Labour market power and the quest for an optimal minimum wage: evidence from Italy

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Labour Market Power and the Quest for an Optimal Minimum Wage: Evidence from Italy*

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Abstract

This study investigates the recent trends in labour market power in Italy and assesses the impact of a potential minimum wage using a large sample of manufacturing firms. We show that, despite an average shift of labour market power from companies to workers, monopsony power is still widespread, especially in some sectors and regions. The introduction of a minimum wage would be beneficial to workers and the economy as it reduces the monopsony power of highly productive firms paying low wages; however, it may also have a negative impact, since firms with low wages and low labour productivity may react by reducing the number of their employees or even by exiting the market. Finally, we find that an optimal minimum wage, which minimises the negative effect and maximises the positive effect for the economy, ranges between 8.25 and 9.65 euro per hour.

Keywords: minimum wage, monopsony, market power, market imperfections.
JEL Classification: J23, J38, J42, L13.

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1 Introduction

Over the last two decades, economists' attitude toward minimum wages has substantially changed. Starting from Card and Krueger (1995), a long-standing scepticism based on the notion that an increase in labour costs inevitably leads to lower demand has given way to a more nuanced approach (Blumkin and Danziger, 2018; Dube, 2019; Manning, 2021), despite the persistence of disagreement in the profession (O'Neill, 2015). On one hand, the recognition that deviations from perfect competition are both larger and more common in the labour market than in other parts of the economic system implies that a "textbook model" analysis of the minimum wage does not apply. On the other hand, increased data availability and advances in empirical research have shown that the introduction of wage floors (or their increase) generally have a little or no negative effect on employment (McVicar et al., 2019). What is more, this conclusion holds true even when focusing on the groups of workers most likely to be affected by minimum wages (Addison et al., 2015; Cengiz et al., 2019; Manning, 2021). These results are generally robust across countries (Dube, 2019), while some heterogeneity exists across industries, with tradeable sectors and manufacturing experiencing somehow stronger effects (Harasztosi and Lindner, 2019).

One key message from the recent literature is that the effects of minimum wages on employment crucially depend on the context. For instance, results by Clemens and Wither (2019) suggest that the impact on employment may differ if minimum wage spikes take place during expansionary phases of the economic cycle or during recessions. In more general terms, the context shapes the way firms react to wage floors and the margins along which they adjust to the policy change. In this regard, Clemens (2021) highlights that labour demand is just one of the possible adjustment mechanisms, and firms can (and will) adapt also by changing prices (Harasztosi and Lindner, 2019), compressing profits (Draca et al., 2011), increasing productivity (Dube, 2019) or even by means of non-compliance (Garnero and Lucifora, 2021).

One of the factors that significantly affect the implications of a minimum wage is the existence of imperfections in the labour market. In the presence of monopsony power, a minimum wage does not necessarily increase unemployment, since the measure would simply push wages that are kept artificially low by market power toward the level that should prevail without distortions. Moreover, such a policy may also boost both output and labour demand (see Dube, 2019, who reviews more than 50 recent empirical studies on wage floors). Indeed, according to the study by Munguía Corella (2020), who investigates the employment effects of a minimum wage in the US with a focus on young workers, a minimum wage policy has, on the one hand, a negative impact on competitive labour markets and, on the other hand, a (small) positive impact on monopsonistic labour markets.

In this paper, we build on recent empirical work documenting product and labour market imperfections (De Loecker and Warzynski, 2012; Dobbelaere and Mairesse, 2013; Dobbelaere and Kiyota, 2018; Caselli et al., 2021) to examine the patterns of labour market power in the Italian manufacturing sector. We then propose a novel approach that links a potential minimum wage to firm-level product and labour market power to assess the impact of this policy measure on a representative sample of manufacturing firms. This empirical strategy also allows us to estimate an *optimal* minimum wage, that is, the value that minimises the negative effect and maximises the positive effect of this policy on the economy.

To preview our main results, we find that, while the share of firms paying wages that are below the marginal revenue product of labour (namely, monopsonist firms) has fallen significantly over time (from above 50% in 2011 to below 38% in 2018), their number is still high, especially in some regions. A minimum wage would positively affect the economy by reducing the monopsony power of highly productive firms paying low wages, but at the same time put pressure on low-productivity firms. The optimal value that maximises the net effect on the economy ranges between 8.25 and 9.65 euro per hour.

Our work contributes to the literature in several ways. First, by bridging the stream of research analysing firm-level product and labour market power with the literature on the implications of a minimum wage, this study provides evidence on two relevant topics that have often been the object of discussion in the Italian context, but which have not yet been thoroughly scrutinised together. Second, to the best of our knowledge, this contribution is the first one to calculate an optimal minimum wage combining information on firms' wages, the estimated marginal revenue product of labour, and market power. Third, as the debate concerning the implementation of a legal minimum wage has recently gained new momentum, our findings can provide useful directions to policy makers.

Italy represents an interesting case study on several grounds. First, although some proposals on the matter have been put forward in recent years, it is one of the few European countries where no statutory minimum wage exists due to the opposition of both employers and unions, which fear a loss of bargaining power. Second, wage floors are provided by collective agreements that only apply to signatory firms. However, Garnero and Lucifora (2021) document a significant phenomenon of non-compliance, which is facilitated by the large number of (partly) overlapping agreements. Indeed, Garnero (2018) estimates that around 10% of workers are paid one fifth less than the reference minimum wage. Third, the Italian economy exhibits some worrying macro-trends, such as slow output growth, low business turnover, and increasing income inequality, which have been regarded as symptoms of widespread market power (De Loecker et al., 2020).

The remaining of the paper is organised as follows. Section 2 briefly describes the procedure to estimate labour market power and the data. Section 3 illustrates the trends and distribution of labour market power in the Italian manufacturing sector. Section 4 assesses the potential impact of the introduction of national minimum wage in Italy and calculates the values of an optimal minimum wage. Finally, Section 5 concludes.

2 Analytical Framework and Data

2.1 Production Function Estimation

To measure frictions in the labour market, we build on work by De Loecker and Warzynski (2012), Dobbelaere and Mairesse (2013) and Caselli et al. (2021). This approach assumes that firms minimise costs and at least one input (in this case materials) is adjusted freely, while the other factors (capital and labour) may show some frictions in their adjustment. An advantage of this setup is that it requires no specific assumptions on either demand or market structure, nor does it need the computation of the user cost of capital. Moreover, it provides firm-level, time-varying estimates while controlling for unobserved productivity.

We define our measure of labour market power, ϕ, as the ratio between the average labour cost paid by firms (w), which we observe in the data, and the marginal revenue product of labour MRP^L:

$$\phi_{it} = \frac{P_{it}^L}{MRP_{it}^L}, \tag{1}$$

where i is the subscript for firms and t for years. The parameter ϕ captures the wedge between the cost of an additional unit of labour and the revenue it generates (both in nominal terms) and, thus, it is a measure of market power on the side of firms' employees. If $\phi = 1$, the wage is equal to the marginal revenue product of labour and the labour market is competitive. This labour market regime is labelled "competition" or "right-to-manage" (PR). On the other hand, any departure from unity signals frictions, stemming from either the existence of labour market power owned by the firms, resulting in $\phi < 1$ and implying that the marginal revenue of labour is higher than the wage, or from some degree of market power by firms' employees, which results in $\phi > 1$. The labour market regimes associated with $\phi < 1$ and $\phi > 1$ are termed "monopsony" (MO) and "efficient bargaining" (EB), respectively. Possible sources of monopsony power are employer collusion (employer use of non-compete agreements), "job lock" mechanisms, regulatory barriers, market concentration and other labour market frictions such as search costs arising from limited information, application costs and barriers to workers' mobility due to housing costs or family constraints.

As Mertens (2020) and Caselli et al. (2021) show, ϕ can be expressed in terms of the ratio of the output elasticity of materials over the revenue-based materials share and the output elasticity of labour over the revenue-based labour share:

$$\phi_{it} = \frac{\theta_{it}^M/\alpha_{it}^M}{\theta_{it}^L/\alpha_{it}^L} = \mu_{it} \cdot \frac{\alpha_{it}^L}{\theta_{it}^L}, \tag{2}$$

where θ^M and θ^L are the output elasticities of materials, M, and labour, L, and α^M and α^L are the revenue-based materials and labour share, and μ represents firms' product market power (markup) as defined by De Loecker and Warzynski (2012), namely the ratio of the output elasticity of materials over the revenue-based materials share.

While revenue shares can be easily computed using data from firms' balance sheets, the output elasticities need to be estimated.[1] In order to get unbiased estimates of θ_{it}^M and θ_{it}^L, we estimate a production function and employ the methodology developed by Wooldridge (2009) and implemented in Petrin and Levinsohn (2012) to address the simultaneity bias. We adopt a translog specification, which yields firm-level time-varying output elasticities, and perform estimations sector by sector, to account for differences in technology.[2] We

[1]Following De Loecker and Warzynski (2012), we apply a correction to the revenue shares due to the fact that we have data on firm output including an error unobservable to both the econometrician and the firm. Hence, we run a first step in which we regress output on a third-order polynomial of all inputs, which we use to remove the random-error term from output and to obtain estimates of expected output. We then correct the revenue shares by multiplying them by the error term. This adjustment cleans the revenue shares from any variations in output that is not related to variables affecting input demand. We also check how robust this first step is by regressing output on a fourth-order polynomial of all inputs and the results do not change in any significant way. These additional results are available upon request.

[2]As a robustness check, we estimate our production function based on a Cobb-Douglas specification. In this case, the estimated output elasticities are constant within each sector and, despite this, they are close to the average sectoral values obtained using the translog specification. Similarly, the market imperfection parameters are highly correlated across the two specifications. These additional results are

assume that labour is a variable input, and instrument current labour and materials and their interactions with the first and second lags of labour as well as the second lags of capital and materials. We proxy output using deflated revenues, as we do not have information on firm output prices. Additional details on the methodology used to estimate the production function are provided in Appendix A.

2.2 Data

We use data on a large panel of Italian manufacturing firms. The data come from the commercial database AIDA by Bureau van Dijk and cover the decade 2010–2019, but information for both 2010 and 2019 features a large number of missing values; therefore, the analysis is restricted to the period 2011–2018.

The database collects balance sheet information for around 1 million Italian limited companies. We retrieve information on revenues, labour costs, number of employees, book value of the capital stock, expenditures on intermediate inputs (i.e., materials), plus the industrial sector of activity, and the year of birth of the firm. We merge these firm-level data with industry-level deflators for value added, intermediate inputs and tangible assets compiled by the National Statistical Office (Istat) and OECD-Stan.

The data require cleaning to net out the influence of measurement errors and extreme values.[3] We restrict the analysis to manufacturing firms and exclude firms that remain in the sample for less than five consecutive years. The resulting dataset contains 30,416 firms and 235,428 observations.

Table 1 provides some descriptive statistics on our sample, including revenues, number of employees and gross wages per employee. The average firm has approximately 30 employees, while the median has 13. Istat reports that in 2018 the Italian manufacturing sector was composed by over 377,000 firms with the average firm having slightly less than 10 employees and the median firm falling in the category of 0 to 9 employees.[4] This implies that our sample covers slightly less than 10% of manufacturing firms in 2018 and is composed (on average) of larger firms. This is to be expected given that the AIDA database covers only limited companies, which tend to be larger than other types of firms.

Table 1: Descriptive statistics

	Mean	St. dev.	25th pct	Median	75th pct
Revenues (1,000)	7,113	38,600	810.4	1,791	4,565
Employees	29.74	100.1	7	13	26
Wages per employee	35,030	12,932	26,362	34,465	42,557

Notes: The table reports the mean, standard deviation, 25th percentile, median and 75th percentile for revenues in thousands euros, number of employees and gross wages per employee in euros. The number of observations is 235,428.

available upon request.

[3] We delete all observations with missing values on revenues and the three inputs, labour, materials and capital, those exhibiting growth rates for all these variables in excess of 400% or below -80%, and those for which revenues are lower than the sum of labour costs and expenditures on materials.

[4] Data from Istat can be accessed via http://dati.istat.it/.

3 Labour market power in Italian manufacturing

3.1 Descriptive statistics

In this section, we provide some descriptive statistics for our production function estimates as well as product and labour market power to illustrate how market inefficiencies vary across sectors and over time.

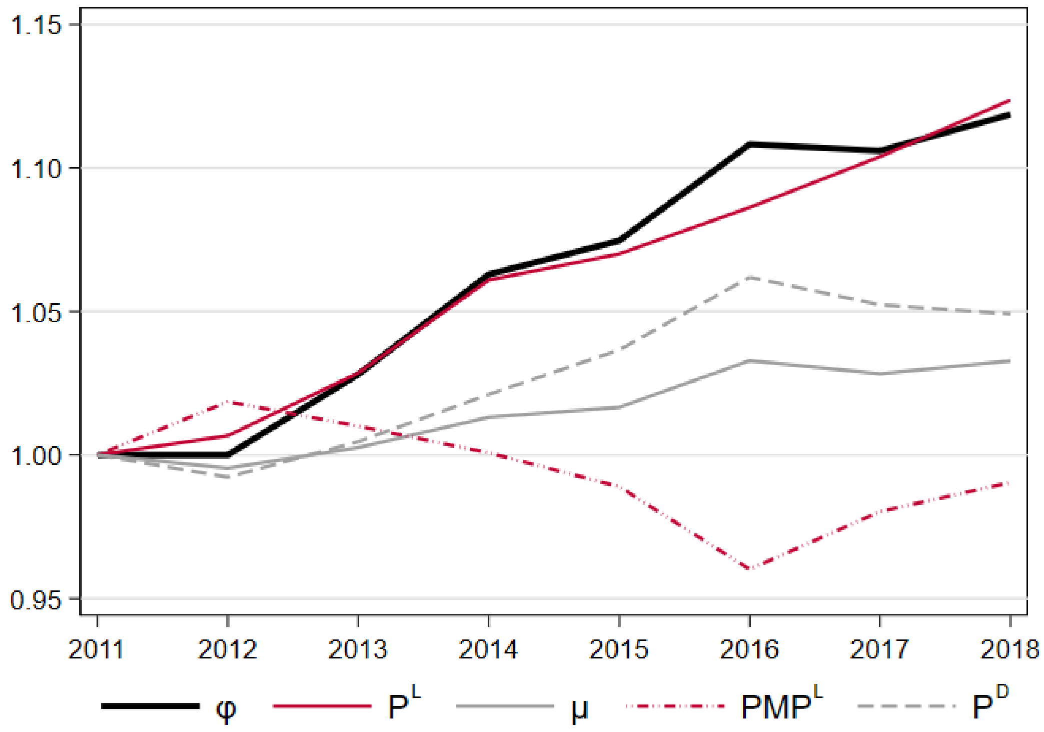
Table 2 presents the average values of the estimated output elasticities of labour, materials and capital derived at the sectoral level from the translog production function as well as the measure of labour market power. The estimated average factor elasticities θ^M and θ^L amount to 0.71 and 0.28, respectively. These values are similar to those found in Mertens (2020) for Germany and Caselli et al. (2021) for France. As expected, the mean parameter estimates vary across manufacturing sectors, which engage in different production processes and thus typically employ different combinations of factors. Specifically, the sector "Food, beverages and tobacco" exhibits the lowest level of θ^L (i.e, 0.172) and the highest level of θ^M (i.e., 0.776); conversely, the sector "Basic metals and fabricated metal products" displays the largest θ^L (i.e., 0.317) and the smallest θ^M (i.e., 0.667). This sectoral heterogeneity is also displayed in our measure of labour market power. Most industries exhibit an average labour market power parameter above 1, implying that firms and workers engage in efficient bargaining resulting in some degree of market power that favours firms' employees, with the exception of the "Chemicals and pharmaceuticals" industry. Mertens (2020) and Caselli et al. (2021) also find that on average German and French firms tend to engage in efficient bargaining. However, mean values mask substantial heterogeneity across firms in the same sector.

Table 2: Production function estimates and labour market power

Sector	No obs	θ^L	θ^M	θ^K	ϕ
Food, beverages and tobacco (10-12)	21 975	0.172	0.776	0.038	1.276
Textiles, apparel and leather (13-15)	26 604	0.296	0.678	0.031	1.099
Wood and paper products (16-18)	24 710	0.289	0.706	0.014	1.019
Chemicals and pharmaceuticals (20-21)	8 700	0.237	0.764	0.025	0.924
Rubber and plastic products (22-23)	11 024	0.259	0.735	0.030	1.176
Basic metals and fabricated metal products (24-25)	78 360	0.317	0.667	0.028	1.088
Computer, electronic and optical products (26)	4 614	0.291	0.715	0.019	1.151
Electrical equipment (27)	8277	0.235	0.772	0.014	1.246
Machinery and equipment (28)	26 095	0.282	0.709	0.027	1.064
Transport equipment (29-30)	3 602	0.266	0.730	0.030	1.149
Other manufacturing (31-33)	21 467	0.306	0.688	0.016	1.116
Total	235 428	0.284	0.701	0.026	1.106

Notes: The sectoral averages of the parameters are unweighted. We estimate the production function for each of the eleven manufacturing sectors listed in the table. To define such sectors, we follow the classification by NACE divisions used by Istat. We combine observations corresponding to NACE codes 20 and 21 in a single sector (Chemicals and Pharmaceutical products) due to the limited number of observations. Moreover, we exclude NACE sector 19 (Coke and refined petroleum products) due to its very small size and its peculiarities. Kleibergen-Paap F statistics (test for informativeness of instruments): sectors 10-12, 7.120; sectors 13-15, 3.167; sectors 16-18, 10.83; sectors 20-21, 4.627; sectors 22-23, 12.05; sectors 24-25, 54.86; sector 26, 4.177; sector 27, 7.504; sector 28, 37.54; sectors 29-30, 2.764; sectors 31-33, 22.41.

Figure 1: Decomposition of labour market power (ϕ) (2011 = 1)



We are also interested in the evolution of labour market imperfections over time. Figure 1 illustrates the trend of average ϕ weighted by the firms' revenue shares (solid black line). Over the period 2011–2018, ϕ experienced an 11% increase, from about 1.05 to 1.17, indicating a shift of labour market power from firms towards their employees. The overall picture does not significantly vary if we use the firms' employment shares as weights.

3.2 Decomposition of ϕ

To shed light on the documented increase in bargaining power, we follow Caselli et al. (2021) and decompose ϕ into four fundamental dimensions: observed wages, the price-cost margin, the marginal product of labour, and prices. To see this, notice that MRP^L_{it} is the product between the marginal product of labour, MP^L_{it}, and the marginal revenue, MR_{it}. Given that, in equilibrium, the latter equals the marginal cost ($MR_{it} = MC_{it}$), and exploiting the definition of the markup as the ratio between price and marginal cost ($\mu_{it} = {}^{P_{it}}/_{MC_{it}}$), ϕ_{it} can be written as:

$$\phi_{it} = \frac{P^L_{it}}{MRP^L_{it}} = \frac{P^L_{it} \cdot \mu_{it}}{P_{it} \cdot MP^L_{it}}, \tag{3}$$

where P_{it} denotes firm-year specific prices on the product market. Since we do not have direct information on firm-level prices and quantities, the terms P_{it} and MP^L_{it} are unobserved, and cannot be separately identified when deflating revenues ($Q_{it}P_{it}$) by means of an industry price index (P^D_t) as a proxy for physical output.

We define $PMP_{it}^L = \theta_{it}^L \frac{Q_{it}}{L_{it}} \frac{P_{it}}{P_t^D} = MP_{it}^L \frac{P_{it}}{P_t^D}$ and substitute for $P_{it} \cdot MP_{it}^L$ in equation (3) to obtain the following expression, in which all elements are measurable

$$\phi_{it} = \frac{P_{it}^L \cdot \mu_{it}}{PMP_{it}^L \cdot P_t^D}. \tag{4}$$

Taking logs of equation (4) leads to the following expression:

$$\log(\phi_{it}) = \log(P_{it}^L) + \log(\mu_{it}) - \log(PMP_{it}^L) - \log(P_t^D). \tag{5}$$

Along with ϕ, Figure 1 also shows its components based on the decomposition just illustrated. We observe that the overall positive trend of our indicator of labour market power is related to the (muted) increase in product market power and, primarily, to the rise in the average nominal gross wage, which more than compensates for the contraction of the value of the marginal productivity of labour that occurred between 2012 and 2016.[5]

3.3 Labour Market Regimes

From the previous section, it emerges that, even though, on average, bargaining power and gross wages have risen in recent years, there are still relevant income differences across workers. Moreover, the overall picture of increasing bargaining power may hide relevant sectoral and geographical heterogeneity. To uncover further information on the distribution of labour market power in the Italian manufacturing sector, we use the estimates of ϕ to classify each firm-year observation into different labour market regimes depending on whether the average wage is above/below the marginal revenue product of labour (see Section 2.1).[6]

Table 3 reports, for each sector, the shares of firm-year observations that fall within each regime. Overall, we see that labour market frictions are pervasive in the Italian economy, with almost 95% of firms in our sample being classified either in monopsony or in efficient bargaining. Thus, although wages and bargaining power have been on the rise over the 2011–2018 period, many manufacturing firms enjoy some degree of monopsony power. The sectors where this market setting is more widespread are *Chemicals and pharmaceuticals* and *Wood and other products*, whereas *Food, beverages and tobacco*, *Transport equipment*, *Rubber and plastic*, and *Electrical equipment* present the highest shares of firms in which, on average, the wage is higher than the marginal revenue product of labour.

Even though we do not show it, significant heterogeneity is observed at the geographical level too. In particular, in Central and Southern Italy there is a higher number of firms with monopsony power compared to Northern Italy.

Finally, the distribution of labour market regimes has changed over time. Consistent with the positive average trend of ϕ, Figure 2 shows that, between 2011 and 2018, the number of observations that falls into the MO category declined from 50.3% to 37.9%, while the number of observations characterized by efficient bargaining increased from 44% to 56.5%.

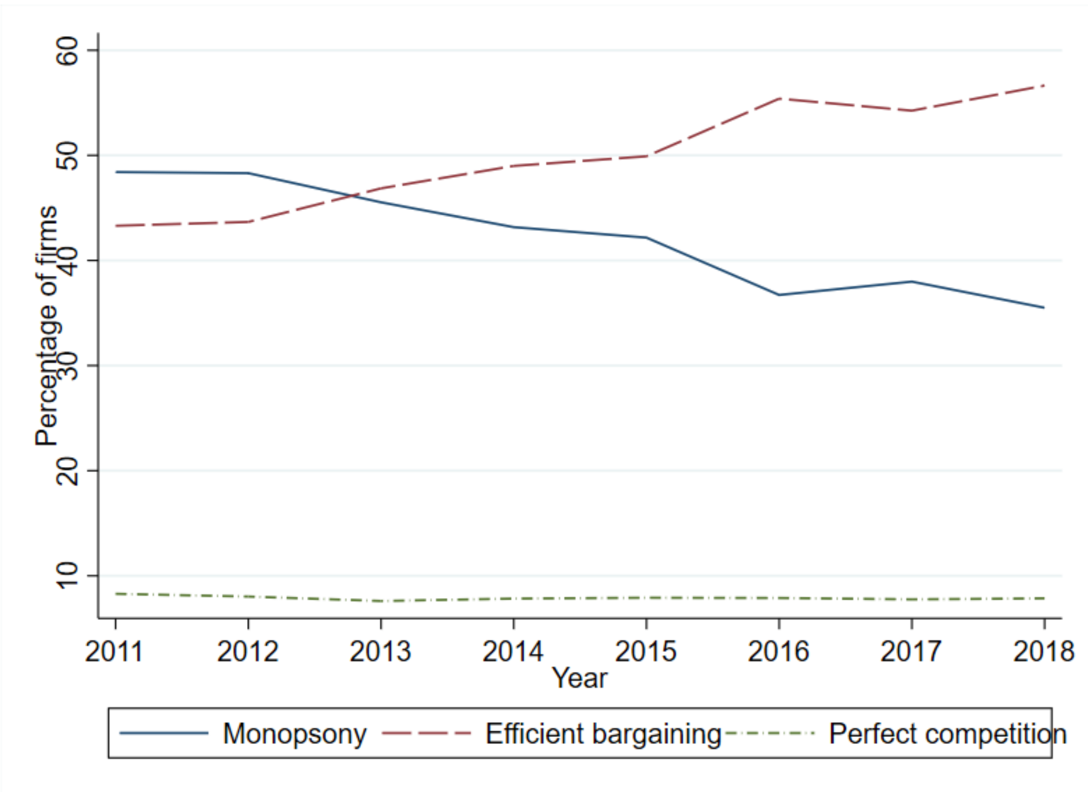
[5]Further analysis reveals that the rise in labour costs is driven by an increase in the compensation of employees, while social security contributions and other charges change very little.

[6]The classification of each firm-year observation in the different regimes follows Dobbelaere and Mairesse (2013) and Caselli et al. (2021), and is based on a 5% confidence interval around $(\theta_{it}^M/\alpha_{it}^M - \theta_{it}^L/\alpha_{it}^L)$.

Table 3: Labour market regimes by sector

Sector	PR	EB	MO
Food, beverages and tobacco (10-12)	18.1%	56.4%	25.6%
Textiles, apparel and leather (13-15)	8.6%	46.7%	44.7%
Wood and paper products (16-18)	8.7%	39.1%	52.2%
Chemicals and pharmaceuticals (20-21)	8.6%	26.2%	65.2%
Rubber and plastic products (22-23)	11.0%	58.6%	30.4%
Basic metals and fabricated metal products (24-25)	3.4%	52.3%	44.3%
Computer, electronic and optical products (26)	15.9%	51.7%	32.4%
Electrical equipment (27)	13.2%	66.5%	20.2%
Machinery and equipment (28)	4.9%	49.7%	45.4%
Transport equipment (29-30)	16.2%	56.7%	27.1%
Other manufacturing (31-33)	8.7%	48.6%	42.7%
Total manufacturing	7.9%	49.9%	42.2%

Figure 2: Labour market power and regimes over time



This brief overview of the labour market regimes offers a more nuanced picture compared to the preliminary analysis of the evolution of ϕ. In particular, it shows that, although, on average, there is a rise in employees' labour market power to the detriment of the employers, the presence of monopsony power is still widespread, especially in some manufacturing sectors and in Central and Southern Italy. These labour market frictions may be attenuated by the introduction of a legal minimum wage, which may prevent monopsonistic firms in a strong negotiating position from squeezing their workers.

4 A firm's perspective on the minimum wage

In this section, we take advantage of our measure of labour market power and the definitions of labour market regimes at the firm-year level to assess the potential impact of the introduction of a national minimum wage in Italy from the firm's perspective.

The premise of our novel approach is that firms paying an average wage below the statutory minimum will be affected by the introduction of a minimum wage as they will face higher labour costs. Among these firms, those that pay an average wage above their marginal revenue product of labour (i.e., those with lower labour productivity) may reduce employment or be driven out of the market since the gap between wages and productivity will increase further after the introduction of a minimum wage. This is clearly to be considered a negative effect on the economy, at least in the short run before resources are reallocated to other (potentially more-productive) firms. On the other hand, highly productive firms with a marginal revenue product of labour above the average wage will start paying higher wages after the introduction of the minimum wage. This can be regarded as a positive effect on the economy, as it is supposed to reduce firms' monopsony power and it may increase employment levels.

4.1 Definition of a minimum wage and a classification of firms

In order to conduct our assessment, we first need to define a hypothetical minimum wage and classify our firms in different categories based on their degree of labour market power and whether their average wage and marginal revenue product of labour are above or below the chosen minimum wage.

We choose a minimum wage of 9 euro per hour, which is similar to the level set in Germany in 2015 and corresponds to the value discussed by the Italian Parliament. This hourly wage is intended to be gross of income tax but net of social security contributions (as minimum wages are generally computed this way). To reconcile this definition with our firm-level data on labour costs, which are expressed on a yearly basis and include social charges, we proceed as follows: first, we compute the average share of social security contributions (SSC) in the total wage bill for firms with labour costs around the average $\pm 10\%$; this amounts to 28.4%. Then, we obtain the yearly minimum wage (MW) as the hourly minimum wage times the average number of hours worked (168 hours per month times 12 months) divided by $(1 - SSC)$:

$$MW = \frac{9€ \times 168 \times 12}{1 - SSC} = 25,332€.$$

Next, we use this hypothetical minimum wage, together with data on ϕ, average wages and MRP^L (with the latter being derived as the ratio between wages and ϕ) to classify firms in four categories (Cat).

- Cat 1: firms with low wages, low labour productivity, and with workers holding some degree of market power (i.e., $w < MW$, $MRP^L < MW$ and $\phi \geq 1$). The impact of a minimum wage on these firms is likely to be negative, as imposing a wage that exceeds the marginal revenue product that workers provide may reduce firms' labour demand and, in extreme cases, push them out of the market;

- Cat 2: monopsonist firms with low wages and low labour productivity (i.e., $w < MW$, $MRP^L < MW$ and $\phi < 1$). The effect of the minimum wage on firms and workers is ambiguous: on one hand, as in the case of Cat 1, it may induce exit or a fall in employment; on the other hand, it would attenuate firms' monopsony power by leading to higher wages and thus be beneficial to workers and the economy;

- Cat 3: firms with low wages but high labour productivity (i.e., $w < MW$, $MRP^L > MW$ and $\phi > 1$). By definition, these firms enjoy monopsony power; a minimum wage can reduce market imperfections, benefit workers and increase efficiency.

- Cat 4: firms already paying wages equal or higher than the minimum wage (i.e., $w \geq MW$). The impact of the minimum wage is likely to be negligible.

Accordingly, the introduction of a minimum wage would cause two concomitant opposite effects on the workers and the economy: on one hand, there would be a negative effect, since firms with low wages and low labour productivity may respond by reducing the number of their employees or even by exiting the market; on the other hand, there would be a positive effect which is attributable to the reduction of monopsony power.

The distribution of all our sampled firms in 2018 across the four aforementioned categories is illustrated in Panel(a) of Figure 3, from which it can be noticed that the majority of the firms fall into Cat 4. Moreover, as it can be observed in Panel (b) of Figure 3, this group expanded between 2011 and 2018, while the shares of firms in categories 2 and 3 decreased. Nonetheless, in 2018 the remaining categories still account for more than 15% of the sampled firms, suggesting that the introduction of a minimum wage may have a significant impact on the labour market.

Moreover, relevant differences in the distribution of firms across categories emerge at the geographical level. As illustrated in Figure B1 in Appendix B, firms whose average wage is below the hypothesised minimum wage are mainly located in Southern Italy and, to a lesser extent, in Central Italy. Thus, we expect the introduction of a minimum wage to mainly affect the regions beloning to these two macro-areas.

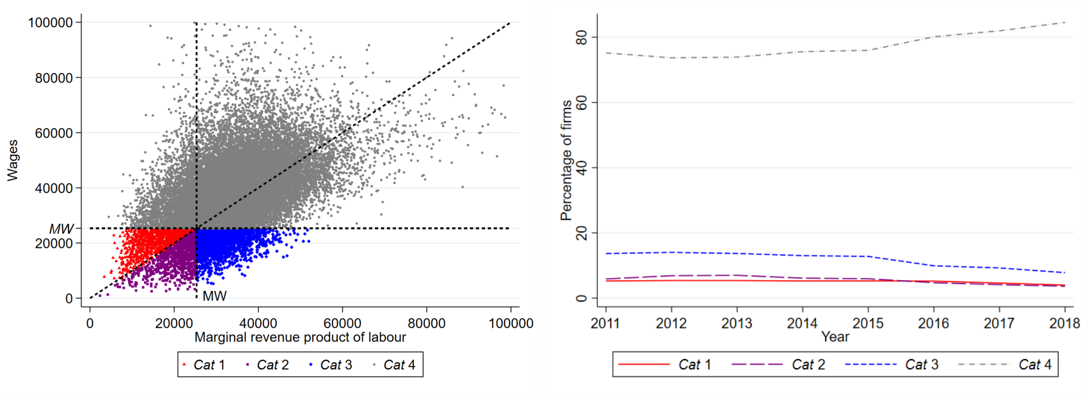
4.2 Regression Analysis

In this section, we study how our classification of firms relates to a number of firm-level characteristics. To this purpose, focusing on year 2018, we employ a multinomial probit (MNP) specification to estimate the following equation:

$$MWcat_{ik} = \beta_{0k} + \beta_{\omega k}\omega_{-3,i} + \beta_{\mu k}\mu_{-3,i} + \beta_{Xk}X_{-3,i} + \epsilon_{ik} \quad (6)$$

Figure 3: Classification of firms by average wages, MRPL and minimum wage

(a) 2018 (b) Evolution



where $MWcat_{ik}$ is the MW category of firm i in 2018, $\omega_{-3,i}$ is total factor productivity (TFP) for firm i in 2015, μ is the markup, X is a vector of other firm characteristics (i.e., number of employees, age and a dummy indicating if the firm engaged in outward FDI), and ϵ_{ik} is the error term. While we refrain from interpreting the results below in causal terms, we still wish to mitigate potential endogeneity issues. Thus, we observe the firm-level characteristics at time t-3 (i.e., in 2015). Since the explanatory variables μ and ω are estimated rather than observed, we compute bootstrapped standard errors.

Table 4 displays the marginal effects from the MNP regressions. Two main considerations prompted by the results are the following. First, as it can be expected, firms with high TFP (in the past) are more likely to fall in *Cat* 4, namely, to pay high wages. Second, firms with high markups are more likely to be in *Cat* 1 or in *Cat* 2 compared to the omitted category. This less anticipated finding suggests that, interestingly, some firms compress wages to compensate for low labour productivity and still earn high rents via higher margins.

4.3 Optimal minimum wage

We saw that the net effect of the introduction of a minimum wage on workers and the economy is ambiguous as two concomitant opposite effects unfold. In light of these considerations, we present a simple comparative statics exercise where we define an *optimal* minimum wage, namely the value that minimises the share of firms in *Cat* 1 (i.e., those with low wages and low labour productivity that would be negatively affected by the introduction of a minimum wage) and maximises the share of firms in *Cat* 3 (namely, the firms with high labour productivity paying low wages which would experience a reduction in monopsony power).[7] Accordingly, we calculate the difference between the share of firms in *Cat* 1 and the share of firms in *Cat* 3 for distinct values of the minimum wage for every year between 2011 and 2018.

As displayed in Panel (a) of Figure 4, the value that minimises this difference for 2018 (based on the unweighted share of firms) equals 23,260 euro (or 8.25 euro per hour net of

[7] As these two opposite effects on firms can be both observed in *Cat* 2, thus making the final result ambiguous, we decide to exclude these companies from the analysis.

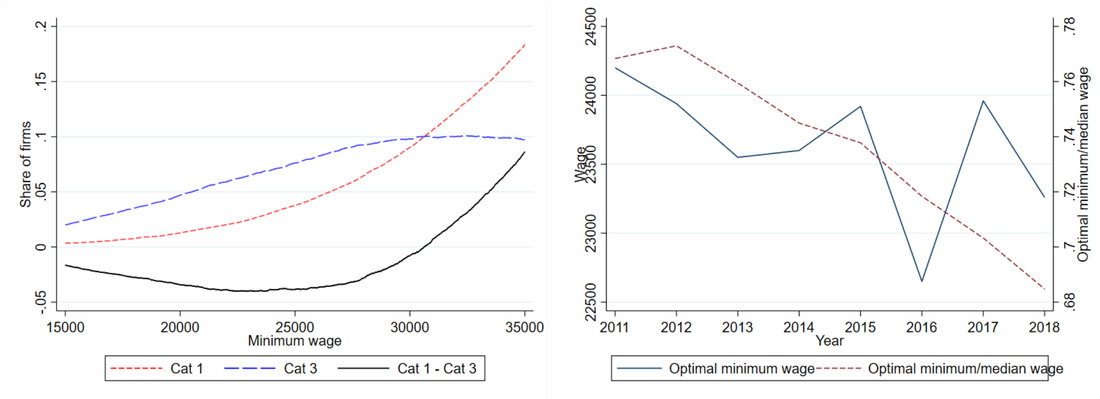
Table 4: Marginal effects of firm characteristics on minimum wage category, 2018

	(1)	(2)	(3)	(4)
Cat 1. Low w, low MRP^L, $\phi >= 1$				
TFP_{t-3}	-0.730	-0.438	-0.547***	-0.379***
	(0.547)	(0.363)	(0.223)	(0.088)
	[0.079]	[0.080]	[0.050]	[0.049]
$markup_{t-3}$			0.215***	0.193***
			(0.023)	(0.015)
			[0.007]	[0.007]
Cat 2. Low w, low MRP^L, $\phi < 1$				
TFP_{t-3}	-0.441	-0.298***	-0.441*	-0.364***
	(0.364)	(0.135)	(0.228)	(0.095)
	[0.065]	[0.055]	[0.054]	[0.053]
$markup_{t-3}$			0.169***	0.132***
			(0.021)	(0.010)
			[0.007]	[0.007]
Cat 3. Low w, high MRP^L				
TFP_{t-3}	-0.314	-0.142	-0.354	-0.102
	(0.255)	(0.277)	(0.360)	(0.239)
	[0.080]	[0.087]	[0.099]	[0.116]
$markup_{t-3}$			-0.141***	-0.254***
			(0.031)	(0.030)
			[0.016]	[0.019]
Additional controls	no	yes	no	yes
Sector FE	yes	yes	yes	yes
NUTS-1 FE	yes	yes	yes	yes
Observations	28,537	28,531	28,537	28,531

Notes: The regressions are estimated via multinomial probit. The baseline category is high-wage firms (*Cat* 4). Standard errors in parenthesis are bootstrapped and clustered at the firm level, while standard errors in squared brackets are robust. ***, ** and * indicates coefficients significantly different from zero at 1, 5 and 10% level respectively.

Figure 4: Optimal minimum wage

(a) 2018 (b) Evolution



SSC), and thus it is 8.5% lower than the hypothesised minimum wage. When we weight observations using employment shares, we get a higher value (27,160 euro or 9.65 euro per hour net of SSC), which is 7% above the reference of 9 euro per hour, but still falling in the same range (see Figure B2 in Appendix B). Consequently, the minimum wage of 25,332 euro used in this analysis and discussed in the Italian Parliament falls within this range.

We also show how the optimal minimum wage has evolved between 2011 and 2018. Panel (b) of Figure 4 indicates that the optimal minimum wage (left y-axis) has remained relatively stable, with just a slightly declining trend during the period under scrutiny. This is consistent with the shift of labour market power from the employers to their employees, which implies a decline in the magnitude of the (positive) impact of the minimum wage and a limited consequent reduction in monopsony power. Finally, it can be noticed that the optimal minimum wage calculated for 2018 corresponds to about 63-73% of the median manufacturing wage observed in our sample for that year (right y-axis), a value that lies within the range considered unlikely to have a negative impact on employment by Dube (2019).

5 Conclusions

Building on recent empirical work on the estimation of labour market imperfections, we investigate the recent trends in labour market power in a large sample of Italian manufacturing firms. We document a significant overall shift of labour market power from the employers to their employees, which is mainly associated with an increase in the average gross nominal wage. However, this somehow reassuring picture hides relevant wage inequality across workers, and also relevant sectoral and geographical heterogeneity in terms of the diffusion of monopsony power, which is still a significant phenomenon in some sectors and regions. By comparing the (average) wage paid by each firm with its estimated marginal revenue product of labour and a hypothetical minimum wage, we classify firms in four distinct categories, and see whether and how they would be affected by this policy. Firms with low wage and low marginal productivity of labour would face additional pressure, with negative implications for workers and the economy coming from a possible reduction in labour demand. On the other hand, for highly productive firms that pay a wage lower than the marginal revenue product of labour, a minimum wage would yield a reduction in monopsony power, thus increasing market efficiency. Interestingly, we also see that low-productivity firms paying low wages typically exhibit relatively high markups, suggesting that wage compression is used to achieve high rents despite the low marginal productivity of labour. Also, as it can be expected, firms paying high wages perform well in terms of total factor productivity.

Accordingly, the introduction of a potential minimum wage based on the one recently discussed in the Italian Parliament would have a beneficial impact on the economy, but also a negative effect due to those firms that would react by reducing the number of their employees or even by leaving the market. In light of these considerations, we calculate the minimum wage level that minimises the share of firms that may be harmed while reducing the market power of high-productivity firms paying low wages. The "optimal" minimum wage calculated with the most recent available data (2018) ranges between 8.25 and 9.65 euro per hour and is in line with the values discussed in policy circles. Moreover, it corresponds to around 63-73% of the 2018 median manufacturing wage observed in the sample, a value that lies at the higher end of the range suggested by Dube (2019).

This work presents some limitations. In particular, the time frame of our empirical analysis is limited, data on labour costs are observed only at the firm level, and we focus on the manufacturing sector, which is characterised by higher average wages than low-value-added service sectors. Moreover, the identification of the optimal minimum wage is based on a simple exercise of comparative statics. Despite that, the analysis and findings make a significant contribution to the current academic literature on labour market power and the effect of a minimum wage and provide valuable information to guide evidence-based policy making.

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Appendix

A Estimation procedure: production function coefficients

We consider the following general production function Q for firm i at time t:

$$Q_{it} = Q(L_{it}, M_{it}, K_{it}, \omega_{it}), \tag{A7}$$

where L_{it}, M_{it} and K_{it} are the firm inputs (i.e., labour, materials and capital) and ω_{it} represents productivity. Unobserved shocks to ω_{it} are potentially correlated with input choices, and if not controlled for, can lead to inconsistent estimates of the production function. Accordingly, we employ the Wooldridge-Levinsohn-Petrin (WLP) estimator, as derived from Wooldridge (2009) and implemented in Petrin and Levinsohn (2012). The WLP estimator does not assume constant returns to scale, is robust to the Ackerberg et al. (2015) criticism and is programmed as a simple instrumental variable estimator. The potential endogeneity issues related to the simultaneous determination of inputs and unobserved productivity are addressed by introducing lagged values of specific inputs as proxies for productivity. Specifically, the estimation strategy used in this paper consists in two steps.

First, we use a third-order polynomial on all inputs to remove the random-error term ε_{it} from observed output and hence obtain an estimate of the expected output ($\hat{Q_{it}}$). Then, we use a general production function of the following type:

$$\hat{q_{it}} = f_s(l_{it}, k_{it}, m_{it}, B_s) + \omega_{it} + \epsilon_{it} \tag{A8}$$

where $\hat{qit}$ is the natural log of expected (deflated) sales of firm i at time t, l_{it}, k_{it} and m_{it} are the logs labour, capital and materials used by the firm, B_s is the parameter vector to be estimated sector by sector in order to calculate output elasticities, ω_{it} is the firm-level productivity term that is observable by the firm but not by the econometrician, and ϵ_{it} an error term that is unobservable to both the firm and the econometrician.

Productivity is, thus, assumed to be Hicks neutral and specific to the firm, as in the approach using inputs to control for unobservables in production function estimations (Levinsohn and Petrin, 2003; Ackerberg et al., 2015). We assume that labour is a variable input, and instrument current labour and materials and their interactions with the first and second lags of labour as well as the second lags of capital and materials. To control for time-variant shocks common to all plants, we add year fixed effects.

We adopt a translog specification, which, unlike the Cobb-Douglas, permits us to recover firm-level time-variant output elasticities. The production function is a revenue function, since data on firms' output prices are not available, and is allowed to change across different sectors, as implied by the subscript s. Leaving subscripts i and t aside for simplicity, the translog function f_s can be written as:

$$f_s = \alpha + \beta_{s,L} l + \beta_{s,K} k + \beta_{s,M} m + \beta_{s,L^2} l^2 + \beta_{s,K^2} k^2 + \beta_{s,M^2} m^2 + \beta_{s,KL} kl + \beta_{s,KM} km + \beta_{s,LM} lm. \tag{A9}$$

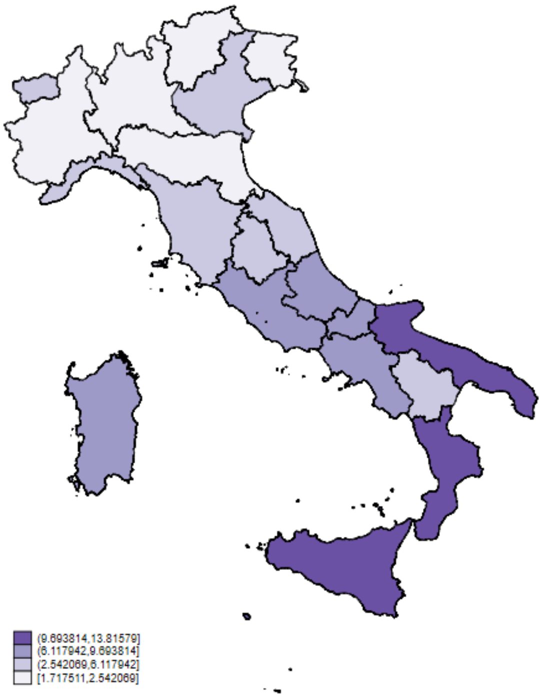
Thus, the parameter vector is made up of nine parameters for each sector. The estimated parameters of the translog production function allow us to compute the output elasticity of materials. Using the estimates of the output elasticity and the calculated revenue shares of materials, we can now compute labour market power according to equation (1) and markups at the firm-year level based on equation (2).

B Additional Figures and Tables

Figure B1: Percentage of firms by category and region, 2018

(a) Category 1

(b) Category 2



(c) Category 3

(d) Category 4

Figure B2: Optimal minimum wage, weighted by employment

(a) 2018 (b) Trend