher incidence of the minimum wage at the individual level.

[8]In the empirical analysis, we show that top-ups do not drive our results by estimating the regressions on a sample that either excludes white collars or the workers in the 20% of the wage distribution, since these are the cases in which top-ups account for a relatively larger fraction of the overall earnings.

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

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

We then use the cushions to derive the establishment minimum-wage bite as

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

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 we 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.[11] Then, a higher value of the bite implies that a given establishment features a relatively higher share of workers whose salary is close to the wage floors.

In the worker-level regression, we will estimate how the pass-through of firm-specific shocks into wages depends on both the workers' cushion and the establishments' bite.

2.4 Estimation of the Firm-Level Labor-Demand Shocks

Our empirical analysis aims at uncovering the pass-through of exogenous shifts in firm labor demand on workers' wages. Our baseline for the firm-level labor-demand shocks is given by a series of firm-specific TFP shocks, given the prominence of these innovations in both empirical and theoretical work. To construct this series, we estimate a firm-level Solow residual by positing a Cobb Douglas production function, and use the control function approach of De Loecker and Warzynski (2012). More specifically, we assume that capital is pre-determined one period ahead – so that it is not correlated with the current productivity shock – whereas labor is set flexibly. We posit that the Hicks-neutral productivity shock follows a first-order Markov process, and back out this unobserved process by estimating the output elasticity with respect to labor, which is then instrumented using its own lagged values. 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 measure cannot be computed for the first two years of the dataset, that is, 1995 and 1996. This approach leads to the estimation of a series of firm-specific TFP shocks spanning from 1997 until 2015. Importantly, in the estimation of the shock we do not impose the complementarity between workers of different efficiency levels. In this way, we are not plugging into the estimated series the implications that the complementarity *per se* produces on the sensitivity of wages to productivity shocks.

We also consider alternative specifications for the firm-level labor-demand shocks. In this way, we ascertain that our findings do not hinge on a single source of exogenous variation – the firm-specific TFP shocks – but rather can be generalized using different labor-demand shifters. To do so, we evaluate the robustness of our empirical analysis using either firm-specific labor productivity shocks or firm-specific export shocks.

The firm-specific labor productivity shock trades off a weaker exogeneity with a much

[11] While we consider a 20% relative distance as our baseline measure for computing the establishment bite, our results are robust to changes in this threshold.

more flexible specification with respect to the TFP series. To back out the labor productivity shocks, we compute the difference between the log-change of firms' sales with the log change of firms' total number of employees, that is

$$\Delta \text{labor productivity}_{f,t} = \Delta[\log(\text{real sales}_{f,t}) - \log(\text{employees}_{f,t})]. \tag{3}$$

The firm-specific export shock is derived as a Bartik-like shift-share variable, in the spirit of Mayer et al. (2022) and Aghion et al. (2018). More specifically, 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 $FD_{s,p,t}$ as:

$$FD_{s,p,t} = \sum_d \frac{X_{s,p,d,1995}}{\sum_p X_{s,p,d,1995}} M^{-IT}_{s,p,d,t}, \tag{4}$$

where $X_{s,p,d,1995}$ are total exports of sector s from the Italian province p to destination country d in 1995, and M^{-IT}_{spdt} are total imports to d – excluding the imports from Italy – in year t. By deriving foreign demand while 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 attribute the province-sector foreign demand to each firm i, we use firms' lagged revenue share of exports, $\frac{X_{f,t-1}}{Y_{f,t-1}}$, and obtain the firm-level trade shifter:

$$\Delta \tilde{Z}_{f,t} = \frac{X_{f,t-1}}{Y_{f,t-1}} * \frac{\Delta FD_{s,p,t}}{FD_{s,p,t-1}}. \tag{5}$$

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

$$\Delta Z_{f,t} = \frac{1}{3} \sum_{\tau=1}^{3} \Delta \tilde{Z}_{f,t-\tau}. \tag{6}$$

2.5 Firm-level pass-through of labor-demand shocks into wages

We start by estimating the effects of firm-specific labor-demand shocks on wage dynamics at the firm level. More specifically, we run the following panel regression for firm f in year t:

$$\Delta \log \text{wage}_{f,t} = \beta \text{Shock}_{f,t} + \mathbf{X_{f,t-1}}'\gamma + \alpha_f + \delta_{p,s,t} + \epsilon_{f,t}, \tag{7}$$

where $\Delta \log \text{wage}_{f,t}$ is the growth rate at the firm level of the average monthly wage per employee, $\text{Shock}_{f,t}$ is one of the three series of firm-specific labor-demand shocks (either as a continuous variable or as a dummy variable that equals 1 for all the negative realizations of the shock), $\mathbf{X_{f,t-1}}$ is a set of lagged firm controls that include firm size measured both in terms of the log number of employees and log assets, the share of blue-collar workers in total employment, and firm sales measured in terms of log turnover. 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.

Table 1: The firm-level wage pass-through of firm-specific labor-demand shocks

	Dependent variable: Δ log wage$_{f,t}$					
	(1)	(2)	(3)	(4)	(5)	(6)
TFP shock$_{f,t}$ (negative dummy)	-0.013* (0.006)					
TFP shock$_{f,t}$ (continuous values)		0.010* (0.006)				
Labor productivity shock$_{f,t}$ (negative dummy)			-0.043*** (0.001)			
Labor productivity shock$_{f,t}$ (continuous values)				0.002*** (0.001)		
Export shock$_{f,t}$ (negative dummy)					-0.011* (0.006)	
Export shock$_{f,t}$ (continuous values)						0.013* (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 Column (1), we consider a dummy variable for the negative realizations of the TFP shocks; in Column (2), we consider the TFP shocks in continuous values; in Column (3), we consider a dummy variable for the negative realizations of the labor productivity shocks; in Column (4), we consider the labor productivity shocks in continuous values; in Column (5), we consider a dummy variable for the negative realizations of the export shocks; in Column (6), we consider the export shocks in continuous values. All regressions include firm and province-sector-year fixed effects, as well as one-year lagged control for firm size measured both as the log of the number of employees and the log of total assets, the share of blue collars, and firm sales, measured as the log 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.

Our preferred measure for the firm-specific labor-demand shocks, Shock$_{f,t}$, 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), as well as both the dummy variables and the continuous series of the labor productivity shocks and the export shocks.

Table 1 reports the results of the estimation of regression (7). 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 series of labor productivity shocks. This analysis, thus, confirms that firm labor-demand shocks alter the average wage per employee. 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 levels.

2.6 Worker-level analysis

This section shows that the firm-level analysis on the pass-through of firm shocks into wages conceals a large heterogeneity, as the pass-through is concentrated in high-paid workers employed in minimum-wage-intensive establishments. To uncover this fact, we leverage the employer-employee data and run the analysis at the worker level. In this way, we can characterize how the pass-through jointly depends on the incidence of minimum wages at both the worker and establishment level.

More specifically, we estimate the following worker-level regression:

$$\begin{aligned}\Delta \log \text{wage}_{i,e,f,t} =& \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \\ & \dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \alpha_{i,e} + \alpha_t + \epsilon_{i,e,f,t},\end{aligned} \tag{8}$$

where $\Delta \log \text{wage}_{i,e,f,t}$ is the percentage growth of the daily wage of worker i employed by establishment e associated with firm f in year t, $\text{Shock}_{f,t}$ is a dummy variable that takes the value 1 if firm f experiences a negative TFP shock in year t and 0 otherwise, and $\text{bite}_{e,f,t-1}$ is the bite of minimum wages of establishment e associated with firm f in year $t-1$. The terms $\alpha_{i,e}$ and α_t indicate worker-establishment and year fixed effects. To compute the standard errors, we use the INVIND survey weights and perform a two-way clustering by workers and firms.

The specification of regression (8) includes worker-establishment and year fixed effects, which allows us to control for any time invariant unobserved heterogeneity at the worker-establishment level, as well as any common time variation across establishments and firms. In this way, we absorb any difference in labor quality across establishments, improving the identification of the effects of the firm-specific labor-demand shocks. In addition, the fact that we combine firm-specific shocks and exploit the variation in the incidence of minimum wages at the establishment level allows us to address the concern that the firm-specific shocks may be biased towards certain skill groups, and could thus be intrinsically related to the firm's labor structure as well as its relevance of minimum wages. Finally, the worker-establishment fixed effects allow us to control for establishments' average efficiency levels. In this way, we can evaluate how productivity shocks affect wages 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-level labor-demand 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 then evaluate the relevance of the incidence of minimum wages at the individual level, we estimate regression (8) 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 2: The worker-level wage pass-through of firm-specific negative TFP shocks

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.004	-0.009	-0.003	-0.002
	(0.003)	(0.006)	(0.002)	(0.003)
Shock$_{f,t}$ × Establishment MinW Bite$_{e,f,t-1}$		0.011		-0.031*
		(0.014)		(0.017)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	19,039	19,039	517,746	517,746

Note: The table reports the estimates of panel regressions at the worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the daily wage growth of worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative realizations of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

Table 2 presents the estimated effect of a negative TFP shock on workers' wage growth, distinguishing between the workers close to the minima (Columns 1 and 2) and those far from it (Columns 3 and 4). On average, when we exclude the interaction term, the pass-through of firm shocks into wages is negative but not statistically significant for either type of workers (Columns 1 and 3). However, we find that it is key to account for the interaction of the incidence of minimum wages at both the individual and establishment levels. Indeed, when we include the interaction term, we find that the wage of high-paid workers employed in minimum-wage-intensive establishments drops amidst a negative TFP shock (Column 4). These are workers with a large enough wage cushion that could be adjusted downwards. Instead, the wages of workers earning close to the minima are not responsive (Column 2), independently of the bite of their establishment of operation, thus confirming that the floors do act as *de facto* minimum wages. This table establishes the existence of an asymmetric pass-through of firm shocks, such as the entire wage adjustment is concentrated among those high-paid workers who are employed in establishments with relatively more minimum-wage workers.

Table 3: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks

	Dependent variable: Δ log wage$_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.001	-0.007	-0.002	0.001
	(0.003)	(0.008)	(0.002)	(0.003)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		0.009		-0.044**
		(0.017)		(0.020)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	12,454	12,454	320,678	320,678

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

Since we observe only daily wages, our asymmetric pass-through could be driven by additional factors other than the actual effect of firm-level shocks into wages, such as the variation in the total hours worked as well as in top-ups and bonuses. This concern could be particularly relevant given the differences in hours worked and top-ups between blue collars and white collars. To address this concern, we focus on a workforce which is more homogeneous across establishments and run the regression (8) on a sample of only blue-collar workers. We report the results of this exercise in Table 3.

We find that focusing on blue-collar workers increases the size and precision of our estimates, without altering the qualitative patterns derived in Table 2. Once again, we find that the wage of those workers close to the floors does not react to the negative firm productivity shocks, as the pass-through is concentrated among high wage workers in minimum-wage-intensive establishments. This relationship is not only highly statistically significant, but also highly economically relevant: a one standard-deviation increase in the minimum-wage bite at the establishment level leads to a reduction in the nominal wage growth of high-paid workers amidst the firm negative productivity shock by 0.3 percentage points, which account for roughly 10% of the average wage growth.

2.7 Robustness checks

We perform a comprehensive battery of robustness checks to provide further evidence in favor of the asymmetric pass-through of firm specific shocks as a function of the incidence of minimum wages at both the worker and establishment levels. In particular, Appendix B validates our findings over four key additional dimensions.

First, Table B.1 shows that the asymmetric pass-through holds also in the case in which we categorize the workers close to the minimum wage as those whose cushion is up to 30%, while a cushion above 30% determines the workers whose wage is way above the floors.

Second, Tables B.2 and B.3 show that the economic and statistical significance of the pass-through in 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, a dummy variable which equals one for the negative realizations of either the labor productivity shocks or the export shocks.

Third, Tables B.4 - B.6 show that the asymmetric pass-through and the lack of adjustment in the wages of the workers close to the floors holds also when looking at the response of the three firm-specific labor-demand shocks in their continuous values. This result highlights that positive shocks are also associated with a lack of upward adjustment in the wages of the workers close to the minima. Consequently, these workers are truly shielded from the variation in firm risk, since the lack of adjustment holds both upwards and downwards.

Fourth, Table B.7 shows that the asymmetric pass-through and the relevance of minimum wages in shaping it holds also when focusing on worker groups with similar ages, when excluding the workers at the very top of the wage distribution, when excluding workers with temporary contracts and thus focusing only on those with permanent ones, as well as when controlling for furlough policies.

Overall, our findings offer a novel view on the insurance within the firm highlighted by Guiso et al. (2005), Ellul et al. (2018), and Lagakos and Ordoñez (2011), as we uncover a relatively lower amount of insurance provision toward high wage workers associated with firms with high shares of minimum-wage employees. Thus, the presence of the minimum wage raises the insurance of the workers whose labor earnings are around the wage floors, at the cost of a larger 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.

2.8 The job-loss and labor-earnings pass-through

So far, we have provided corroborating evidence on the way in which the incidence of minimum wages at the establishment level shapes the asymmetric pass-through of firm shocks into wages across workers. However, what are the implications for employment outcomes? This section provides direct evidence on how the asymmetric pass-through of firm shocks into wages is mirrored by an asymmetric pass-through of firm shocks in job losses.

To do so, we run a similar analysis to regression (8) with the only difference that the dependent variable is now $\text{JobLoss}_{i,e,f,t}$, which is a dummy variable that equals one if worker i employed in establishment e associated with firm t in year t loses the job. That is, we estimate the following regression:

$$\begin{aligned} \text{JobLoss}_{i,e,f,t} =& \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \\ & \dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \alpha_{i,e} + \alpha_t + \epsilon_{i,e,f,t}. \end{aligned} \tag{9}$$

Table 4 reports the results of regression (9) on the sample of blue-collar workers, and shows that in this case the workers whose wage is far from the floors do not experience any job loss amidst a negative firm TFP shock, independently of whether or not they are employed in minimum-wage-intensive establishments. In this case, the job losses are concentrated among those workers whose wage is close to the floors, and who are employed in establishments with relatively more minimum-wage workers.

This result highlights the way in which minimum wages shape the transmission of firm shocks. When firm labor demand drops, the wage adjustment is concentrated among high-paid workers in minimum-wage-intensive establishments. However, these establishments also shed some of the workers whose wage is close to the floors.[12]

Altogether, the evidence on the asymmetric pass-through of wages and employment outcomes along the wage distribution contributes to the general wisdom that bargained minima dampen the variation in wages at the cost of a larger variation of employment. We show that while this fact holds true for the workers whose wage is closer to the minima, the opposite is the case for high-paid employees: the minima do not influence their employment outcomes,

[12] 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) and Harasztosi and Lindner (2019).

Table 4: The blue-collar job-loss pass-through of firm-specific negative TFP shocks

	Dependent variable: $\text{JobLoss}_{i,e,f,t}$			
Worker MinW $\text{Cushion}_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
$\text{Shock}_{f,t}$	-0.003	-0.018**	0.002	0.001
	(0.006)	(0.008)	(0.002)	(0.002)
$\text{Shock}_{f,t} \times$ Establishment MinW $\text{Bite}_{e,f,t-1}$		0.048**		0.012
		(0.020)		(0.024)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	11,803	11,803	263,260	263,260

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the probability of losing the job by the end of the year (i.e., a dummy variable that equals one if a blue-collar worker loses the job) of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, $\text{Shock}_{f,t}$, which is a dummy variable for all the negative observations of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW $\text{Bite}_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

but generate additional volatility in their wages. Then, the natural question is whether the variation in employment outcomes out-weights the wage changes so that low-wage workers bear the bulk of the adjustment amidst a firm shock. We show that this is not the case by estimating a regression in which the dependent variable is the log change in workers' total labor earnings:

$$\begin{aligned}\Delta \log \text{Earnings}_{i,e,f,t} =& \beta_1 \text{Shock}_{f,t} + \beta_2 \text{Establishment MinW Bite}_{e,f,t-1} + \dots \\ & \dots + \beta_3 \text{Shock}_{f,t} * \text{Establishment MinW Bite}_{e,f,t-1} + \alpha_{i,e} + \alpha_t + \epsilon_{i,e,f,t},\end{aligned} \tag{10}$$

where $\Delta \log \text{Earnings}_{i,e,f,t}$ combines the change in wages with that in the employment status, such that $\text{Earnings}_{i,e,f,t} = 0$ if worker i is laid off by establishment e at time t.

Table 5 reports the results of this exercise, and highlights that notwithstanding the relatively higher probability of losing a job for low-wage workers, the adjustment in labor earnings amidst a negative firm TFP shock is still concentrated among those high-paid workers employed in minimum-wage-intensive establishments. This is consistent with the fact that low-wage workers who are laid off following a negative firm-level shock manage to find new jobs, and thus quickly move across firms.

Table 5: The blue-collar labor-earnings pass-through of firm-specific negative TFP shocks

	Dependent variable: $\Delta \log \text{Earnings}_{i,e,f,t}$			
Worker MinW Cushion$_{i,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.000	0.024	-0.002	0.006
	(0.039)	(0.068)	(0.013)	(0.016)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		-0.003		-0.184*
		(0.162)		(0.103)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	36,662	36,662	441,345	441,345

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the log-change in labor earnings of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

2.9 Summary of the stylized facts

To sum up, the empirical analysis reveals that minimum wages shape the pass-through of firm-specific labor-demand shocks into wages. On the one hand, workers close to the minimum wage experience no variation in wages, but face a relatively larger probability of losing their job. On the other hand, workers whose salary is way above the wage floors – but are employed in establishment intensive in minimum-wage-workers – experience a relatively higher wage sensitivity, and no change in the employment outcomes. The same pattern holds true also when looking at the total labor earnings, thus highlighting that high-paid workers are relatively less insured against firm shocks. Instead, the labor earnings of the workers whose wages are close to the floors do not significantly vary with firm risk. All in all, our empirical results uncover the key role of the incidence of minimum wages at both the individual and establishment levels to understand 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 labor-demand shocks into wages, and to provide a proof of concept that the asymmetric pass-through generates heterogeneous welfare implications across the labor-earnings distribution. 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 efficiency levels. The rationale of our choice is two-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 firms with different shares of minimum-wage workers. Second, the fact that the asymmetric pass-through holds at the establishment level suggests that this feature cannot be fully explained by worker-firm bargaining.

Specifically, we consider a model economy which is populated by a continuum of households, who are ex-post heterogeneous in consumption and wealth due to an uninsurable idiosyncratic labor-earnings risk, as in Aiyagari (1994). The production side consists of a continuum of ex-ante identical firms with decreasing returns to scale technologies. As in Hopenhayn (1992), the presence of idiosyncratic productivity shocks leads to a non-degenerate firms' distribution. Firms hire workers subject to a minimum-wage constraint. Importantly, firms' production function is characterized by complementarities in the labor supplied by workers with different efficiency levels.

3.1 Firms

The production side of the economy consists of a continuum of ex-ante identical firms of unit measure. Firm are characterized by idiosyncratic TFP level z, that 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 $\mathbb{Z} = \{z_1, \ldots, z_{N_z}\}$. Firms produce the final good of the economy, Y, with the technology

$$Y = z(K^\alpha L^{1-\alpha})^\eta, \tag{11}$$

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.

In the spirit of Krusell et al. (2000), Caselli and Coleman (2006), and Shao et al. (2021), we posit that firm total labor consists of an aggregator that allows for imperfect substitutability between workers of different efficiency groups. Formally, the effective labor of a given firm is an aggregation across labor of different efficiency workers, defined as:

$$L = \left(\sum_{i=1}^{N_x} [x_i \mu(x_i)]^\rho \right)^{\frac{1}{\rho}}, \tag{12}$$

where $\mu(x)$ is the firm-specific measure of workers with efficiency units x. The efficiency unit of worker is also a discrete random variable following an arbitrary stationary stochastic process with transition matrix $\Gamma_x(x, x')$. We denote the set of possible values of x by $\mathbb{X} =$

$\{x_1, \ldots, x_{N_x}\}$. The parameter ρ captures the degree of complementarity, such that workers of different efficiency units are perfect substitutes if $\rho = 1$, and imperfect substitutable as long as $\rho < 1$. This labor aggregation follows closely 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.[13] In this setting, workers are perfectly substitutable within each efficiency level, and imperfectly substitutable across efficiency levels.

We assume that there is anonymity in firms and workers conditional on z and x. Workers who are going to work in a z-firm in a period are pooled together and drawn randomly into z-firms. This is to rule out dynamic considerations of firms when attracting workers, so that firms decide on the measure of workers from each efficiency level independently of the past. In addition, upon the realization of a x-z pair, the worker is fully mobile between firms of productivity z. This implies that the wage for a given x is the same for each firm of productivity z. We denote this wage by $w(x, z)$.[14]

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

$$\pi(z) = \max_{K, \{\mu(x_i)\}_{i=1}^{N_x}, Y} \quad Y - (r + \delta)K - \sum_{i=1}^{N_x} w(x_i, z)\mu(x_i) \tag{13}$$

$$\text{s.t.} \quad Y = z \left[K^{\alpha} \left\{ \left(\sum_{i=1}^{N_x} (x_i \mu(x_i))^{\rho} \right)^{\frac{1}{\rho}} \right\}^{1-\alpha} \right]^{\eta}. \tag{14}$$

In this setting, the firm problem does not need to explicitly take into account the existence of a minimum-wage constraint

$$w(x, z) \geq \underline{w}, \tag{15}$$

which imposes the same wage floor $\underline{w}$ for any firm productivity and worker efficiency levels. Since firms take wages as given, the restriction imposed by the minimum wage emerges in general equilibrium, but without appearing explicitly in any agent optimization problem.

3.2 Workers

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

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}, \tag{16}$$

[13] Our labor aggregation captures the potential complementarities between efficiency groups within firms, rather than within countries or sectors. This feature parsimoniously generates a pattern for labor demand such that firms hire workers with different efficiency levels, see Iranzo et al. (2008). Blankenau and Cassou (2011) consider the same specification, and apply it to production functions at the industry level. On the theoretical front, Rosen (1978) and Kremer and Maskin (1996) study the implications of imperfect substitution between different labor units within the firm.

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

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

Workers face an uninsurable idiosyncratic labor earnings risk: in each period they observe the realization of their efficiency units, x, whose stochastic properties are described above. In addition, workers face a further source of uncertainty: with probability $1-s$, workers are obliged to work in their employer of last period. In this case, they are subject to the same uncertainty for the firm-level productivity as their employer, so that they will move along the TFP-ladder with their firm following its transition matrix Γ_z. Instead, with probability s, a worker receives the opportunity to decide on the firm-level productivity to work for.

Conditional on the own labor efficiency, x, and the productivity of the firm they are employed in, z, workers face a probability $U(x,z)$ of not being hired by this match due to the rationing implied by the presence of a minimum-wage constraint. If households are not hired, they receive an exogenous unemployment income, b. If they are hired, they receive the wage rate $w(x,z)$. Although the function $U(x,z)$ is endogenous, workers take it as given. The unemployment spell of a worker, conditional on x and z, is independently drawn over time.

Workers can accumulate positive levels of a risk-free asset, a, and also hold infinitesimal shares of each firm in the economy, which are uniformly distributed across workers. Consequently, we can define the value function $V(a,x)$ associated with a worker with asset holdings a and efficiency level x, starting a period with the opportunity to decide on which firm to work for, as:

$$V(a,x) = \max_{z \in \mathbb{Z}} V^o(a,x,z). \tag{17}$$

When maximizing the value function in Equation (17), workers consider the value associated with matching to each particular firm, $V^o(a,x,z)$. Specifically, when deciding to match to a particular firm TFP level z, workers take into account that with a probability that depends on both worker efficiency level and firm productivity level, $U(x,z)$, they will end up unemployed (i.e., $u=1$), and with the remaining probability, $1-U(x,z)$, the match will become active (i.e., $u=0$). Thus, the function $V^o(a,x,z)$ averages the values associated with each employment status, weighted by the respective probabilities, as follows:

$$V^o(a,x,z) = [1-U(x,z)]\,\tilde{V}(a,x,z \mid u=0) + U(x,z)\tilde{V}(a,x,z \mid u=1), \tag{18}$$

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

$$\tilde{V}(a,x,z;u) = \max_{a' \geq 0} \frac{c^{1-\gamma}}{1-\gamma} + \beta E_{x'|x}\Big\{ sV(a',x') + (1-s)E_{z'|z}\left[V^o(a',x',z')\right] \Big\} \tag{19}$$

$$\text{s.t. } c = (1-u)w(x,z) + ub + a(1+r) - a' + \Pi \tag{20}$$

where Π denotes the firm profits that are rebated back equally to all workers. Equation (19) takes into account that, in the next period, workers keep being attached to the current firm at which they are employed with a probability s, whereas they can reset their occupational choice with the remaining probability.

The only reason for a positive unemployment rate in this model is the presence of an exogenous minimum-wage constraint, which rations the employment of those workers whose marginal product of labor is below the wage floor $\underline{w}$. We refer to Appendix C for the definition of the stationary general equilibrium of the model. The next section shows how the presence of the minimum wage alters the wage sensitivity to firm TFP shocks by affecting the rationing of low-efficiency workers.

3.3 The role of complementarities in firm labor demand

This section provides an analytical characterization of how 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 with the equilibrium labor market clearing condition, and obtain the wage which ensures that a firm is indifferent between hiring or not a worker of efficiency x, given the rest of the workers in the firm:

$$w(x,z) = (1-\alpha)\eta\left(\frac{\alpha\eta}{r+\delta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} z^{\frac{1}{1-\alpha\eta}} L^{\star}(z)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}-\rho} x^{\rho}\mu^{\star}(x,z)^{\rho-1}, \tag{21}$$

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

To the extent that workers with a relatively lower efficiency level earn lower wages, their salary will be closer to the minimum wage.[15] Conjecturing this property, we denote the efficiency level of worker that yields its equilibrium wage in a firm with productivity z to equal the minimum wage as $\underline{x}_z$. Below this level there is rationing, as the marginal product of labor of the worker is below the wage floor.

Suppose that a firm receives a negative TFP shock, so that its productivity level decreases from z to $z' < z$. In this case, the efficiency level threshold due to the minimum wage increases, that is, $\underline{x}_{z'} > \underline{x}_z$. As a result, there is a relatively larger pool of low efficiency workers that fall below the threshold, and thus rationing increases, which raises the scarcity of those low efficiency workers who are still employed.

The complementarities across efficiency levels in firm labor demand is then key in modulating how the changes in rationing at the lower end of the efficiency level distribution affect the wage elasticity with respect to firm TFP shocks for all the workers who are not rationed, that is, all the workers whose efficiency level is $x > \underline{x}_{z'}$. To see how the wages of a given efficiency level x change with the mass of workers in all the remaining efficiency levels, which

[15] This happens if the ergodic probability density function of x is decreasing in x, as in our calibration.

we denote by $\hat{x}$, we take the following derivative of the wage function $w(x, z)$:

$$\frac{dw(x,z)}{d\mu(\hat{x},z)} = \left[\frac{(1-\alpha)\eta}{1-\alpha\eta} - \rho\right] \Xi\left(x,z\right), \tag{22}$$

where $\Xi(x, z)$ equals a convolution of variables and parameters which is always non-negative:

$$\Xi\left(x,z\right) = (1-\alpha)\eta\left(\frac{\alpha\eta}{r+\delta}\right)^{\frac{\alpha\eta}{1-\alpha\eta}} z^{\frac{1}{1-\alpha\eta}} L^{\star}(z)^{\frac{(1-\alpha)\eta}{1-\alpha\eta}-2\rho} x^{\rho}\hat{x}^{\rho}\left[\frac{\mu^{\star}(x,z)}{\mu^{\star}(\hat{x},z)}\right]^{\rho-1} > 0. \tag{23}$$

The derivative in Equation (22) is positive if and only if

$$\rho < \frac{(1-\alpha)\eta}{1-\alpha\eta}. \tag{24}$$

With full substitutability across units (i.e., when $\rho = 1$), the condition (24) is not satisfied, and consequently a reduction in the measure of low efficiency workers increases the wage of high efficiency workers. In other words, the rationing at the lower end of the wage distribution raises the remuneration of high-paid employees. Instead, if the degree of imperfect substitution across workers of different efficiency levels is sufficiently low, then the derivative becomes positive and the rationing of low efficiency workers leads to a drop in the wages of high efficiency workers. Accordingly, in the aftermath of a negative TFP shock, the increased rationing at the lower end of the efficiency distribution amplifies the reduction 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-specific shocks into wages observed in the data, and isolates the channels that allow the model to be consistent with it. To do so, we discipline the analysis by calibrating the model to match the main features of the Italian economy, including the process of firm-level productivity shocks, the process of worker-level labor earnings, as well as the relevance of the minimum wage (defined with respect to the average wage of the Italian economy). We then use our calibrated model to show how the complementarities across workers provide a technological rationale to the asymmetric wage pass-through of productivity shocks. Finally, we use the model as an ideal laboratory to study how the asymmetric wage pass-through alters the welfare implications of removing minimum wages along the wage distribution.

4.1 Calibration

Table 6 reports the entire set of values assigned to the parameters of the model, which is calibrated at an annual frequency. We calibrate the parameters that govern the standard features of the model to the values widely used in the literature. In particular, we set the risk aversion parameter, 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 parameter, η, to 0.85. Finally, the capital depreciation rate, δ, is set to 0.06.

We then construct the transition matrices for the discrete Markov chains governing the

Table 6: Parameters

Parameter	Value	Description/Target
		Panel A: Calibrated outside of the model
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
ρ	0.3	Elast. of substitution between units $= 1.4$
π_z	0.95	Autocorrelation of firm productivity shocks
σ_z	0.12	Standard deviation of firm productivity shocks $= 0.40$
		Panel B: Calibrated within the model
π_x	0.983	Autocorr. log-wages $= 0.62$
σ_x	0.10	Std. log-wages $= 0.36$
ψ_x	0.98	Decreasing p.d.f. over x's
s	0.11	Prob. of changing firms $= 0.10$
$\underline{w}$	448	55% of average wage
b	326	40% of average wage

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).

dynamics of firm TFP, Γ_z, and that of worker efficiency, Γ_x, to resemble two AR(1) processes with persistence parameters π_z and π_x, and standard deviations σ_z and σ_x, respectively. We do so following the Tauchen (1986) algorithm. This gives us four parameters to calibrate these two processes. We start by setting the parameters that govern the firm-level shock process, π_z and σ_z, following our estimations of the auto-correlation and the volatility of the firm-level TFP series used in the empirical evidence (see the discussion in Section 2.4).

We calibrate the persistence and the volatility of the worker efficiency, π_x and σ_x, to match the persistence and the standard deviation of log-wages in the data. Due to skill-specific diminishing returns in the production function, our model implies that, all else being equal, workers from more populated skill groups earn lower wages. Consider two skill groups of workers, whose efficiency levels equal x_1 and x_2, respectively, with $x_2 > x_1$. If the efficiency level x_1 is relatively less common in the economy, then these workers earn higher wages than the workers with efficiency x_2. This property complicates the ranking of efficiency groups of workers in the wage ladder. Accordingly, we introduce skewness to the process of idiosyncratic efficiency, x, such that the skills become increasingly rare as we move higher in the x-ladder. To be specific, for each x and $x' > x$, we reduce the probability of moving next period from x to x', i.e. $\Gamma_x(x, x')$, by a fraction ψ_x, and then normalize this manipulated version of the transition matrix to maintain the sum of transition probabilities equal to 1 for each x.

We set ψ_x to be the minimum rate at which the ergodic distribution of x's exhibits a decreasing probability density function over x.

We calibrate the workers' probability of having an option to choose the firm productivity, s, to match the fraction of workers changing firms in Italy, estimated at 10 percent.[16] We then calibrate the level of the minimum wage, $\underline{w}$, to equal 55 percent of the average wage, which is the minimum wage to average wage ratio observed in our data. To set the amount of unemployment benefits, we refer to OECD data, showing that for a worker earning 67 percent of the average wage in the economy, the income if unemployed in the next two quarters equals 60 percent 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 percent of the average worker income.

We calibrate the complementarity between workers' efficiency groups, ρ, to match the estimate of around 1.4 for the elasticity of substitution between aggregate skill groups, as derived by Ciccone and Peri (2005). In our model, this elasticity translates to a value of $\rho = 0.3$.

4.2 Employment rationing due to the minimum wage

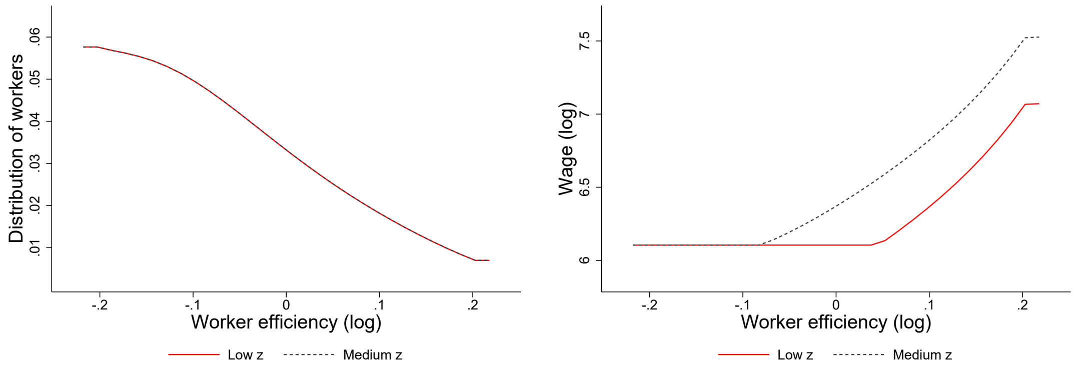
We start by discussing how wages vary over workers' efficiency levels, x, and firms' productivity, z. As highlighted in the previous section, we calibrate the $x-$process to sustain a probability density function that decreases with the level of x, as illustrated in Figure 1a. The shape of this function guarantees that wages increase with workers' efficiency levels, as we can see in Figure 1b. This figure also highlights that for any given worker efficiency levels, wages increase with the firm TFP level. As a result, the minimum wage tends to bind relatively more for relatively lower levels of both the worker efficiency and the firm TFP.

How does the minimum wage translate into a rationing of low efficiency workers? Figure 2 addresses this question by reporting how the probability of being unemployed varies with both workers' efficiency and firms' TFP. Since wages decrease with both x and z, the figure shows that unemployment is much more likely for low-efficiency workers when they are employed in low-TFP firms. In these cases, the MPL of low-x workers can be lower than the minimum wage, so that they end up being unemployed. A corollary of this result is the fact that a negative firm TFP shocks increases the employment rationing of all those workers with a sufficiently low level of efficiency x. Analogously, a positive firm TFP shock reduces the rationing at the low end of the efficiency distribution and makes low-paid workers relatively less scarce.

[16] In the model, a worker does not have a motive for changing a firm but to work for a different firm TFP level. Accordingly, we target the fact that workers change with firm level TFP every period with a 10 percent probability.

Figure 1: The distribution of workers and firms

(a) Distribution of efficiencies within firms (b) Wages across efficiency levels



Note: The left panel reports the ergodic distribution of the worker efficiency levels, x, in logs. The right panel reports the logarithm of the wage function $w(x, z)$ that corresponds to each of these efficiency levels, x. We report the wage function for two different firm TFP levels, z: the firms whose productivity is at the 25th percentile of the ergodic firm TFP distribution (*low*), and those at the 50th percentile (*medium*).

Figure 2: Unemployment across efficiency levels

Note: The figure plots the unemployment rate $U(x, z)$ across worker efficiency levels, x. We report the unemployment rate for two different firm TFP levels, z: the firms whose productivity is at the 25th percentile of the ergodic firm TFP distribution (*low*), and those at the 50th percentile (*medium*).

4.3 The asymmetric pass-through of firm shocks into wages

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

$$\frac{\log w(x, z_k) - \log w(x, z_{k-1})}{\log z_k - \log z_{k-1}}. \tag{25}$$

Equation (25) 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 $k - 1$.

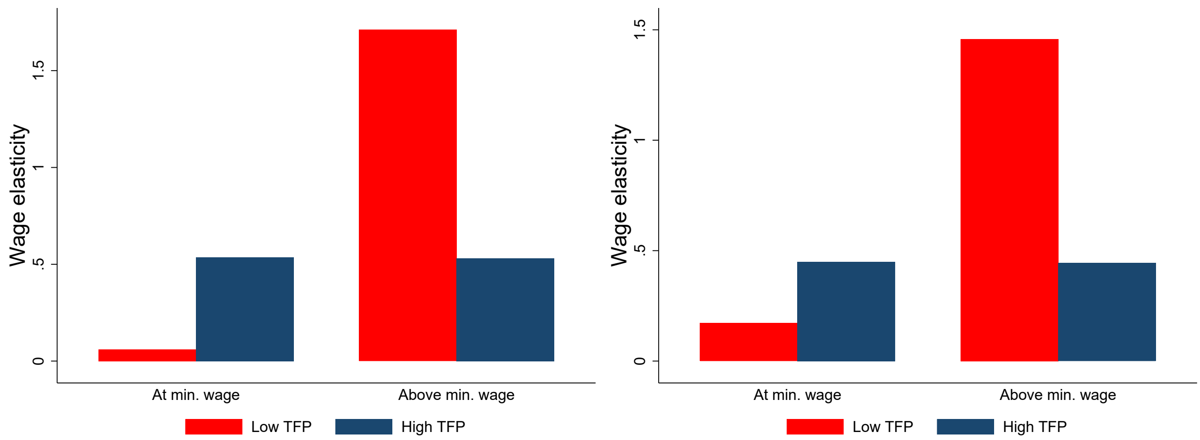
In the spirit of our empirical analysis, we compute the wage elasticity to TFP shocks in

Equation (25) 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 two different points in the distribution of firm TFP: one for the TFP level associated with the 25th percentile of the productivity distribution across firms, and one for its average. Since the level of firm TFP pins down its exposure to minimum-wage workers, we can compare the wage elasticity for a high firm bite (i.e., the case of a low productivity firm) and an average firm bite (i.e., the case of an average productivity firm).

Figure 3 reports these elasticities for two cases: the wage elasticity with respect to negative productivity shocks in Panel (a), and the wage elasticity with respect to positive productivity shocks in Panel (b). First, the figure shows that the workers whose wage is close the minimum have a wage elasticity to negative TFP shocks that is close to zero, independently of the firms' bite. Second, high-cushion workers are instead characterized by a large wage elasticity to negative TFP shocks, only as long as they are employed in a firm with a low TFP, and thus highly intensive in minimum-wage workers. Third, we find similar patterns for the wage elasticity with respect to positive TFP shocks.

Figure 3: Wage elasticity to negative and positive firm-level TFP shocks

(a) Negative TFP Shock (b) Positive TFP Shock



Note: The figures plot the wage elasticity with respect to firm-level TFP described in Equation (25). The left panel is for a negative TFP shock (i.e., an innovation which is one standard deviation below the mean) and the right panel is for a positive TFP shock (i.e., an innovation which is one standard deviation above the mean) in our benchmark calibration. In each figure, we show the elasticities for the 25th (red bars) and the 75th (blue bars) percentiles of the firm TFP distribution. For each sign of the shock, we plot the average elasticities for the low-cushion workers (i.e., the workers whose wage is within 20% above the minimum wage) and high-cushion workers (i.e., the workers whose wage is 20% above the minimum wage).

How does the model account then for the asymmetric pass-through? First, recall that the presence of a minimum-wage constraint implies rationing in equilibrium. More precisely, the workers whose MPL is below the minimum wage in the counterfactual full-employment economy could end up being unemployed. When a firm is hit by a negative TFP shock, the MPL of all workers decreases, and the rationing of low-efficiency workers increases. This extra rationing alters the wages of all low-efficiency and high-efficiency workers who are still employed. On the one hand, since there is perfect substitutability across workers within efficiency levels, the extra rationing of low-efficiency workers dampens the drop in the wage of the low-efficiency employees who are not laid off, because they become relatively scarcer. On the other hand, the complementarity across workers of different efficiency levels implies that the extra rationing of low-efficiency workers amplifies the drop in the MPL of the employees at the higher end of the wage distribution. In other words, the interaction of the rationing implied by the minimum wage and the complementarity across efficiency levels in firm labor demand shapes the wage elasticity to firm productivity shocks across workers.

In the case of the adjustment amidst a negative productivity shock, the presence of the minimum wage could mechanically imply that wages cannot go further down. Interestingly, the model can also account for the lack of response in the event of positive productivity shocks. Again, the mechanism is exactly the mirror image of that determining the asymmetric response of wages to firm shocks in the case of negative innovations. Indeed, when firm productivity increases, then the rationing goes down. As a result, low-efficiency workers are relatively less scarce, and thus their wage elasticity is dampened. At the same time, the higher fraction of low-efficiency workers benefits the employees with high efficiency levels, whose wage increases both for the direct effect of the change in firm-level TFP and for the positive effect due to the complementarity in firm labor demand.

4.4 The role of complementarities

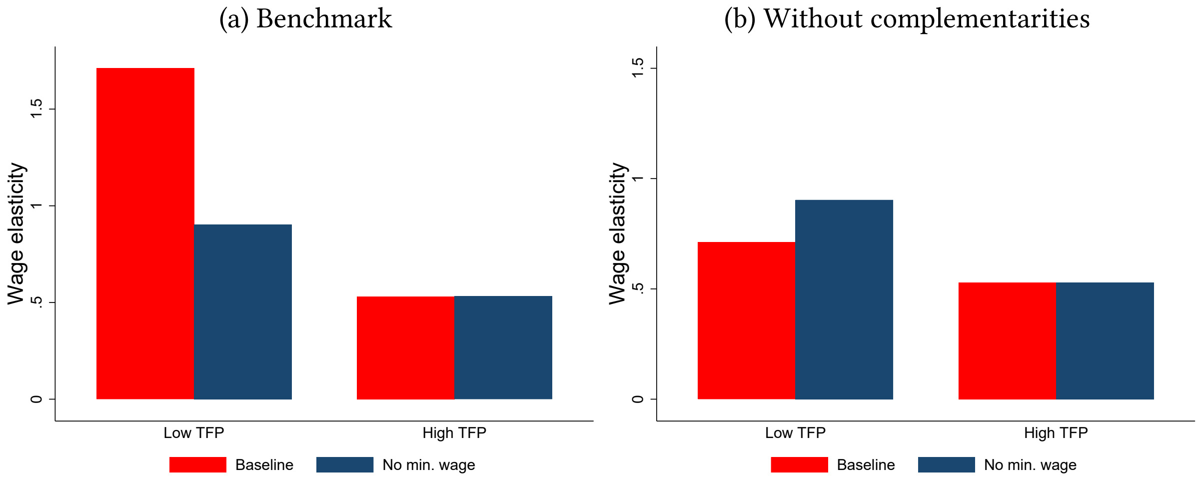
In our framework, with and without the minimum wage, workers' wages are subject to a pass-through from firm-level TFP shocks, because a higher TFP increases workers' productivity. The minimum wage affects this pass-through via three different channels. First, it directly restricts the movements in the wage at the lower end by construction, hence reducing the elasticity of wages. Second, the rationing of the workers at the minimum wage mitigates the wage effects of TFP shocks on workers far from the minimum wage through the diminishing returns to total labor input. Third, the presence of complementarities in firm labor demand implies that the same rationing at the lower end of the efficiency levels amplifies the pass-through of high-paid workers. The latter is the key mechanism that allows our model to account for the asymmetric pass-through estimated in the data.

To isolate the role of the complementarities, we compare the implications for the wage elasticity of the benchmark model with those of a counterfactual economy in which workers are always perfectly substitutable across efficiency levels (i.e., $\rho = 1$).[17] Then, we perform an exercise which involves three different steps. First, we shut down the minimum wage in both model economies. Second, we compute the wage elasticity using equation (25) in all

[17]We calibrate the counterfactual economy so that (i) the minimum wage leads to the same unemployment level, (ii) the unemployment income maintains the ratio of unemployment income to the average wage; and (iii) the volatility of worker-level efficiency shocks maintains the dispersion of log-wages as in the baseline model.

cases. Third, we compute the percentage point increase in the wage elasticity of high-cushion workers due to the minimum wage in both economies. We report the results in Figure 4.

Figure 4: Wage elasticity to firm TFP shocks, the minimum wage, and the complementarities



Note: The figures plot the wage elasticity with respect to firm-level TFP described in Equation (25), when the underlying change in the TFP is equivalent to an innovation of one standard deviation below the mean. In both panels, we focus on the wage elasticity of those workers whose wage is way above the minimum (i.e., the workers whose minimum-wage cushion is above 20%). The left panel is for the benchmark calibration with the substitutability parameter, ρ, at 0.3, and the right panel is for the alternative calibration with higher substitutability with ρ at 0.95. For each calibration, we plot the elasticities for the baseline with the minimum wage (red bars), and the counterfactual without the minimum wage (blue bars). For each model we show the elasticities for the 25th and the 75th percentiles of the firm TFP distribution.

Panel (a) shows that removing the minimum wage does not alter the elasticity of high-cushion workers in firms with few minimum-wage workers (i.e., high TFP firms). However, removing the minimum wage halves the wage elasticity of high-cushion workers employed in minimum-wage intensive firms. This is exactly in line with our empirical evidence, that shows how minimum wages tilt the wage sensitivity with respect to firm-level TFP shocks toward high-paid workers employed in minimum-wage-intensive establishments.

Panel (b) reports similar statistics for the economy featuring no complementarities across workers' efficiency levels in firm labor demand. While this economy implies a similar pattern of the effects of minimum wages on the wage elasticity of high-cushion workers in low-bite firms, this version implies a counterfactual effect of minimum wages on the wage elasticity of high-cushion workers in minimum-wage intensive firms. Indeed, in this economy the presence of the minimum wage dampens the wage elasticity, rather than amplifying it. Thus, abstracting from the complementarities in firm labor demand would imply not only a quantitatively different pattern for the wage elasticities of firm-level TFP shocks, but actually would generate a pattern which is qualitatively at odds with our empirical evidence.

Consequently, our model accounts for the asymmetric pass-through of firm-level productivity shocks into wages via a technological channel due to the presence of complementarities across different efficiency levels in firm labor demand.

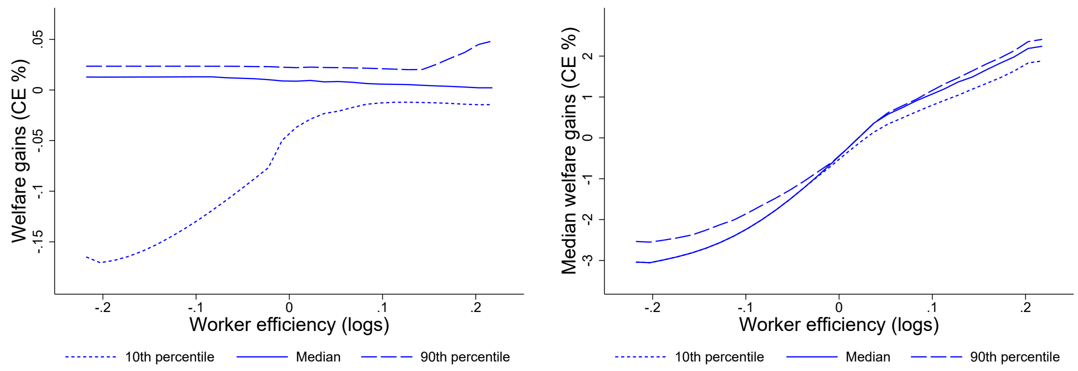
4.5 Welfare implications

Since our model provides implications on 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 just report how welfare changes over the wage distribution when removing the minimum-wage constraint.[18]

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 being moved from the baseline economy to one without the minimum wage.[19] Then, we compare how the welfare gains and losses are distributed among the entire household population, as well as on the sample of workers who are employed by minimum-wage-intensive firms. We report the results of this exercise in Figure 5.

Figure 5: Welfare gains/losses from removing the minimum wage

(a) All population (b) Workers of minimum-wage intensive firms



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, that is, they equal the constant rate of change imposed on workers' current and future consumption to bring them to the value they would achieve in the model economy without the minimum wage. We use the distribution of the baseline economy to weight these states. The left figure gives the 10th percentile, median, and the 90th percentile of gains for each worker efficiency level in the overall population. The right figure does the same for workers in a firm with the TFP at the 25th percentile among all firms, that is, the firms with the highest intensity of minimum-wage workers.

Panel (a) shows that the median welfare change caused by removing the minimum wage is close to zero. However, the dashed and dotted lines report the 10th and 90th percentile of the distribution of the welfare changes for each point of the wage distribution and show that the lack of welfare changes at the median level masks substantial heterogeneity. Indeed, the

[18]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).

[19]To be specific, we compute the consumption equivalence term, that is, the constant rate of change imposed on workers' current and future consumption to bring them to the value they would achieve in the world without the minimum wage.

distribution of welfare changes is highly tilted towards large welfare losses at the low end of the wage distribution, whereas at the higher end we observe some welfare gains. Next, we uncover how the heterogeneity in the welfare gains and losses from removing the minimum wage is accounted for by differences across firms in the intensity of minimum-wage workers and differences across households in their wealth levels.

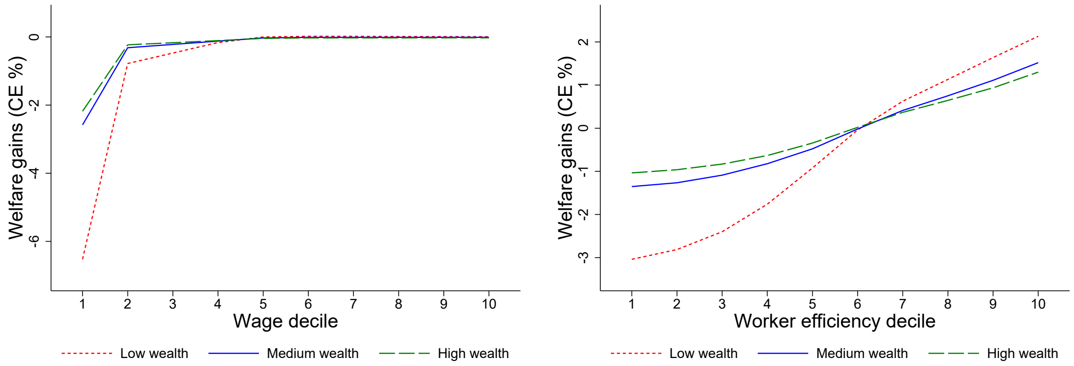
Panel (b) reports the welfare gains and losses over the wage distribution by focusing solely on those workers who are employed by firms in the first quartile of the TFP distribution, that is, the firms with the highest intensity of minimum-wage workers. The figure shows that removing the minimum wage substantially reduces the welfare of workers with low efficiency levels (up to a welfare drop of 3% in life-time consumption equivalence terms), and these losses are almost mirrored in absolute terms by the welfare gains among high-paid workers (up to a welfare surge of 2% in life-time consumption equivalence terms). Thus, although the minimum wage increases the unemployment risk of low-efficiency workers, the lower volatility of wages implied by the dampening of the pass-through of firm-level TFP shocks dominates such that these workers benefit from the presence of a wage floor. Instead, the opposite applies to high-paid workers who can benefit from a lower cyclicality of wages in an economy without minimum wages. Importantly, Panel (b) captures the quantitative relevance of the asymmetric pass-through on welfare across workers because it focuses on the case in which the incidence of wage floors alters most the allocation of firm risk across workers, that is, the minimum-wage intensive firms.

The heterogeneity in the welfare effects of removing the minimum wage is not shaped only by differences in firm TFP levels, but also by differences in wealth levels across households. To make this point, we report in Figure 6 the welfare changes of removing the minimum wage across the wage distribution by different levels of households' wealth: the dotted line indicates the workers in the lowest tercile of the wealth distribution (i.e., wealth-poor households), the continuous line indicates the workers in the second tercile, whereas the dashed line indicates the third tercile of the wealth distribution (i.e., wealth-rich households).

Panel (a) shows that when focusing on the entire households' population, the welfare changes of removing the minimum wage are quite flat with the remarkable exception of low-wage wealth-poor workers, whose welfare drops substantially when removing the wage floors. Again, these dynamics mask substantial heterogeneity in the welfare changes. Indeed, if we focus on the firms with the highest intensity of minimum-wage firms, then we observe that the welfare losses are concentrated among wealth-poor low-efficiency workers while the gains are among high-paid workers with low wealth levels, as depicted in Panel (b). Thus, while the distribution of welfare changes across wage levels depends on the incidence of minimum wages at the worker and firm level, these dynamics are substantially amplified when focusing on households with low wealth buffers.

Figure 6: Welfare gains/losses from removing the minimum wage: The role of wealth

(a) All population (b) Workers of minimum-wage intensive firms



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, that is, they equal the constant rate of change imposed on workers' current and future consumption to bring them to the value they would achieve in the model economy without the minimum wage. Panel (a) shows the gains and losses for each decile of the wage distribution across three group of workers: those at the first, second, and third terciles of the wealth distribution, respectively. Panel (b) shows an analogous plot by focusing only on workers who are employed by firms in the 25th percentile of TFP, that is, the firms with the highest intensity of minimum-wage workers.

The complementarities across workers with different efficiency levels in firm labor demand is key in shifting the welfare gains from removing the minimum wage from the low end of the wage distribution toward high-paid workers. Figure C.1 in Appendix C reports how the welfare changes of removing the minimum wage vary over both the wage and wealth distribution for the counterfactual economy that features perfect substitutability across workers with different efficiency levels. In this case, the model prescriptions are completely reversed, such that wealth-poor low-wage workers gain from eliminating the minimum-wage constraint, and the welfare losses are concentrated in the high end of the earnings distribution.

All in all, this section has shown that 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, we have found that also the welfare gains at the higher end of the wage distribution are 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 remuneration 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. Interestingly, 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 insurance within the firm highlighted by Guiso et al. (2005), Ellul et al. (2018), Lagakos and Ordoñez (2011), 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 then build a general-equilibrium incomplete-market model with heterogeneous agents and heterogeneous firms to provide a proof-of-concept that the asymmetric pass-through due to the wage floors generates heterogeneous welfare implications across workers. In this setting, we can parsimoniously account for the way in which the minimum wage modulates the pass-through of firm productivity shocks into wages by introducing a complementarity across different efficiency skill levels in firms' production function.

The model shows that the asymmetric pass-through tilts the benefits of removing minimum wages toward high-paid workers at the expense of those on low wages. These dynamics are further amplified when comparing individuals at the lower end of the wealth distribution. These results, thus, 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 level and worker level. Panel A reports firm-level information on the average monthly wage, the firm size in terms of employees, the share of blue-collar workers, log total assets, log turnover, the bite of minimum wage for the establishments associated to each firm, as well as the estimated series of firm-idiosyncratic TFP shocks. Panel B reports worker-level information on daily wages, the probability of losing a job, as well as the share of blue-collar, permanent, and part-time workers.

Table A.1: Summary statistics

	Mean	Standard Deviation
Panel A: Firm-level Variables		
Average Monthly Wage in Euros	2,403.6	643.1
Firm Size	500.9	1,319.0
Share of Blue-collar Workers	61.37	20.86
Log Total Assets	9.05	1.75
Log Turnover	11.31	1.72
Establishment level Bite	10.17	14.81
TFP Shock	0.56	21.26
Observations	2,511	
Panel B: Worker-level Variables		
Daily Wage in Euros	96.12	34.88
Probability of Losing a Job	3.02	17.11
Share of Blue-collar Workers	62.42	48.43
Share of Permanent Workers	98.31	12.90
Share of Part-time Workers	2.73	16.30
Observations	546,614	

B More on the Empirical Results

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. While the benchmark analysis in Section 2.6 has characterized the role of the incidence of minimum wages at the worker level by estimating the regression (8) on two samples of workers, one whose minimum-wage cushion is up to 20%, and one with a cushion above 20%, Table B.1 confirms the empirical evidence of Table 3 by splitting workers around a 30% minimum-wage cushion.

We ascertain the robustness of our results to alternative specifications for the firm-level labor-demand shocks. We complement the analysis of Section 2.6, which has relied on negative TFP shocks, by estimating regression (8) using either firm-specific labor productivity shocks, or firm-specific export shocks. We report the results of these two cases in Tables B.2 and B.3, respectively.

Then, we show that the asymmetric pass-through of the firm-specific labor-demand shocks into wages characterizes not only the response to negative shocks, but also that of positive shocks. To uncover this result, we use the series of firm-specific shocks in their continuous values, rather than focusing on their negative realizations. Tables B.4, B.5, and B.6 report the evidence on the asymmetric pass-through with respect to the continuous series of firm-specific TFP shocks, labor productivity shocks, and export shocks, respectively.

Finally, we study the pass-through of the firm-specific shocks into the wages of high-paid workers in a series of different samples, which allow us to isolate potential confounding factors. 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, top-ups, 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.7.

Table B.1: The blue-collar worker-level wage pass-through of firm-specific negative TFP shocks: The role of workers' cushion

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-30%	0-30%	>30%	>30%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.002	0.001	-0.001	0.001
	(0.003)	(0.004)	(0.003)	(0.003)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		-0.008		-0.053**
		(0.012)		(0.024)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	35,785	35,785	293,105	293,105

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm-level TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 30%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 30%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

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

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.014**	-0.020***	-0.016***	-0.013***
	(0.005)	(0.007)	(0.002)	(0.002)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		0.019		-0.038**
		(0.020)		(0.018)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	13,520	13,520	365,935	365,935

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm labor productivity shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

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

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.005	-0.006	0.002	0.005
	(0.004)	(0.011)	(0.003)	(0.004)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		0.030		-0.038*
		(0.023)		(0.023)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	5,991	5,991	190,508	190,508

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm export shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

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

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.002	0.004	0.003	-0.004
	(0.007)	(0.017)	(0.006)	(0.007)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		0.014		0.101***
		(0.035)		(0.035)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	12,454	12,454	320,678	320,678

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is the series of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

Table B.5: The blue-collar worker-level wage pass-through of firm-specific labor productivity shocks

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	0.050**	0.064**	0.077***	0.063***
	(0.020)	(0.026)	(0.009)	(0.012)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		-0.071		0.150*
		(0.074)		(0.086)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	13,520	13,520	365,935	365,935

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is the series of firm labor productivity shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

Table B.6: The blue-collar worker-level wage pass-through of firm-specific export shocks

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$			
Worker MinW Cushion$_{i,e,f,t}$:	0-20%	0-20%	>20%	>20%
	(1)	(2)	(3)	(4)
Shock$_{f,t}$	-0.001	0.010	0.007	-0.006
	(0.011)	(0.013)	(0.012)	(0.009)
Shock$_{f,t}$ $\times$ Establishment MinW Bite$_{e,f,t-1}$		-0.056		0.205**
		(0.035)		(0.103)
Worker-Establishment FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	5,991	5,991	190,508	190,508

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is the series of firm export shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. Columns (1) and (2) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is below 20%, and Columns (3) and (4) estimate the regressions – without and with the interaction term, respectively – for all workers whose minimum-wage cushion is above 20%. All regressions include firm and province-sector-year fixed effects. Regressions in Columns (2) and (4) also control for the establishment minimum-wage bite in isolation. 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.

Table B.7: The blue-collar worker-level wage pass-through of negative firm-specific TFP shocks: Alternative workers' samples

	Dependent variable: $\Delta \log \text{wage}_{i,e,f,t}$					
	Worker MinW Cushion$_{i,e,f,t}$:>20%					
	(1) Benchmark	(2) Young Workers	(3) Old Workers	(4) Excluding Top 20%	(5) Excluding Furlough	(6) Permanent Workers
Shock$_{f,t}$	0.001	0.003	-0.000	0.002	0.002	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Shock$_{f,t}\times$	-0.044**	-0.056***	-0.040*	-0.048**	-0.034**	-0.043**
Establishment MinW Bite$_{e,f,t-1}$	(0.020)	(0.022)	(0.022)	(0.019)	(0.016)	(0.020)
Worker-Establishment FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	320,678	165,422	150,293	279,946	219,664	315,431

Note: The table reports the estimates of panel regressions at the blue-collar worker-level on annual data from 1997 to 2015. In all regressions, the dependent variable is the wage growth of a blue-collar worker i employed in the establishment e associated with firm f in year t, and the key independent variables are the series of firm-specific labor-demand shocks, Shock$_{f,t}$, which is a dummy variable for all the negative observations of firm TFP shocks, and its interaction with the lagged value of the establishment minimum-wage bite, Establishment MinW Bite$_{e,f,t-1}$. All regressions focus on the sample of workers whose minimum-wage cushion is above 20%. Column (1) reports the results of the benchmark regression, Columns (2) and (3) split the sample by the age of the workers, such that Column (2) is estimated on a sample of young employees, whose age is between 20 and 41 years old, whereas Column (3) is estimated on a sample of old employees, whose wage is above 41 years old. Column (4) excludes the workers whose wage is in the top 20% of the sample, and Column (5) excludes the workers who have been subject to furlough policies. Column (6) excludes workers with temporary contracts. All regressions include firm and province-sector-year fixed effects, as well as control for the establishment minimum-wage bite in isolation. 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.

C More on the Model

C.1 Convexifying the workers' problem

The occupational choice problem is non-convex, as wokers can choose between a discrete set of different firm productivities. 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 level of firm TFP, adding to the value obtained by working in this firm level TFP. 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.[20] 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. Accordingly, the larger are these shocks, the steeper the wage profiles will be between low and high TFP firms.[21] We will revisit this aspect when we calibrate these shocks.

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

$$V(a, x, \boldsymbol{\epsilon}) = \max_{z \in \mathrm{Z}} \{V^o(a, x, z) + \epsilon_z\}, \tag{C.1}$$

where $V^o(a, x, z)$ denotes the value that workers with efficiency level x and asset holdings x receive from matching to a firm with productivity level z, as defined in Equation (18).

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 parameterπ_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. 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.

[20] 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.

[21] For instance, Shao et al. (2021) use such shocks to generate higher wages in firms with higher productivity.

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 $A(a, x, z; u)$, and the occupational-choice policy function as $O(a, x, z, \boldsymbol{\epsilon})$. 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 $\mathbf{O}(a, x, z)$.

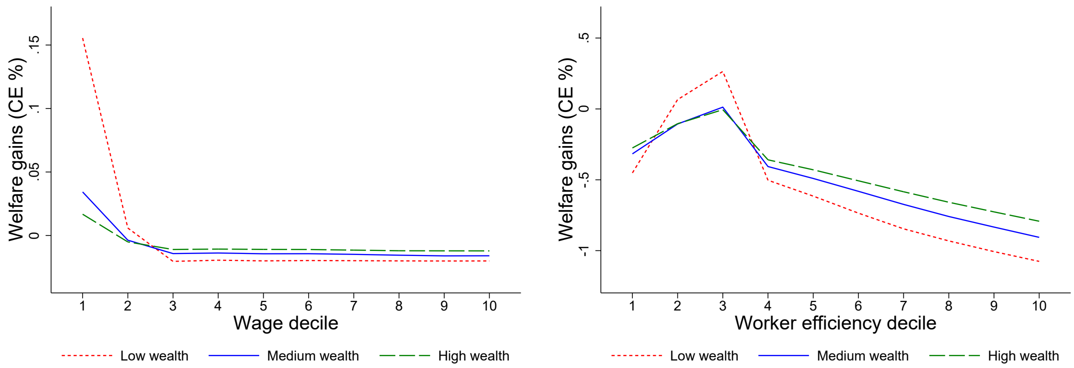
The SGE is a set of policy functions $A(a, x, z; u)$, $\mathbf{O}(a, x, z)$ for the workers, factor demands $K^\star(z)$ and $\mu^\star(x, z)$, firms' profit function $\pi(z)$, a probability distribution of workers $\lambda(a, x, z)$, an interest rate r, a wage function $w(x, z)$, an unemployment probability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

- The policy functions $A(a, x, z; u)$ and $\mathbf{O}(a, x, z)$ solve the worker problem (19) for each (a, x, z) given the prices, the unemployment probability function, and total profits.
- Firms' demand choices $K^\star(z)$ and $\mu^\star(x, z)$ solve their static profit maximization for each z given the prices.
- The profits received by households are consistent with the profits of each firm, given the prices:
$$\Pi = \sum_{j=1}^{N_z} \pi(z_j)\phi(z_j)$$
- The wages satisfy the minimum wage constraint: $w(x, z) \geq \underline{w}, \forall x, z$.
- 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:
$$\Phi(z)\mu^\star(x, z) = [1 - U(x, z)] \sum_a \lambda(a, x, z), \forall x, z \tag{C.2}$$
with $U(x, z) \geq 0$. Moreover, $U(x, z) > 0$ if and only if $w(x, z) = \underline{w}$.
- The asset market clears:
$$\sum_{j=1}^{N_z} \Phi(z_j)K^\star(z_j) = \sum_{j=1}^{N_z}\sum_{i=1}^{N_x}\sum_a \lambda(a, x_i, z_j)a.$$
- The distribution across worker states is time-invariant: $\lambda(a', x', z') =$
$$\sum_{j=1}^{N_z}\sum_{i=1}^{N_x}\sum_a \Gamma_x(x_i, x_i')\lambda(a, x_i, z_j) \times \sum_{u=0}^{1}\Big\{(uU(x, z) + (1-u)[1 - U(x, z)])\times \tag{C.3}$$
$$\mathbb{I}_{\{A(a,x,z;u)=a'\}}\Big[\Big(1 - s\Big)\Gamma_z(z, z') + s\mathbf{O}(a', x', z')\Big]\Big\}.$$

The last bracket captures the transitions of workers into firms of productivity z' due to the lack of option to switch (first part of the parenthesis) as well as receiving the option to quit and switching to a particular z'.

Figure C.1: The role of wealth in the welfare gains/losses from removing the minimum wage: The counterfactual economy with no complementarities in firm labor demand

(a) All population (b) Workers of minimum-wage intensive firms



Note: The figures report the welfare gains and losses from removing the minimum-wage constraint for each point of the wage distribution in a counterfactual economy in which there is no complementarity across efficiency levels in firm labor demand. The gains/losses are computed in consumption equivalence terms, i.e. they equal the constant rate of change imposed on each worker's current and future consumption to bring them to the value they would achieve in the model economy without the minimum wage. Panel (a) shows the gains and losses for each decile of the wage distribution across three group of workers: those at the first, second, and third terciles of the wealth distribution, respectively. Panel (b) shows an analogous plot by focusing only on the workers who are employed by firms in the 25th percentile of TFP, that is, the firms with the highest intensity of minimum-wage workers.