# Rent sharing, wage floors and development

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May 28, 2024

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Firms benefiting from favorable demand conditions tend to raise wages. However, we show that firms with labour market power facing binding wage floors will absorb these positive revenue-productivity shocks as excess profits instead of increasing wages or employment. Our prediction follows from a simple but novel theoretical insight under a standard framework of monopsonistic competition, and we empirically test this theory in South Africa using firm-level administrative data. We first explain how firm wage-setting behavior changes at a productivity threshold directly related to the wage floor, and then show how the predicted wage, employment and profit patterns are evident in the cross-section of firms covered by collective bargaining agreements. We then replicate and extend a leading method of identifying rent-sharing elasticities, but estimated separately by firm revenue-productivity bins. As predicted by the theory, we find that firms below the threshold increase wages and employment less, and profits more, in response to revenue-productivity shocks, and that there is a break at the threshold where wage floors bind. The study complicates the conclusions emerging from the literature on firm rent-sharing, and forms part of an explanation for "stalled" development and "jobless growth".

For comments and suggestions on earlier versions of this work we owe particular thanks to Arindrajit Dube, and thanks to Daniele Girardi, Matt Woerman, Ayanda Hlatshwayo, C. Friedrich Kreuser, Murray Leibbrandt, Carol Newman, and John Rand, as well as participants of the 2024 ASSA "How do firms respond to unions" paper session, a UNU-WIDER Work-in-Progress meeting, the 2023 ESSA Conference, and the UMass Labor Group. For assistance with data access we thank the team at the NT-SDF, with special thanks to Michael Kilumelume for sharing his insights and work on the data. We gratefully acknowledge funding from UNU-WIDER as part of the SA-TIED programme, and funding from the research initiative "Structural Transformation and Economic Growth" (STEG), a programme funded by the Foreign, Commonwealth & Development Office (FCDO), contract reference STEG_LOA_2206_Budlender. The views expressed are not necessarily those of the FCDO.

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# 1 Introduction

The conclusion emerging from a burgeoning literature on rent-sharing is that firms faced with more favorable demand conditions tend to raise wages. But are all firms equally likely to share rents? Or will some respond by taking higher profits instead? And what are the implications for firms' employment responses? We consider these questions in a setting where some firms are bound by wage floors. We first examine the question by drawing out a novel insight from a standard model of monopsonistic competition, which we show implies differential rent-sharing and concomitantly differential employment responses. We then test these predictions using South African administrative data.

We show that in a standard setup of monopsonistic competition, firms with labour market power, lower productivity, and binding wage floors will absorb revenue-productivity increases as excess profits, instead of increasing wages and employment. This stands in contrast to the usual view where revenue-productivity increases lead to higher wages—per the emerging literature on rent-sharing (e.g. Card et al. 2018; Lamadon et al. 2022)—and increased employment—implicit in both monopsonistic explanations for rent-sharing (Manning 2003; Lamadon et al. 2022) and in classic models of the development process (e.g. Lewis (1954)).[1] Instead, we identify a range of firms where revenue-productivity increases only increase profits, corresponding to a subset of firms which do not share rents and to "stalled" development or "jobless growth" such that increasing labour is not absorbed into the wage sector.

While unevenness in rent-sharing is of general relevance, the developmental implications may be particularly important for middle-income countries seeking to develop through increasing firm productivity while protecting workers with high minimum wages (e.g. Brazil and South Africa), as well as low-income countries with relatively high wage floors associated with subsistence or efficiency wages. It also has implications for common approaches used to estimate labor supply elasticities.

Our prediction follows from a simple but novel theoretical insight building on the work of Dickens et al. (1999) and Manning (2003), who study minimum wages in monopsonistic settings. A large number of studies show that monopsony is a pervasive feature of labor markets (Dube et al. 2019; Bassier et al. 2022; Caldwell and Oehlsen 2018), and may be worse in developing economies (Sokolova and Sorensen 2021; Vick 2017; Bassier 2023; Chau et al. 2022). While many papers seek to understand the direct employment effects of minimum wages under monopsony (Brochu et al. 2023; Butcher et al. 2012; Engbom and Moser 2022; Dustmann et al. 2022), we ask a different question: What are the wage, employment and profit responses of firms that increase their revenue-productivity in monopsonistic labor markets with binding wage floors?

The modern rent-sharing literature suggests that, per a monopsonistic understanding of the

[1] This assumption is also generally common across the modern Labor Economics literature, where though firm heterogeneity and processes of creative destruction provide avenues for technological advancement to have ambiguous effects on overall employment, at the firm-level it is assumed that productivity increases generally lead to increased employment (Cahuc et al. 2014; Autor et al. 2020).

labour market, firms increase wages in response to favorable demand conditions because this is the prerequisite for firm expansion. However, in the presence of a binding minimum wage, firms pay above the unconstrained monopsonistic wage and employ workers either along their labour demand curve (demand-constrained firms, receiving no markdown) or their labour supply curve (supply-constrained firms, receiving a reduced markdown). In the former, very low productivity case, firms do not need to increase wages to expand their size, and wages do not respond to revenue-productivity shocks while employment responds strongly. We focus on the supply-constrained (lower/mid-productivity) firms, which due to the minimum wage employ more workers than in the unconstrained monopsony case, and which in order to expand employment further must increase the wage above the minimum. We show that, up to a threshold, these firms do *not* increase wages (and therefore do not increase employment) in response to favourable revenue productivity shocks, because they instead absorb the shock as excess profits until they have restored their markdown to the unconstrained monopsonistic level. In essence, this region acts as the transition from the no-markdown case to the monopsony-markdown case. For higher productivity firms, where the minimum wage does not bind, the usual monopsonistic rent-sharing dynamics apply. The range of firm productivities which fall in the supply-constrained region is larger for more monopsonistic labour markets and for higher minimum wages.

A secondary contribution and implication of this analysis is that one should be cautious about estimation of labor supply elasticities in the context of high minimum wages. Several prominent papers use a revenue productivity shock to identify wage and employment effects, thereby backing out a labor supply elasticity (e.g. Goolsbee and Syverson (2019), Kline et al. (2019), Saez et al. (2019), Amodio and De Roux (2022), Lamadon et al. (2022), Garin and Silvério (2023) and Kroft et al. (2023)).[2] When the productivity shock takes place across the demand- or supply-constrained regions, the estimate will not identify the desired unconstrained labor supply elasticity.

The key empirical prediction of the model is heterogeneous causal wage, employment and profit responses to revenue-productivity shocks along the firm productivity distribution, which we test using South African administrative tax data.

We first show that firms bound by the country's various collectively-bargained or government-mandated minimum wage regimes do generally exhibit the predicted patterns in the cross-section. After estimating firm-specific productivity using the leading approach in the Industrial Organization literature (Ackerberg et al. 2015), we find that there is a discernible productivity threshold before which wages are flatter with respect to productivity, and close to the minimum wage, and after which the cross-sectional wage-productivity relationship is steeper. This threshold divides supply-constrained and unconstrained firms, and importantly we find that the productivity-employment and productivity-profit relationships change at the same point, in the manner predicted by the theory (steeper for the employment response and flatter for the profit-share response).

[2] This issue also applies to strategies which use minimum wage changes to estimate the firm labor supply elasticity, e.g. Staiger et al. (2010).

We then use these cross-sectionally identified productivity thresholds (for each minimum wage regime) to test our main prediction, which is that the wages, employment and profit share of firms on either side of these thresholds differentially *respond* to revenue-productivity shocks. Our main specification replicates and extends a leading approach in the rent-sharing literature—the Lamadon et al. (2022) "internal instruments" method—which entails constructing a stacked event study where firm-specific treatment is defined as an unusually large observed increase in firm value-added. We estimate heterogeneous wage, employment and profit share responses by firm productivity bin, after recentering firm productivity around the (minimum wage regime-specific) productivity threshold estimated in the cross-sectional exercise. Our results strongly support our theoretical predictions: compared to responses in the unconstrained region, and adjusting for the size of the shock to value-added, in the constrained region the wage response (the rent-sharing elasticity) is 28% lower, the employment response is 29% lower, and the profit share response is almost 3 times higher. These differences are statistically significant, and estimates by bin support the prediction that the break in response size occurs around the productivity threshold.

We show that these results are robust to a variety of other methods for estimating production functions (such as Olley and Pakes (1996), Levinsohn and Petrin (2003), and using a Cobb-Douglas rather than translog functional form), pass falsification tests, and are insensitive to changes in various implementation details.

Interestingly, Card et al. (2016) find a strikingly similar piecewise linear relationship, between firm surplus or productivity (they use value-added per worker) and firm wage policies (they use AKM firm wage premia) in the cross-section using Portuguese data. Though they do not explore this result further, our framework resolves what is otherwise a puzzling pattern, and suggests our results may be applicable beyond South Africa.

The core ideas of the model are introduced in Section 2, while the data and South Africa minimum wage institutions are discussed in in Section 3. The cross-sectional descriptive evidence is presented in Section 4, and the main empirical exercise—replicating and extending Lamadon et al. (2022)—in Section 5. Section 6 concludes.

## 2 Theoretical prediction

### 2.1 Model

Below we briefly recapitulate a simplified version of the Dickens et al. (1999) model of firm responses to minimum wages under monopsony. We then outline our main argument, and illustrate it graphically. We show that this insight is retained when many of the simplifications are relaxed (using the more general model presented in Manning (2003, pp. 338-345)), and highlight the key implications for our purposes. The model assumes there are many firms. Lower case letters denote logs.

### Simple model

The marginal revenue product of labor of firm $i$, is a simple downwards sloping labor demand curve:

$$\mathrm{mrpl}_i = a_i - \eta n_i \,, \tag{1}$$

where $a_i$ is a demand or productivity shifter, and $n_i$ is employment. The elasticity of the labor demand curve under perfect competition would be $1/\eta$. This can be motivated by a production function such as $Y_i = \frac{1}{1-\eta} A_i N_i^{1-\eta}$, where additional factors such as capital can be log-additively included.

The model assumes a firm-facing labour supply curve $w_i = \varepsilon n_i$, where $w_i$ is the firm wage. The firm-facing labour supply elasticity $1/\varepsilon$ is constant across firms and is finite. Such an upwards sloping labor supply curve implies a marginal cost of labor greater than the wage for firm $i$:[3]

$$\mathrm{mcl}_i = \ln(1+\varepsilon) + w_i = \ln(1+\varepsilon) + \varepsilon n_i \,. \tag{2}$$

This model setup represents a very basic and general monopsonistic form, and remains agnostic as to the source of monopsony power (e.g. search frictions or amenities). Setting marginal product equal to marginal cost, the unconstrained employment and wage for firm $i$ are:

$$n_i^* = \frac{1}{\varepsilon+\eta}\left(a_i - \ln(1+\varepsilon)\right) \tag{3}$$

$$w_i^* = \varepsilon n_i = \frac{\varepsilon}{\varepsilon+\eta}\left(a_i - \ln(1+\varepsilon)\right) \,. \tag{4}$$

When the minimum wage $w_{\mathrm{m}}$ is not binding, that is, $w_{\mathrm{m}} \leq w_i^*$, equations 3 and 4 hold and $w_i = w_i^*$ and $n_i = n_i^*$. These are *unconstrained* firms. When the unconstrained wage is lower than the minimum wage ($w_{\mathrm{m}} > w_i^*$) and the latter binds, firms must pay a wage equal to the minimum wage ($w_i = w_{\mathrm{m}}$), and they attract the number of workers supplied at that wage, $n_i = (1/\varepsilon)\, w_{\mathrm{m}}$. These are *supply-constrained* firms.

However, this condition for supply-constrained firms only applies as long as the marginal revenue product of labor for the firm is above the minimum wage. If not, so that $w_{\mathrm{m}} > \mathrm{mrpl}_i$, then the firm is *demand-constrained* and it reduces employment until $\mathrm{mrpl}_i = w_{\mathrm{m}}$. Firms must still pay the minimum wage, but the new employment level is now governed by firm labour demand constraint, so that $n_i = (1/\eta)\,(a_i - w_{\mathrm{m}})$.

Note that in this simplified model, the only firm-specific factor which determines the unconstrained wage in Equation 4, and therefore whether a firm is unconstrained, supply-constrained, or demand-constrained, is its productivity $a_i$. The firm's productivity therefore determines which of these *three qualitatively distinct regimes* the firms falls under.

For the unconstrained and demand-constrained firms, we have the well-known result that firm employment increases with productivity ($a_i$), and for unconstrained firms the wage also increases with $a_i$. Our main insight is that, for supply-constrained firms on the other hand, there is a range of productivity increases for which productivity increases do not increase either

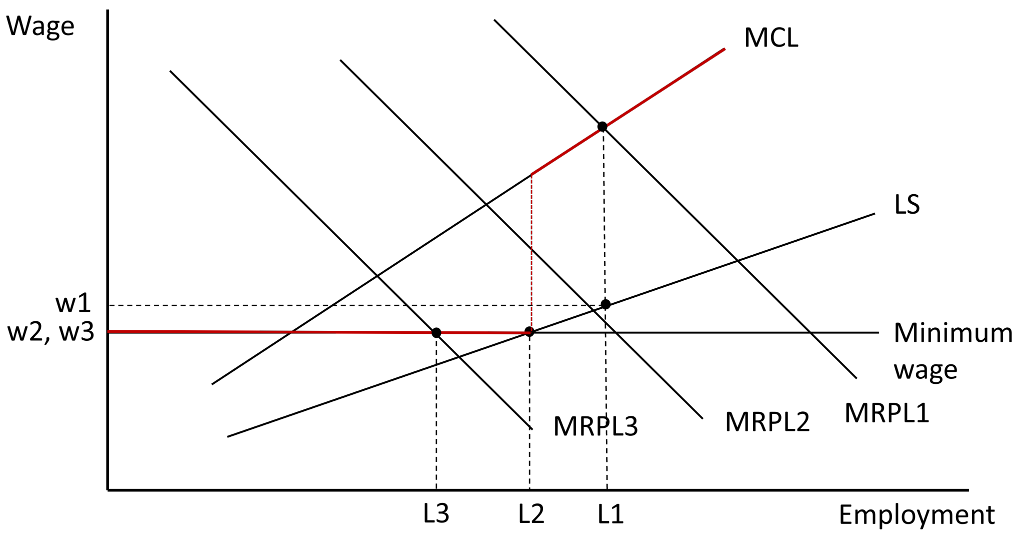
[3] $\frac{\partial WL}{\partial L} = \frac{\partial W}{\partial L} L + W = \varepsilon W + W$, which in log terms is $\mathrm{mcl}_i = \ln((\varepsilon+1)\,W) = \ln(\varepsilon+1) + w$.

the firm's wage or employment. This is because the unconstrained wage in this range remains lower than the minimum wage ($w_{\mathrm{m}} > w_i^*$), meaning that until the unconstrained wage reaches the minimum, the actual wage remains at the the minimum. This supply-bound firm cannot attract additional workers without increasing the wage, so employment remains at the same level, with instead the additional productivity per worker accruing to profits.

### Graphical representation

These qualitatively distinct regimes are illustrated graphically in Figure 1. If there is no minimum wage, the usual monopsony set-up that the marginal cost of labor (MCL) is steeper than the firm-facing labor supply curve (LS) applies.[4] For firms sufficiently productive to be unconstrained by the minimum wage (so on the marginal revenue productivity of labor curve MRPL1), the quantity of labor employed is determined by the intersection of the MCL and MRPL curves (L1), and the wage is marked down such that the wage is on the supply curve for that quantity of labor (w1).

Figure 1: Three revenue-productivity regimes in the presence of a minimum wage




*Notes:* Authors' construction; adapted from Manning (2003, p. 343).

However, in the presence of a binding minimum wage, the "effective" marginal cost of labor changes to the discontinuous red line shown in Figure 1. Wages now cannot be below the minimum wage, so the marginal cost of labour when the LS curve is below the minimum wage is simply the minimum wage itself. Of particular interest to us is the discontinuity in the effective MCL at L2, where firms switch from being minimum wage-constrained to unconstrained. Employment is set where the MRPL curve intersects with the effective MCL curve, which for firms with productivity MRPL2 occurs in the region of the effective MCL discontinuity. It is easy to see that for local shifts in MRPL2, the intersection remains in the discontinuity region,

[4]The marginal cost of labour is steeper than the supply curve because for a monopsonist to hire an additional worker they must increase the wage, which also applies to the wages of already-employed workers.

and subsequently that these shifts in productivity do not change firm employment (or the wage, which is marked down to the minimum wage level). Instead, local shifts in MRPL in these region are reflected as changes in the size of the markdown from the marginal revenue productivity of labour to the (minimum) wage. These are the supply-constrained firms. Because the minimum wage is above their optimal monopsony wage (on the LS curve), they do not change the wage in response to local productivity shifts, and thus their quantity of labour stays fixed along the supply curve.

For low productivity firms with MRPL at MRPL3—demand-constrained firms—there is no markdown. Shifts in MRPL do affect employment but the wage stays at the minimum wage level.

### Full model

The main additions in the full model as presented by Manning (2003, pp. 338-345) are incorporating the average market-level wage as a determinant of aggregate labor supply, and allowing for a firm-specific labour supply shifter $b_i$ (e.g. disamenities) in addition to the revenue-productivity shifter $a_i$. The upwards-sloping firm-facing labor supply curve indicates that labor supply is proportional to a firm's wage premium above the market wage. While in this sub-section we draw out a few key features of the full model, we re-capitulate it in full in Appendix B.

The firm's unconstrained wage becomes

$$w_i^* = \frac{\eta\theta w - \varepsilon \ln(1+\varepsilon)}{\eta+\varepsilon} + v_i\,, \tag{5}$$

where $w$ is the (log of the) average market wage, $\theta$ is an aggregate labour supply coefficient, and $v_i$ is the firm-specific component of the firm's unconstrained wage, given by

$$v_i = \frac{\varepsilon a_i + \eta b_i}{\eta+\varepsilon}\,, \tag{6}$$

where $b_i$ is the firm-specific supply shifter.

In much the same way that $a_i$ determines whether a firm is unconstrained, supply-constrained, or demand-constrained for a given minimum wage in Equation 4, $v_i$ performs this role for the fuller model in Equation 5. Firms with $v_i$ above some threshold $v^*$ will have $w_i^* \geq w_{\mathrm{m}}$ and will be unconstrained, firms with $v_i$ below $v^*$ but above another threshold $v_1^*$ will be supply-constrained, and firms with $v_i$ below $v_1^*$ will be demand-constrained.

It is useful to focus on the productivity component $a_i$ of $v_i$ and think of $v_i$ as an "adjusted firm productivity" term. This allows depiction of the three regimes in Figure 1, under the special case where firms only differ in $a_i$, the positions of their MRPL curves.

Depending on the value of $v_i$, the three cases are:

1. **Unconstrained (i.e. higher productivity, MRPL1): $\boldsymbol{v_i \geq v^*}$**

   The optimal monopsony wage is above the minimum wage. These firms are not affected directly by the minimum wage (but may be affected indirectly through spillovers). Employment is given by Equation B2 and the wage by Equation 5. Both increase when the MRPL1 curve shifts right (an increase in $a_i$).

2. **Supply-constrained (i.e mid/lower productivity, MRPL2)**: $\boldsymbol{v^* > v_i \geq v_1^*}$

   The optimal (unconstrained) monopsony wage would be below the minimum wage, and the minimum wage intersects with the firm-facing supply curve. The wage is set at the minimum wage, and employment is along the labour supply curve at the point where it intersects the minimum wage, given by Equation B5. Shifts in MRPL2 (changes in $a_i$) which keep the firm in this region do not affect wages or employment.

3. **Demand-constrained (i.e. very low productivity, MRPL3)**: $\boldsymbol{v_i < v_1^*}$

   The optimal (unconstrained) monopsony wage would be below the minimum wage, and the minimum wage intersects with the firm MRPL curve. The wage is set at the minimum wage and employment is on the labour demand curve, given by Equation B6. Rightwards shifts of the MRPL3 curve (increases in $a_i$) increase employment but do not increase wages unless the change is large enough to induce $v_i > v^*$.

Following Manning (2003), we provide expressions for $v^*$ and $v_1^*$ in Equations B3 and B4 respectively, but for our purposes here it is sufficient to note that these thresholds are increasing in the minimum wage, and that the range of the supply-constrained region is increasing with $\varepsilon$ (more monopsony):

$$v^* - v_1^* = \frac{\varepsilon \ln(1+\varepsilon)}{\eta + \varepsilon} .$$

It is the supply-constrained region which we are most interested in, where local changes in productivity $a_i$—which do not cause $v_i \geq v^*$ or $v_i < v_1^*$—do not induce changes in the firm wage (set at the minimum wage), nor the firm size (set where the minimum wage intersects the supply curve). Instead, in this region revenue-productivity increases are absorbed by increases in the markdown and profits, until the markdown and profits are at the levels associated with the unconstrained monopsonistic equilibrium.

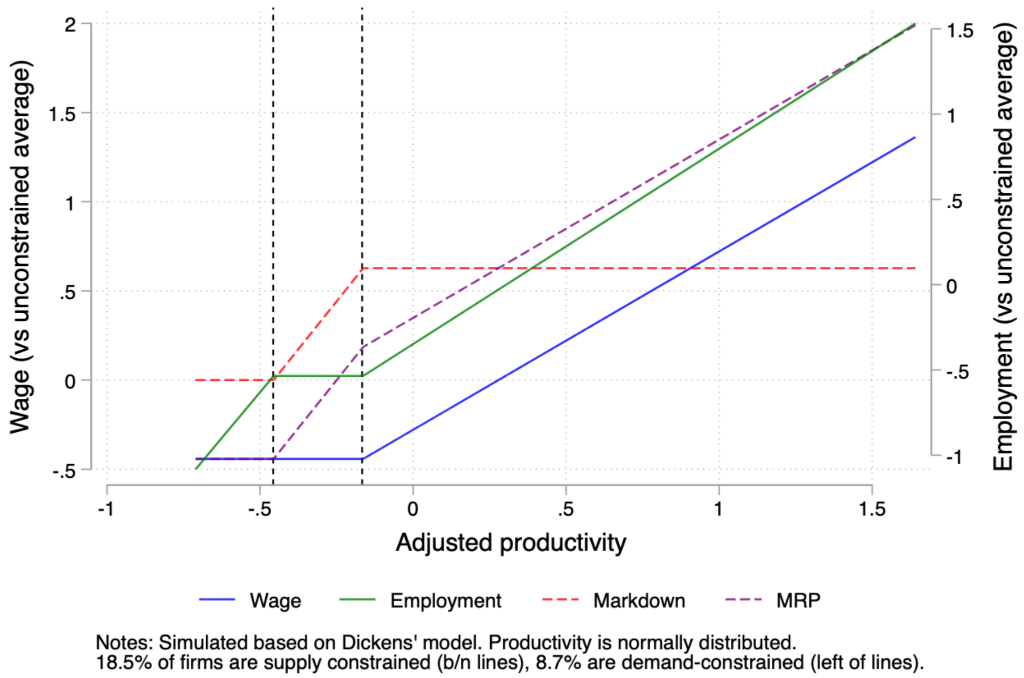
## 2.2 Simulations

In Figure 2 we present simulations which show the firm wage, employment, and markdown implications of the model for a range of firm productivities.[5] The horizontal axis is a firm's $v_i$ or "adjusted productivity" with firm-specific supply shifters ($b_i$ from Equation 6) set to zero, so that location along the axis is determined by the firm-specific productivity shifter $a_i$. This divides firms into very low productivity (demand-constrained), mid/lower-productivity (supply-constrained), and higher-productivity (unconstrained). In reality, fixed costs and negative stochastic shocks mean that some firms with very low productivity draws will either not

[5] For purposes of illustration, we ignore firm-specific supply shifters, we impose that MRPL shifters $a_i$ follow a standard normal distribution, we set the market labour supply elasticity to 1.25 and the firm-facing labour supply elasticity to 1. The simulations are based on 1,000 observations, each representing a firm. Wages and employment are normalized by comparison to the average wage and employment under the perfectly competitive case—that is, no monopsony nor minimum wage. The minimum wage is set at -0.5 log units, that is about 70% of the median wage.

be observed in the empirical data or will be short-lived (Olley and Pakes 1996; De Loecker and Syverson 2021); for these illustrative purposes we therefore somewhat arbitrarily truncate the left tail of the $v_i$ distribution at 1.5 standard deviations from the mean.[6]

Figure 2: Model simulation




*Notes:* Simulations of wage, markdown, marginal revenue productivity and firm employment along firm adjusted productivity distribution for 1000 simulated firms. MRPL shifters $a_i$ follow a standard normal distribution; firm-specific supply shifters $b_i$ set to 0. Market labour supply elasticity is set to 1.25 and firm-facing labour supply elasticity to 1. Wages and employment are normalized by comparison to the average wage and employment under the perfectly competitive case with no monopsony nor minimum wage. The minimum wage is set at -0.5 log units; approximately 70% of the median wage. The left tail of the adjusted productivity distribution is truncated at 1.5 standard deviations from the mean in order to account for firm survival in the observed data.

The right-most region, after the second vertical line (indicating $v^*$), represents the unconstrained case: wages and employment are increasing in productivity. Wages are marked down relative to MRPL as in the standard monopsony optimization, and the markdown level is constant.

The left-most region, before the first horizontal line (indicating $v_1^*$), represents the demand-constrained firms: wages are constrained to equal the minimum wage, though firms do employ more workers as their productivity increases. MRPL is equal to the minimum wage and there is no markdown.

The middle region between the vertical lines is our subject of interest: these are supply-constrained firms. Firms in this region keep wages fixed at the minimum wage, and do not increase employment as productivity increases. Instead, increased productivity is absorbed in higher markdowns, until the markdown is at the optimal level for an unconstrained monopsonist

[6]Appendix Figure A1 shows the untruncated figure with a long left tail.

(at $v^*$). After this point, as firms move to the unconstrained region, they then begin again to increase wages and employment with productivity increases, keeping the standard monopsony markdown.

In cases with less monopsony and/or lower minimum wages (Appendix Figure A1), the supply-constrained region shrinks and moves down the productivity distribution, capturing fewer firms. In our baseline specification in Figure 2, 18.5% of firms are supply-constrained and 8.7% are demand-constrained, suggesting that the mechanisms we discuss affect about 1 in 4 firms. This compares favorably with our empirical results discussed in Section 4.

# 3 Data and Institutional Context

## 3.1 Data

For our empirical analysis we use the administrative National Treasury-South African Revenue Services (NT-SARS) tax data held at the National Treasury Secure Data Facility (NT-SDF) in Pretoria. This is restricted-access data which can only be accessed in person at the NT-SDF for approved projects.[7] The data we use consist of annual firm balance sheet information from Company Income Tax returns ("ITR14" forms) which include information such as sales, costs, profits and industry; and linked worker-level annual payroll data ("IRP5" forms) which can be used to construct firm-level employment, (approximate) monthly wages, and firm geographic location. The data constitute a panel covering the universe of formal-sector firms in South Africa, and while each dataset covers different periods they all reliably cover at least the period from the 2010 to 2019 tax years (approximately the 2009-2018 calendar years).

## 3.2 Minimum wage institutions

Prior to January 2019, a multilayered wage legislation system operated in South Africa, where minimum wages were set by the government for selected broad industry-locations ("Sectoral Determinations", SDs), or by publicly-recognized Bargaining Councils (BCs) consisting of employers and employees at the sub-industry-location level. Minimum wages can vary substantially by these sectors, and we therefore examine firms separately by their BC or SD. A national minimum wage (NMW) was introduced in January 2019 which partially supersedes the BC and SD system, but its introduction was outside the period of our data so we ignore it.[8]

[7] This research was approved under the auspices of the SA-TIED programme workstream 1.

[8] Our theoretical mechanism applies regardless of whether minimum wages are set sectorally or by a NMW, though changing the level of the wage floor applicable to each firm would mean that which firms are demand- or supply-constrained would change. The 2019 NMW was generally implemented as a minimum floor: sectoral minima higher than the NMW remained in effect. Insofar as this means the introduction of a NMW weakly increased the level of firm-specific minimum wages, our model suggest that this would increase the proportion of demand- and supply-constrained firms (see Section 2.2). Empirically, the last 2 months of the 2019 tax year overlap with the period of the national minimum wage, but any dynamics in these months are likely to be irrelevant for our results given our empirical design.

BCs cover industry-regions, and are constituted by trade union and employer representatives who negotiate industry-region minimum wages.[9] This is a set-up common to a variety of European countries (Bhuller et al. 2022; Jäger et al. 2022), but unlike in some of these countries BC agreements are routinely extended to include non-unionized workers (Bassier 2022). We identify BC firms in the SARS-NT data by matching firms according to their industry and location, using the Bassier (2022) dataset of BC agreements. There are 39 private sector BCs; after restricting for key missing variables we identify 30 in the data, which cover approximately 26% of the (formal sector) workers. This Bassier (2022) dataset also provides a minimum wage associated with each BC for each year, but it is highly approximate: BC agreements typically specify multiple occupation-specific wages, but because occupations are not observed in the NT-SARS data the lowest BC-specified wage is taken to be the BC minimum.

SDs are government-set wage minima (and conditions of employment) for sectors not fully covered by BCs, often because they are understood as "hard to organise". There are 11 SDs, 8 of which set minimum wages for formal sector workers (Bassier 2022). SDs are defined more expansively than BCs, and sometimes overlap with BCs; in these cases the BC minimum wages apply. While SDs, like BCs, may set occupation- and location-specific wages, there is usually less heterogeneity in minimum wages than in BCs. We identify SD firms in the NT-SARS data by matching their industry and location to a dataset we create from promulgated government regulations. We identify the 8 formal sector SDs, which exclusively cover about 32% of (formal sector) workers in the data. These are predominantly workers at the lower-end of the wage distribution, unlike BCs which have coverage concentrated in the upper half of the wage distribution (Bassier 2022). We also include minimum wages from these regulations, but these are approximate for the same reason as the BC minima. The BC and SD monthly minima in the 2018 tax year are shown in Table A1.

# 4 Cross-sectional evidence

The prediction we test in this descriptive exercise is the cross-sectional relationship between each firm variable (wage, firm size and markdown) and firm productivity. Embedded in this test is the existence of qualitatively distinct productivity regions.

## 4.1 Production function estimation

We first have to estimate firm-specific productivity, and in doing so we draw from a substantial Industrial Organization literature concerned with production function estimation (Olley and Pakes 1996; Levinsohn and Petrin 2003; Ackerberg et al. 2015; De Loecker and Syverson 2021). Recognising issues with OLS estimation of productivity such as simultaneity/transmission bias and selection/survival bias, we estimate productivity using the proxy variable/control function method of Ackerberg et al. (2015) (ACF) with materials as the proxy variable, probably the

[9] Supplementary establishment-level wages can then also be negotiated above these minima (Bassier 2022).

leading approach in the literature (De Loecker and Syverson 2021; Yeh et al. 2022). Cognisant of the Gandhi et al. (2020) critique of attempts to estimate gross output production functions using proxy variable methods, we specify a value-added production function with a flexible translog form:

$$y_{it} = \beta_l l_{it} + \beta_{ll} l_{it}^2 + \beta_k k_{it} + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + \omega_{it} + \varepsilon_{it} \tag{7}$$

where $y_{it}$ is value-added for firm $i$ in period $t$, $l_{it}$ is firm employment and $k_{it}$ is firm capital stock, all in logs, while $\omega_{it} + \varepsilon_{it}$ is the productivity residual made up of productivity shocks which are observed or predictable for the firm at time $t$ ($\omega_{it}$) and those which are not ($\varepsilon_{it}$).

We show in Appendix Figures A3 and A4 that our main results are robust to a variety of alternative methods of estimating production functions: ACF with a Cobb-Douglas functional form, the Olley and Pakes (1996) method, the Levinsohn and Petrin (2003) method, the ACF correction applied after Olley and Pakes (1996) rather than Levinsohn and Petrin (2003) estimation, and the ACF method estimated separately by various industry categories.

## 4.2 Cross-sectional test

The markdown is of course also unobserved, and so we use the gross profit share as a proxy. This is defined as gross profits over gross profits plus the firm wagebill, and so is equivalent to one minus the labor share as it is defined in Gouin-Bonenfant (2018). At various points we (imprecisely) refer to this as the "capital share", borrowing from the macroeconomics literature which divides income into labor and capital income.

Our first step is to identify a kink ("knot") in the wage-productivity curve. The pattern we look for is as follows: Wages (firm medians) are a piecewise linear continuous function of productivity, defined over two intervals, and containing a discontinuity in its derivative (a "knot") at the boundary between the intervals. We identify the knot in the observed distribution by running two OLS regressions, one to the left and another to the right, for each productivity threshold, and selecting the threshold which maximizes the R-squared.[10] According to the model, this is the productivity threshold $v^*$ where firms move from being supply-constrained to unconstrained.

With this "wage knot" identified, the prediction from this paper is that at the same productivity threshold, there is also a discontinuity in the derivatives in firm size as a function of productivity, and the markdown (capital share) as a function of productivity. We separately regress each of these variables on productivity to the left and right of the "wage knot" productivity threshold, which allows us to examine whether there is indeed a change in the slope as we expect.

Due to the different minimum wages which operate in each BC/SD, the above exercise is implemented separately for firms in each BC and SD. We estimate productivity for each firm

[10] This procedure is analogous to that used by Card et al. (2016) to identify a similar kink in the distribution of AKM firm wage premia against firm log value added.

in "pre-period" windows for each "event" (see Section 5), and then the knot-finding exercise above is implemented only for the years after this pre-period.[11]

With the BC- and SD-specific kink-points and cross-sectional patterns having been separately estimated, we then pool the results across all the different BCs and SDs. In order to account for the different minimum wages and other market-level characteristics of each BC and SD, which will necessarily lead to different $v^*$ wage-kink productivity thresholds, before pooling we re-center productivity in each BC and SD around the estimated wage-kink productivity threshold $\hat{v}^*$ in that BC/SD, so that re-centered productivity above 0 indicates an unconstrained firm and below 0 indicates a constrained firm. We then re-implement the knot-finding algorithm on this re-centered productivity measure, combining all BCs and SDs into one sample.[12]

Finally, though we do not focus on the demand-constrained region, we do try to isolate it from the supply-constrained region by identifying a kink on the employment-productivity curve to the left of the wage threshold (i.e. $\hat{v}_1^*$), for each BC/SD and in the pooled aggregate. In practice, this point is not well-identified, potentially because our sample likely has relatively few very low productivity firms. As discussed in Section 2.2, firms with very low productivity draws will be unobserved or under-represented in actual firm data due to fixed costs and endogenous exit (De Loecker and Syverson 2021). This issue is exacerbated in our analysis of Section 5 which of necessity requires a balanced panel. Additionally, an existing literature suggests that Bargaining Councils contain more productive firms, as larger more productive firms endogenously bargain for minima which smaller unproductive firms cannot sustain (Magruder 2012; Moll 1996).

We also do not *a priori* expect to identify a demand-constrained region in our more powerful pooled cross-sectional exercise, where BCs and SDs are recentered around their estimated wage-kink $\hat{v}^*$, because there is little reason to expect a similar productivity range between the employment-kink $v_1^*$ and the wage-kink $v^*$ across BCs or SDs. In order to illustrate this point, and to more generally facilitate comparison between our pooled empirical results and the theoretical predictions, we present a simulation which analogously pools the simulation of Section 2.2 conducted for 40 different industries with randomly varying labor supply elasticities and minimum wage levels.

### 4.3 Results

Figure 3 shows results pooled across all BCs and SDs, as well as the pooled simulation discussed above. Appendix Figure A2 presents the results separately for a variety of BCs and SDs.

The vertical dotted line indicates the productivity threshold corresponding to the estimated wage kink productivity threshold $\hat{v}^*$.[13] A horizontal dotted line indicates the minimum wage

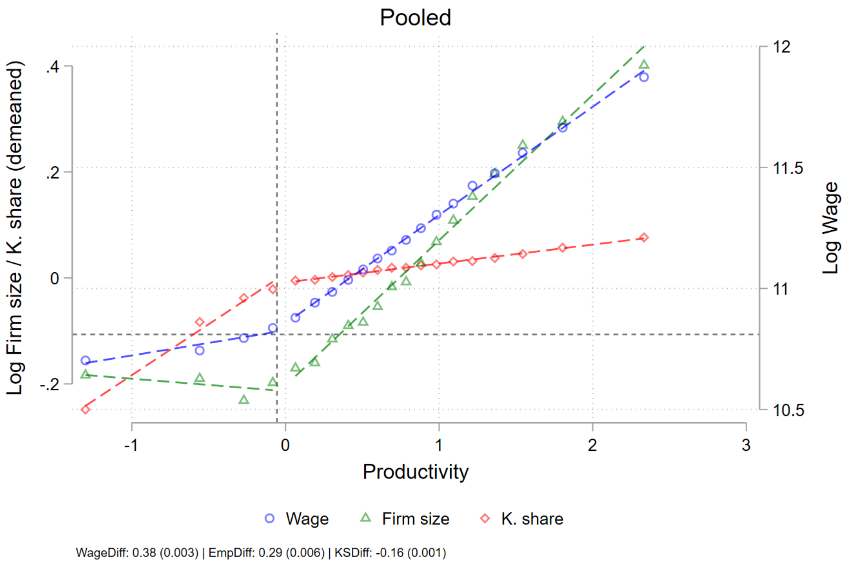
[11] We define firm productivity as the average of firm-year-specific productivity in the pre-period, winsorized at the 1% tails. De Loecker and Syverson (2021) note, in a related context, that this averaging may reduce misspecification error.

[12] In a few cases our knot-finding algorithm does not identify a plausible interior wage-kink $\hat{v}^*$ and instead identifies a kink at extreme wage values; we trim the estimated wage-kinks $\hat{v}^*$ at the 1st and 99th percentile of the pooled firm distribution.

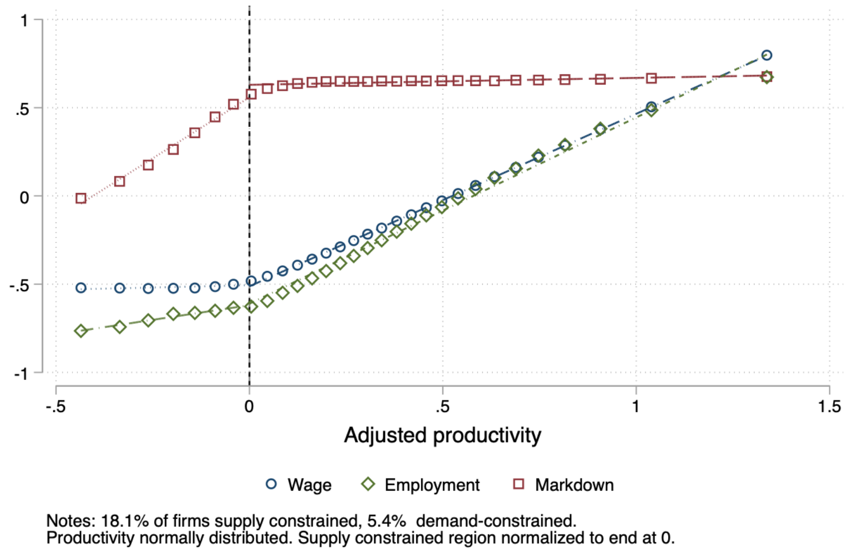
[13] When there are two vertical lines in Appendix Figure A2, the right-most line is the estimated wage kink

Figure 3: Pooled cross-sectional results

(a) Pooled empirical results




(b) Pooled simulation




*Notes:* Panel (a) shows firm median wage, employment, and profit share by 20 recentered firm productivity bins (productivity estimated using the ACF method of Section 4; ventiles), for pooled BCs and SDs. Underlying firm productivity is recentered around the estimated wage-knot $\hat{v}^*$ estimated for each BC/SD. The algorithm outlined in Section 4 is used to fit underlying firm median wages as a piece-wise continuous linear function of productivity. Analogous linear fits of employment and profit share are then plotted on either side of the identified wage knot. The line is the value of the aggregate wage-knot $\hat{v}^*$ identified by the algorithm. The horizontal line is the average minimum wage across firms. Panel (b) shows results from pooled model simulations, where the simulation of Section 2.2 is run separately for 40 different industries with randomly varying LSEs and minimum wages, and then industries are pooled after re-centering their adjusted productivity $v_i$ around the wage-kink threshold $v^*$.

associated with the general worker (lowest paid) occupation in that BC/SD (or, in the pooled case, the average minimum wage across all the firms). Blue markers show the bin-specific averages of firm median wages; green markers firm employment, and red markers the capital share.

The pooled aggregate case clearly exhibits the predicted features of the model. For wages and firm size, the slope is flatter before the wage-kink threshold, and then more steeply increasing after the threshold. For the profit share, the slope is increasing more to the left of the wage-kink threshold, and flatter to the right. The differences in the slopes around the wage-kink threshold are statistically significant at the 5% level. Reassuringly, the wage-kink is found to be close to 0 on the re-centered productivity threshold, and the average minimum wage appears to correspond quite closely to the firm median wage at $\hat{v}^*$, where firms move from being constrained to unconstrained.

While the same patterns hold for most of the individual BCs and SDs in Appendix Figure A2, they are sometimes noisy or simply not evident for particular BCs or SDs. We view this as unsurprising, given that we are testing a strong prediction that only arises under specific conditions of high minimum wages and significant monopsony, and which in any case may not be detectable given the unavoidably approximate nature of our productivity estimation routine and varying BC/SD sample size.

In Figure 3, 20.2% of observations fall in the constrained region. However, because this is a cross-sectional pooled exercise, firms which appear in the panel for more years are over-represented. If we weight each firm equally, 24% of firms are found in the constrained region. This suggests that the mechanism we discuss affects about 1 in 4 firms in South Africa, and compares favorably to our simulations in Section 2.2, where the baseline simulation suggested 18.5% of firms are supply-constrained and 8.7% demand-constrained.

## 5 Heterogeneous responses to shocks

While this descriptive cross-sectional evidence is encouraging, the ideal evidence for our theoretical predictions is heterogeneity in *responses* to revenue-productivity increases, for firms along the productivity distribution. To this end, we replicate and extend the "internal instrument" approach to identifying rent-sharing elasticities from Lamadon et al. (2022) (LMS).

### 5.1 Method

The core of the LMS "internal instrument" method is a firm-level event study analysis where treatment is defined as an above-median increase in value-added between periods -1 and 0, with some additional specification and variable- and sample-definition restrictions. In the original paper, Lamadon et al. (2022) focus on the effects of these value-added shocks on earnings. We extend this firstly by also examining effects on employment and the capital share, but most

threshold $\hat{v}^*$ and the left-most line is the estimated demand-constraint productivity threshold $\hat{v}_1^*$.

importantly by examining heterogeneous responses along the firm productivity distribution. Here we draw from an unpublished presentation by de Frahan et al. (2022), who themselves extend the Lamadon et al. (2022) method to examine heterogeneous effects on employment as well as earnings, but along the firm size distribution.[14] We then further extend this analysis by estimating elasticities with respect to changes in value-added rather than semi-elasticities with respect to the binary treatment, which account for the differently-sized value-added responses (to the binary treatment) in each of the heterogeneity regions.

The sample, key variables and events are defined as follows:

1. Identify "stayers" in the worker data who remain employed at the same firm for 8 consecutive years, separately defining stayers for the event periods 2010-2017, 2011-2018, 2012-2019, and 2013-2020, which covers the usable period of the employment data. Drop their records in the first and last years of this tenure (when they may have entered or separated), and only keep workers who are full-time employed over this 6 year period at their firm. Count the number of stayers in each firm for each event period and create year-specific firm-level statistics for stayers' wages (e.g. mean wage, median wage).

2. For each event, only keep firms which have at least $N$ stayers.
   - Lamadon et al. (2022) use a 10-stayers minimum as their baseline, but this is overly restrictive when it comes to the South African firm-size distribution and a labour market context defined by high churn (Kerr 2018). However, in order to identify effects on wages of stayers one does need to restrict to firms with at least one stayer. In our baseline specification we use a 2-stayer minimum, to mitigate measurement error in one-stayer firms where the one stayer may be an owner or otherwise unrepresentative of employer/employee dynamics. In Appendix Figure A5 we show that our main results are not sensitive to the number of stayers.

3. Only keep firms which have province and 1-digit industry information, using the interaction of these variables to create 81 labor markets
   - Appendix Figure A6 shows results when different industry and geography variables are used, including using the 2-digit industry and the "district" geography variable, which creates 2600 labor market interactions. Our main results are essentially unchanged.

4. Over the 6-year period for each event, we treat the first three periods as the pre-period and the latter three as the post. Treatment is defined as an above-median increase in firm value-added between periods -1 and 0 for each event, where the median increase is weighted by firm size. Events are stacked (Cengiz et al. 2019). Period -2 is used as the omitted reference period to allow for some mean reversion dynamics in period -1. For

[14] While not a focus of this paper, we note that we have been able to replicate the de Frahan et al. (2022) findings in our data, finding qualitatively similar results.

the same reason, periods 1 and 2 are considered the post periods of interest, rather than period 0. Period -3 is used to assess pre-period parallel trend violations.

### 5.2 Aggregate results

The aggregate event study regression is:

$$y_{i,t,m,e} = \lambda_{i,e} + \delta_t \times \gamma_{m,e} + \sum_{s=-3,s\neq-2}^{2} \beta_s \times \mathbb{1}[t = s] \times D_{i,e} + \varepsilon_{i,t,m,e} \tag{8}$$

where $y_{i,t,m,e}$ is the log of the outcome for firm $i$ at time $t$ in labor market $m$ for event $e$, $\lambda_{i,e}$ is firm-event fixed effect, $\gamma_{m,e}$ is a market-event fixed effect which is interacted with the time fixed effect $\delta_t$ to control for market-event-time fixed effects, $D_{i,e}$ is the treatment variable and the $\beta_s$ are the coefficients of interest, relative to period -2. Standard errors are clustered at the market-event level.

The aggregate event-study result for our preferred specification (see below) is shown in Figure 4, with the first-stage VA response in orange, employment in green, and the median wage of stayers in blue.[15] This closely replicates the figure in the de Frahan et al. (2022) presentation, which also suggests some mean reversion in VA and other dynamics in period -1, but which are small relative to the size of the post-period effects (and seems to dissipate between period 0 and period 1 in any case).

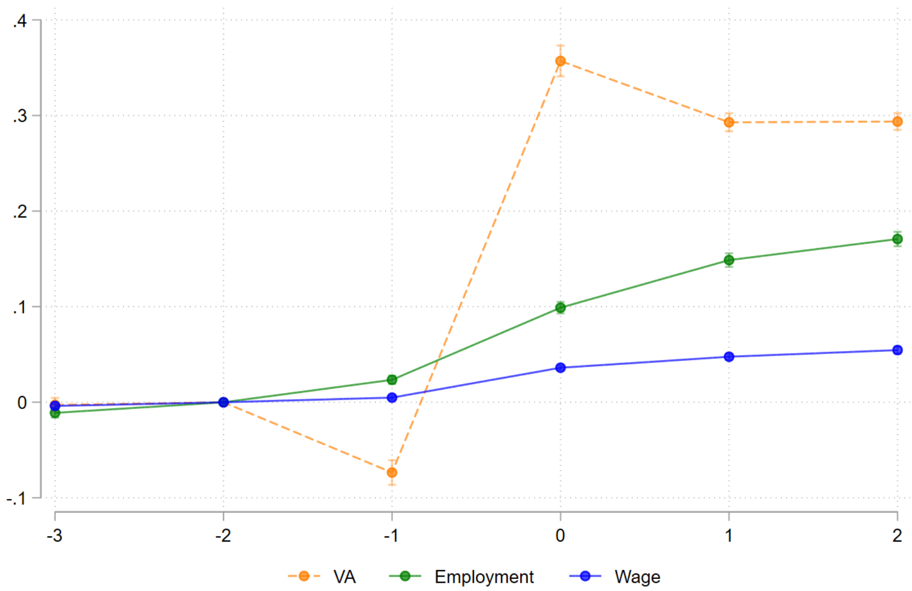
### 5.3 Heterogeneous responses

Following the pooling procedure used for our cross-sectional result (Section 4), we use the re-centered productivity terms estimated in Section 4 and previously used to construct the pooled Figure 3: that is estimated firm-specific productivity from equation 7 minus the BC- or SD-specific $\hat{v}^*$ wage-kink productivity threshold from the knot-finding exercise. We then estimate heterogeneous responses along this re-centered productivity distribution. Recall that the "wage-kink" indicates the productivity threshold at which firms switch from being supply-constrained to unconstrained.

The theoretical prediction when plotting marginal effects is smaller effects on wages and employment in the supply-constrained region, followed by larger wage and employment effects in the unconstrained region. The prediction is the opposite for the profit-share: larger effects in the supply-constrained region and smaller effects in the unconstrained region. Empirically, the difference between the regions may be somewhat attenuated; apart from the issues of combining different labor markets discussed above, or any other dynamics we exclude from the highly stylised model, simple measurement error in our firm productivity measure and wage kink-finding algorithm would attenuate observed differences between the region, as some unconstrained firms will be observed in the constrained region and vice versa.

[15] Effects on employment necessarily cannot make the same "stayers" restriction when defining firm size as we must allow changes in firm size, but the same criteria are used to choose which firms qualify for the analysis.

Figure 4: LMS aggregate results




*Notes:* Figure shows LMS-style event study where treatment is above-median increase in firm value-added between periods -1 and 0. Estimates are normalised relative to period -2. Orange line shows response of log value-added, green log employment, and blue the log of median wage of firm stayers (incumbents). Various sample restrictions are discussed in Section 5. 95% confidence intervals are shown with vertical bars.

Our results are shown in Figure 5, which presents heterogeneous treatment effects across re-centered productivity bins, as well as aggregate responses on either side of the dashed line where re-centered productivity=0 ($\hat{\upsilon}^*$). Due to the measurement error discussed above we judge our estimated $\hat{\upsilon}^*$ threshold as approximate, and drop firms close to the threshold.[16] Treatment effects are the average across post-periods 1 and 2; the dashed lines reflect pre-trend tests for each bin (the coefficients for period -3), and confidence intervals are at the 95% level.[17] We divide firms into 10 approximately equally-sized bins.[18]

It is clear from visual inspection that the wage and employment responses are higher in the unconstrained region, while the profit share is lower, and that these responses differentially break around the threshold $\hat{\upsilon}^*$. While the 95% confidence intervals for the wage responses overlap (very) slightly when comparing constrained to unconstrained firms, the difference between the

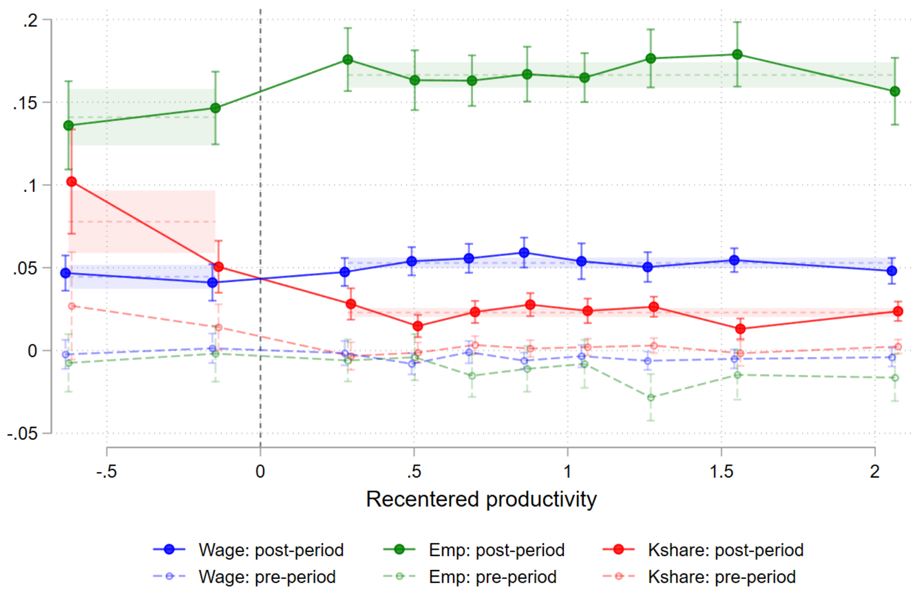
[16] In our baseline specification we drop the 5% of constrained firms with the highest recentered productivity values, and the 5% of unconstrained firms with the lowest such values. Our results are not sensitive to this trimming procedure; see Appendix Figure A7.

[17] We use the average effect across post-periods 1 and 2 as our post-period treatment effect to increase power while avoiding the mean-reversion or other dynamics in period 0 evident in Figure 4. Results are essentially unchanged if we use only period 2 instead.

[18] We require that there be at least 2 bins on either side of $\hat{\upsilon}^*$, as the value of the bins is in seeing the shape of the marginal response against productivity, which means in practice that the bins in the constrained region are smaller than those in the unconstrained region; 12% of firms fall in the constrained region in this baseline specification.

estimates is still statistically significant at the 5% level.[19] The statistical significance of the break in the profit share response is visually apparent. Pre-trend coefficients are generally not statistically significantly different from zero.

Figure 5: LMS semi-elasticities by re-centered productivity




*Notes:* Figure shows estimates from LMS-style event studies when estimated by productivity bin. The horizontal axis is firm productivity (estimated using the ACF method of Section 4), recentered around the BC or SD-specific cross-sectional estimate of the productivity wage-kink $\hat{v}^*$. Ten approximately equally-sized productivity bins (deciles) are created. The solid lines and points show the average treatment effect across post-periods 1 and 2. The dashed lines and hollow points show effects estimated for pre-period -3. 95% confidence intervals are shown with vertical bars. The horizontal dashed lines with attendant shaded regions (95% confidence intervals) show applicable post-period treatment effects estimated across the productivity bins, separately below and above the wage-kink value $\hat{v}^*$ where recentered productivity equals zero. Red is for firm profit share, green firm employment, and blue the median wage of firm stayers (incumbents).The sample is restricted to firms which have at least 2 stayers over the event-study period and drops the most productive 5% of constrained firms and least productive 5% of unconstrained firms around the recentered productivity threshold. For all outcomes, responses above and below the $\hat{v}^*$ threshold are statistically significantly different from each other at the 5% significance level (difference calculated using the Delta method).

While Figure 5 shows that firm responses to a binary value-added shock are heterogeneous in the manner predicted by the theory, and that pre-trends are approximately flat, we also need to account for differently-sized responses in value-added to the binary treatment in the different regions, in order to generate truly comparable elasticities in the different productivity regimes. This also creates more interpretable measures; for example the elasticity of the wage to value-added is the familiar rent-sharing elasticity estimated in much of the prior literature.

We find that while the change in value-added is similar in the constrained and unconstrained

[19] Approximated using the delta method.

regions in our baseline specification, it is slightly larger in the constrained region (0.34 vs 0.29 log points). This has the effect of relatively decreasing elasticities in that constrained region and increasing them in the unconstrained region.

Figure 6, which we consider our main result, shows the wage, employment and profit share responses as elasticities with respect to the induced changes in value-added.[20] It shows clearly the pattern predicted by the theory, with statistically significant differences between constrained and unconstrained firms in their wage, employment and profit-share responses, which break around the estimated wage-kink $\hat{v}^*$.

Appendix Figures A3 and A4 show robustness to alternative methods of estimating the underlying production functions, Appendix Figure A5 shows robustness to the number of stayers, Appendix Figure A6 shows robustness to the choice of time-varying labour market fixed effects, and Appendix Figure A7 shows robustness to the proportion of firms dropped around the estimated threshold.

In terms of magnitudes, the elasticity of the wage with respect to value-added (the rent-sharing elasticity) is 0.133 (0.011) in the constrained region and 0.185 (0.0054) in the unconstrained region; 0.414 (0.0251) and 0.583 (0.0118) for the employment elasticity; and 0.229 (0.0185) and 0.08 (0.0045) for the profit share elasticity.[21] The rent-sharing elasticities are very similar to what have been found in the existing literature.[22] As is visually apparent from Figure 6, the differences between the estimates above and below the productivity threshold $\hat{v}^*$ are all statistically significant. They imply that in the constrained region, relative to the unconstrained region, the rent-sharing elasticity is 28% lower, the employment elasticity is 29% lower, and the profit share elasticity is 186% higher.

We view the findings in Figure 6, which seem robust, as good evidence for our main theoretical predictions.

# 6 Conclusion

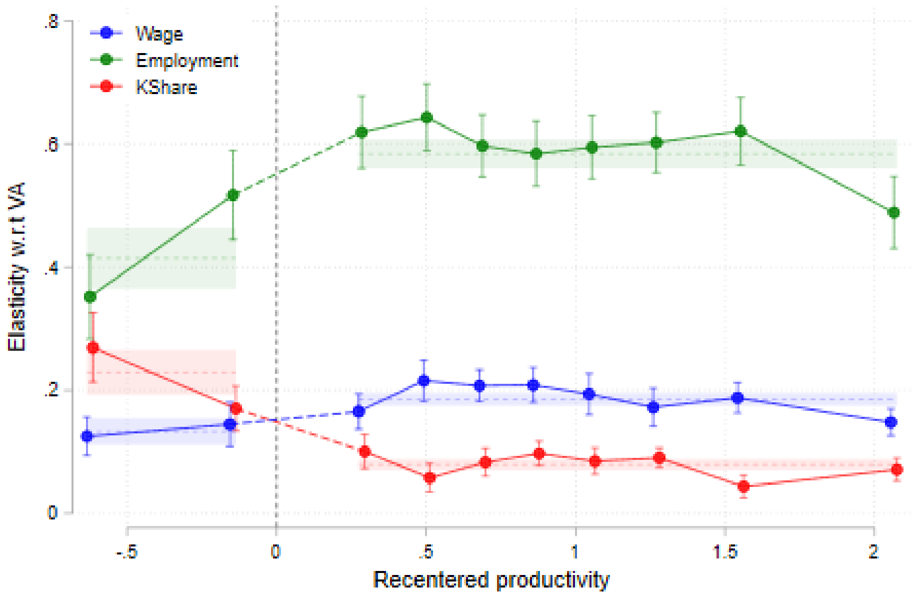
This paper investigates how monopsonistic firms adjust wages and employment in response to marginal revenue-productivity shocks such as more favourable demand conditions. While a large prior literature has emphasized a rent-sharing response—that firms increase wages when faced with such a shock, which the monopsony literature understands as the pre-requisite for expansion in production and employment—we ask whether all firms are equally likely to respond in this way, and in particular consider the case where some firms are bound by a minimum wage. We first show that theoretically we should expect heterogeneous responses: lower-productivity,

[20]We estimate these coefficients with regressions of the log change between the post-period (periods 1 and 2) and period -2 on the equivalent change in value-added, with the change in value-added instrumented by the binary treatment. We include fixed effects analogous to those in equation 8 and again cluster at the market-event level.

[21]Standard errors are shown in brackets.

[22]E.g. between 0.137 and 0.156 in Card et al. (2016); between 0.13 and 0.19 in Lamadon et al. (2022); and between 0.14 and 0.17 in Bassier (2023).

Figure 6: LMS elasticities by re-centered productivity, with respect to value-added




*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added. The horizontal axis is firm productivity (estimated using the ACF method of Section 4), recentered around the BC or SD-specific cross-sectional estimate of the productivity wage-kink $\hat{v}^*$. Ten approximately equally-sized productivity bins (deciles) are created. The horizontal lines show the average treatment effect across post-periods 1 and 2. 95% confidence intervals are shown with vertical bars and shaded regions. Red is for firm profit share, green firm employment, and blue the median wage of firm stayers (incumbents).The sample is restricted to firms which have at least 2 stayers over the event-study period and drops the top 5% of constrained firms and bottom 5% of unconstrained firms around the recentered productivity threshold. Elasticities are estimated by regressing the pre-post change in the outcome on the pre-post change in value-added, with the change in value-added instrumented by the binary treatment variable (together with fixed effects discussed in Section 5.

supply-constrained minimum-wage-bound firms will absorb revenue-productivity shocks as excess profits per worker instead of increasing wages and employment, unlike demand-constrained or unconstrained firms. We then test this prediction in South African administrative data, finding support for the theoretical prediction both in the cross-section and when replicating and extending a leading approach to estimating rent-sharing elasticities from shocks to value-added. The results complicate and enrich the emerging conclusion from the rent-sharing literature—that firms do share rents with workers—by suggesting that this depends on how the firm judges its current level of rents relative to what it expects to receive at its unconstrained equilibrium. While minimum wages may have a variety of positive effects in monopsonistic settings, a firm that is compelled to accept a lower markdown due to a binding minimum wage will not stop trying to increase that markdown when the opportunity arises. This has implications for the common developing-country complaint of "stalled" development or "jobless growth". If labour regulations or other labour supply constraints (e.g. subsistence or efficiency wages) bind and firms earn profits below their desired level, they may choose to respond to market and productivity expansions by simply absorbing these gains as windfall profits rather than expanding production and increasing employment, at least up to some threshold. These firm-side responses seem especially important for understanding labour and development dynamics in developing countries.

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## Appendix A: Additional tables and figures

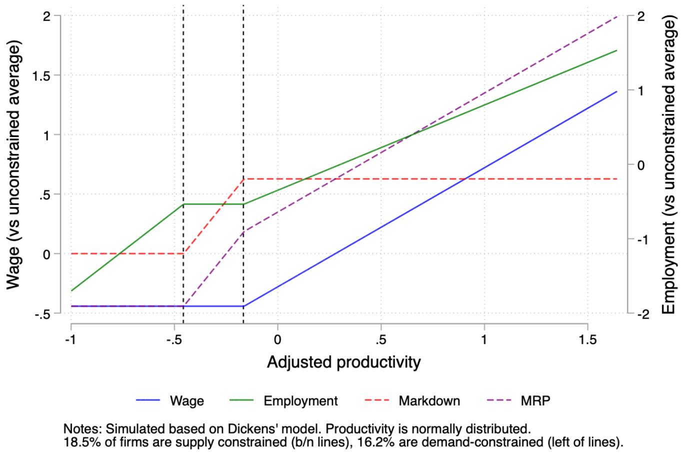
Table A1: Bargaining Council (BC) and Sectoral Determination (SD) Minimum Wages

| **Name** | **Type** | **Minimum wage (monthly ZAR)** |
|---|---|---|
| Building (Bloemfontein) | BC | 4174 |
| Building (Boland) | BC | 3575 |
| Building (Cape) | BC | 4810 |
| Building (EC) | BC | 6237 |
| Building (Kimberly) | BC | 6237 |
| Chemical | BC | 6255 |
| Civil engineering | BC | 6237 |
| Clothing manufacturing | BC | 4476 |
| Electrical | BC | 3995 |
| Fishing | BC | 3553 |
| Food and restaurant | BC | 3087 |
| Furniture (KZN) | BC | 2526 |
| Furniture (WC) | BC | 2713 |
| Furniture (national) | BC | 2714 |
| Hairdressing | BC | 2796 |
| Laundry (Cape) | BC | 3735 |
| Leather | BC | 4963 |
| Meat trade | BC | 3281 |
| MEIBC | BC | 7550 |
| Motor industry | BC | 3812 |
| Restaurant catering | BC | 3420 |
| Road Freight and Logistics | BC | 5066 |
| Road passenger | BC | 6071 |
| Textile | BC | 5546 |
| Transnet | BC | 7702 |
| Tyre | BC | 11402 |
| Wood and paper | BC | 5799 |
| Contract cleaning | SD | 3126 |
| Private security | SD | 3192 |
| Farm worker | SD | 2998 |
| Forestry | SD | 2998 |
| Hospitality | SD | 3169 |
| Wholesale and retail | SD | 3184 |

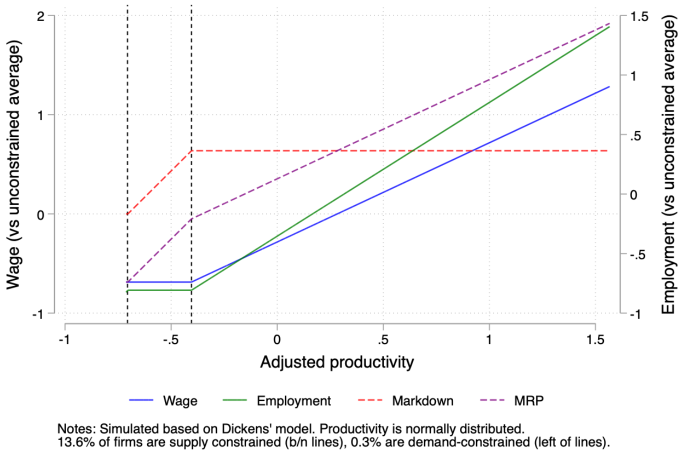
*Notes:* Table shows monthly minimum wages associated with each bargaining council (BC) and sectoral determination (SD) in the 2018 taxyear, in nominal Rands. The names are abbreviated. MEIBC refers to the Metal and Engineering Industries Bargaining Council.

Figure A1: Additional simulations

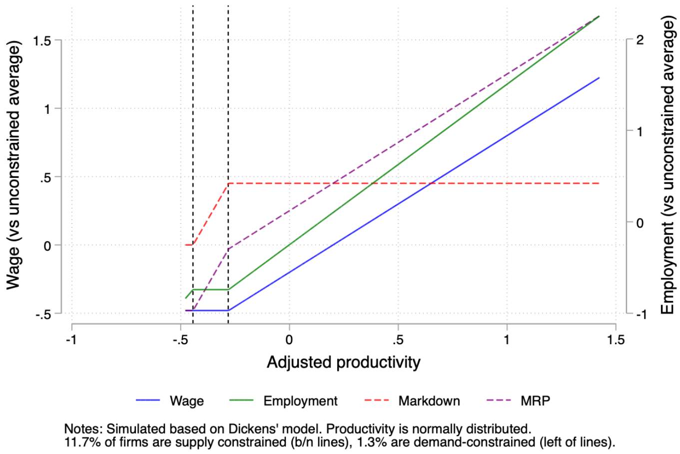
(a) No fixed cost truncation




(b) Lower minimum wage

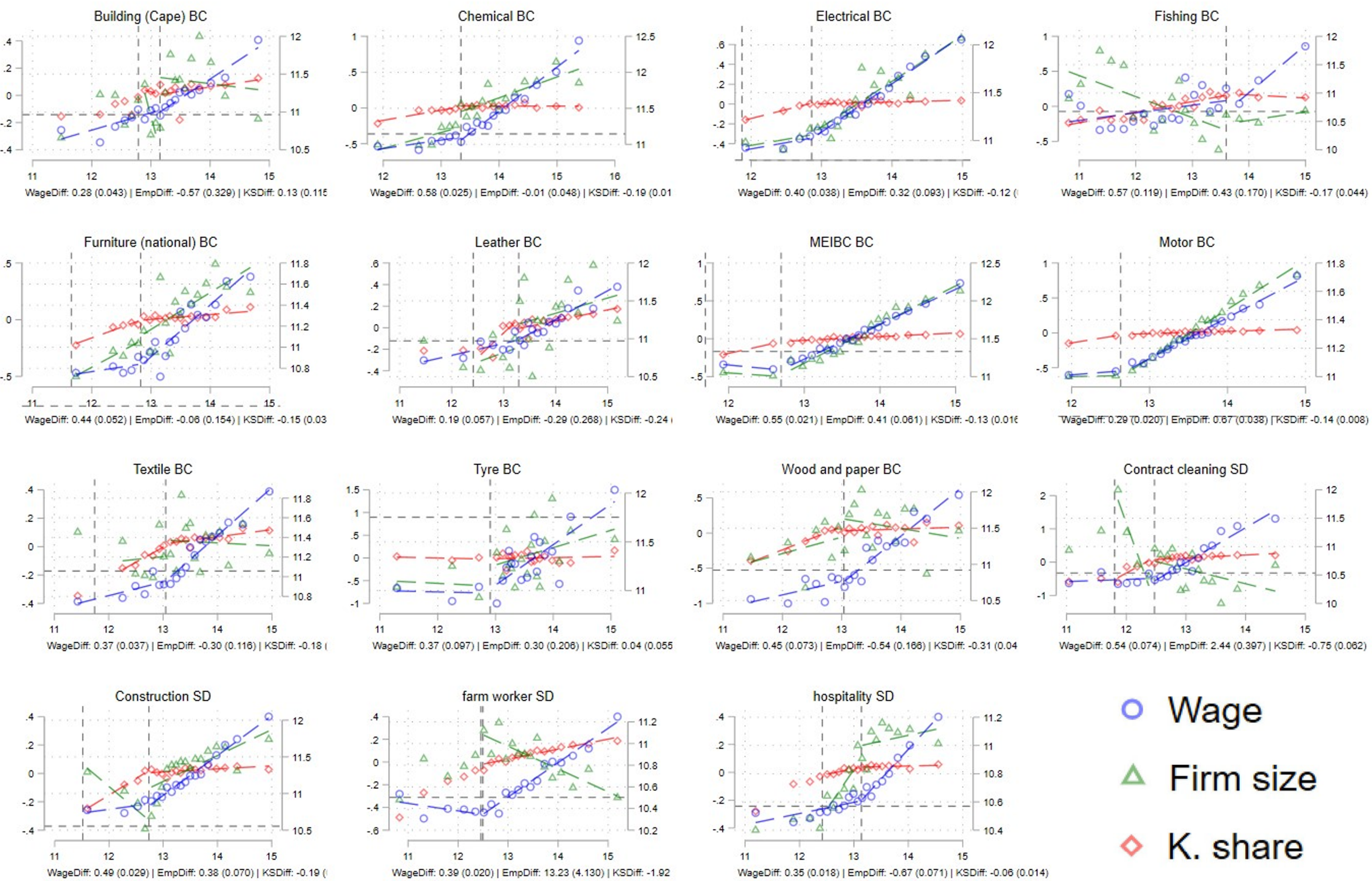



(c) High minimum wage, low labour supply elasticity




*Notes:* Simulations are as in Figure 2, except there is no truncation of low productivity firms in Panel (a), the minimum wage is lower (-0.75 log points) in Panel (b) and the firm-facing labour supply elasticity is set to 2 in Panel (c).

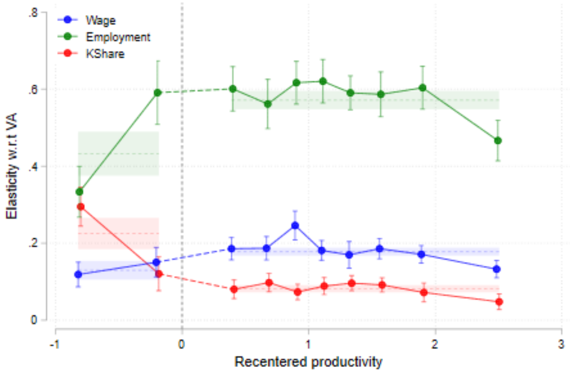
Figure A2: Cross-sectional case-studies



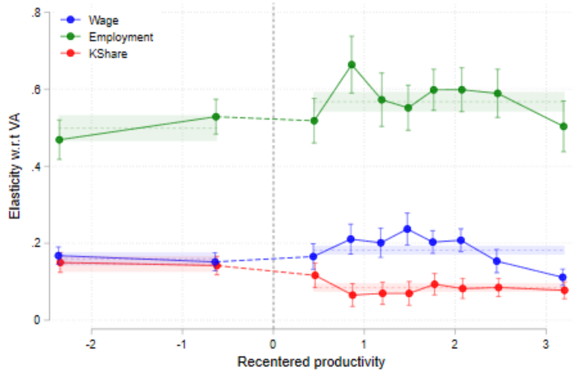

*Notes:* Figure shows firm median wage, employment, and profit share by 20 firm productivity bins (productivity estimated using the ACF method of Section 4; ventiles), for selected BCs and SDs. The algorithm outlined in Section 4 is used to fit underlying firm median wages as a piece-wise continuous linear function of productivity. Analogous linear fits of employment and profit share are then plotted on either side of the identified wage knot. The right-most vertical line is the estimated value of the wage-knot $\hat{v}^*$. If the there is a second left-most line, this identifies the estimated demand-constrained value $\hat{v}_1^*$. The horizontal line is the BC/SD minimum wage.

Figure A3: LMS elasticities with respect to value-added: Cobb-Douglas production function variations

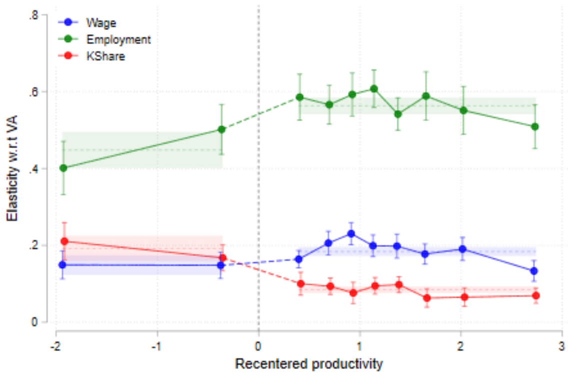
(a) Olley-Pakes




(b) Levinsohn-Petrin



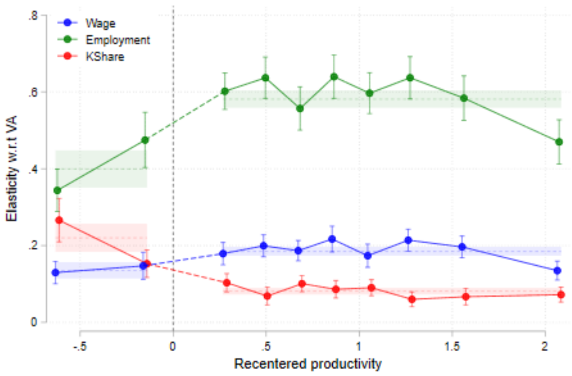

(c) ACF



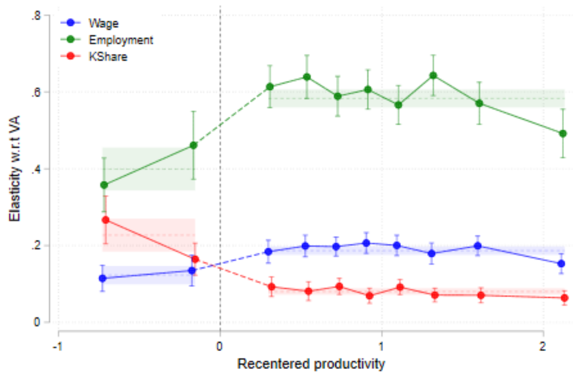

*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added, as more fully described in Figure 6. Each panel shows results when the production function underlying the recentered productivity term is estimated using the specified method for Cobb-Douglas production functions. The specification is otherwise the same as in Figure 6.

Figure A4: LMS elasticities with respect to value-added: Alternative production function estimation routines

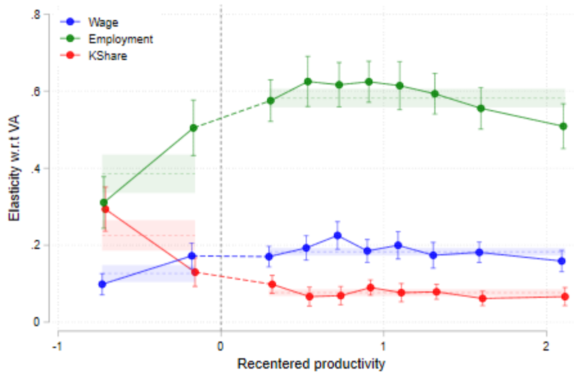
(a) Estimated by 1-digit industry




(b) Estimated by 2-digit industry

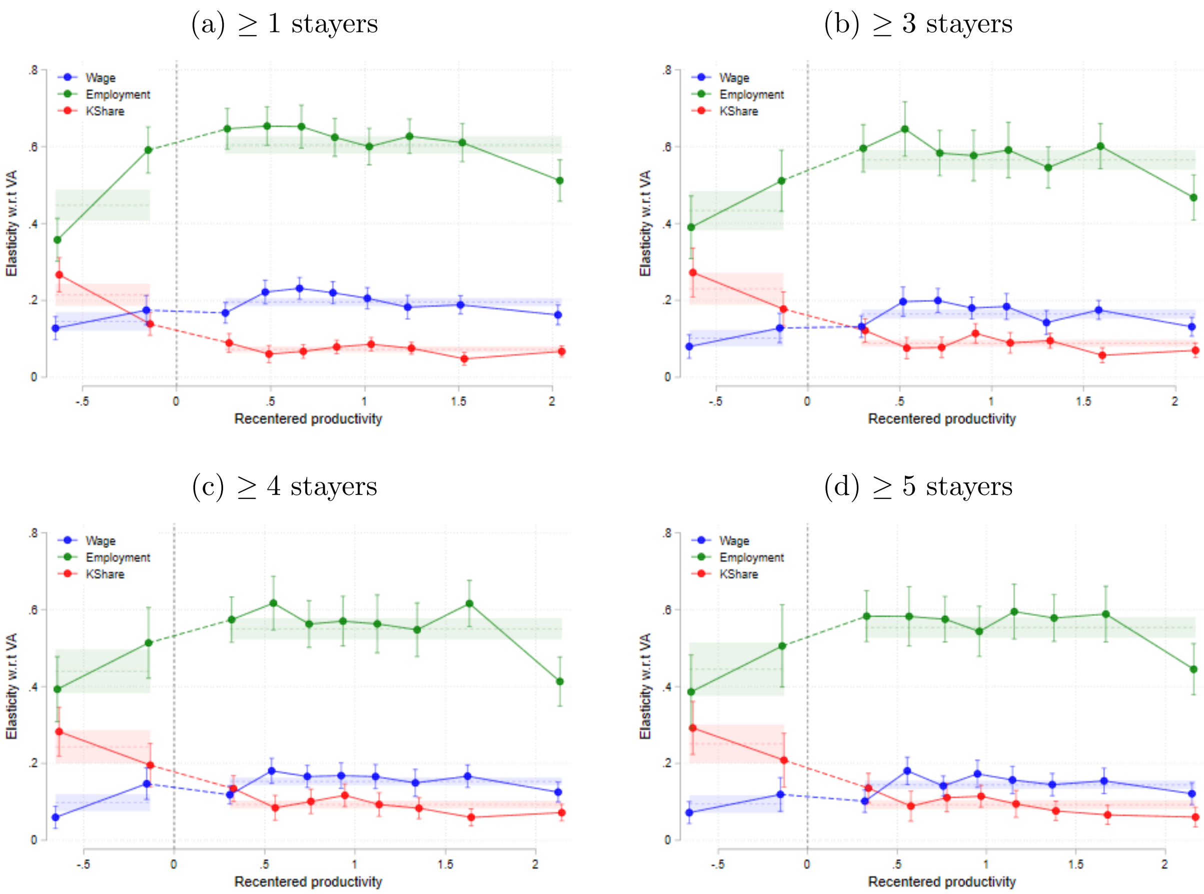



(c) ACF correction of Olley-Pakes




*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added, as more fully described in Figure 6. Panels (a) and (b) show results when production functions are estimated separately by 1- and 2-digit industries respectively. Panel (c) shows results when the ACF correction is applied to Olley-Pakes rather than Levinsohn-Petrin production function estimation. The specification is otherwise the same as in Figure 6 (including the specification of translog production functions).

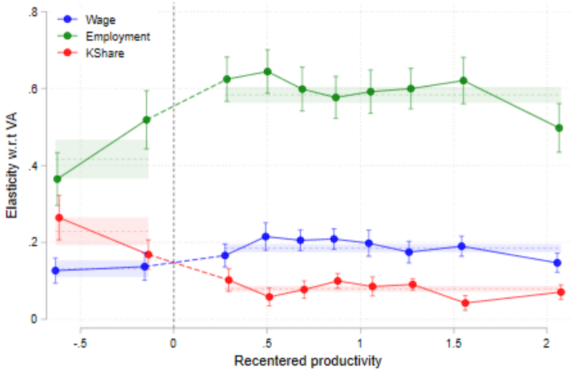
Figure A5: LMS elasticities with respect to value-added: various "stayer" sample restrictions



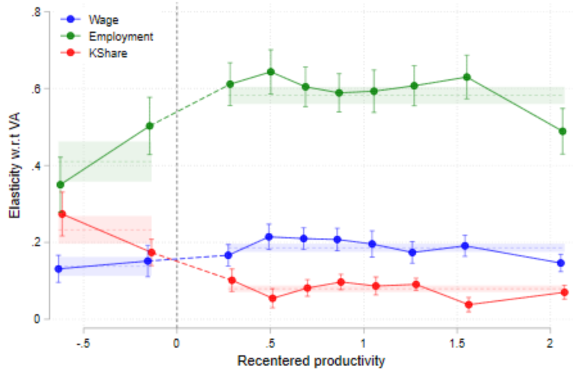

*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added, as more fully described in Figure 6. Each panel shows results when the sample is restricted to have at least 1, 3, 4 or 5 stayers over the event-study period. The specification is otherwise the same as in Figure 6.

Figure A6: LMS elasticities with respect to value-added: various labour market definitions

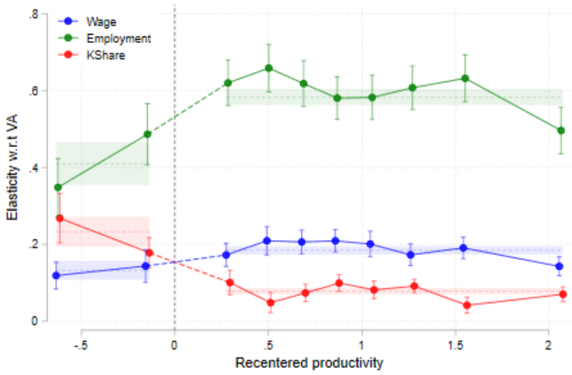
(a) Province × 2-digit industry




(b) District Council × 1-digit industry



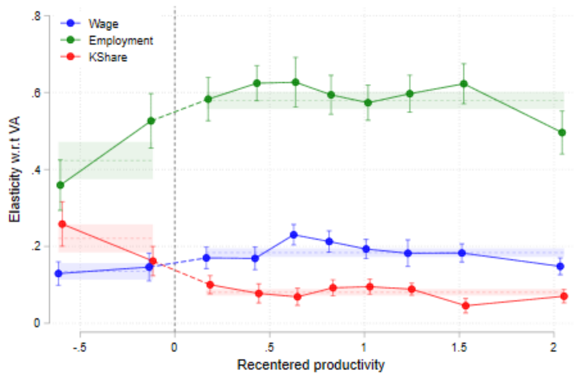

(c) District Council × 2-digit industry



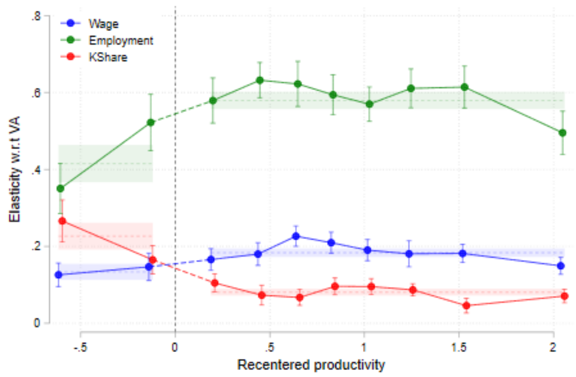

*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added, as more fully described in Figure 6. Each panel shows results when labour market fixed effects are defined by interactions of different geography and industry variables. There are 9 provinces and 52 district councils. The 1-digit industry level has 9 industry categories while the 2-digit level has 50 industry categories. The specification is otherwise the same as in Figure 6.

Figure A7: LMS elasticities with respect to value-added: trimming around the recentered productivity threshold

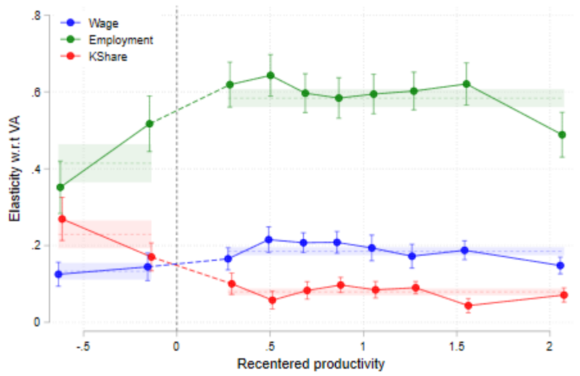
(a) No trimming



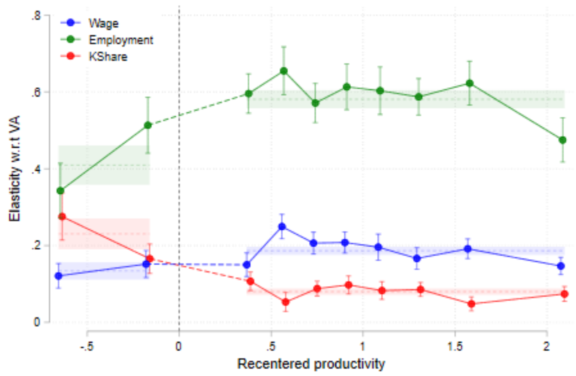

(b) Trimming at 1%




(c) Trimming at 5%




(d) Trimming at 10%




*Notes:* Figure shows outcome estimates from LMS-style event studies when estimated by productivity bin and divided by the effect on value-added, as more fully described in Figure 6. Each panel shows results for different choices of dropping firms close to the productivity threshold, where "Trimming at $x$%" means dropping the most productive $x$% of constrained firms and least productive $x$% of unconstrained firms. The specification is otherwise the same as in Figure 6.

## Appendix B: Full model detail

The full model in Manning (2003, pp. 338-345) is different from the simplified model in Section 2.1 mainly in that Manning (2003) incorporates the average market wage as a determinant of aggregate labour supply and a firm-specific supply-shifter $b_i$ (e.g. disamenities), so that the firm-specific labour supply depends on the firm wage premium relative to the market wage and the firm-specific disamenity. The model below is essentially a stripped-down re-presentation of Manning (2003).

Specifically, retain Equation 1 for the demand for labour, but now model the share of total employment ($N$) supplied to firm $i$ ($N_i$) as a function of its own wage ($W_i$) relative to an average market-level wage index ($W$) and the value of its disamenity ($B_i$): $\frac{N_i}{N} = \left(\frac{W_i}{B_i W}\right)^{1/\varepsilon}$. If one then models the labour supply to the whole market as $N = N_0 W^{\phi}$ and takes logs (again denoting logs of variables as lower case letters), the labour supply to the individual employer is

$$w_i = (1 - \varepsilon\phi)w + \varepsilon(n_i - n_0) + b_i \,,$$

or, subsuming $n_0$ into $b_i$ and defining the coefficient on the average wage as $\theta$,

$$w_i = \theta w + \varepsilon n_i + b_i \,. \tag{B1}$$

The marginal cost of labor in the absence of the minimum wage is then

$$\mathrm{mcl}_i = \ln(1+\varepsilon) + w_i = \ln(1+\varepsilon) + \varepsilon n_i + \theta w + b_i \,,$$

which diverges from the simplified Equation 2 in its two additional terms reflecting the influence of the average wage and the firm-specific disamenity. Equating the expression for the MRPL in Equation 1 to the MCL above, and substituting in Equation B1, the firm's unconstrained wage is given by Equations 5 and 6, while the unconstrained employment level is

$$n_i^* = \frac{-\theta w - \ln(1+\varepsilon) + a_i - b_i}{\eta + \varepsilon} \,. \tag{B2}$$

With the introduction of a minimum wage $w_{\mathrm{m}}$, the discussion of the fuller model in Section 2.1 explains how the value of a firm's "adjusted productivity" term $v_i$ relative to the thresholds $v^*$ and $v_1^*$ determines which of the qualitative distinct demand-constrained, supply-constrained or unconstrained regions it falls into. Expressions for these threshold values can be derived by noting that $v^*$ is the value of $v_i$ where the unconstrained wage $w_i^*$ is greater than or equal to the minimum wage $w_{\mathrm{m}}$, so that, from Equation 5,

$$v^* = w_{\mathrm{m}} - \frac{\eta\theta w - \varepsilon \ln(1+\varepsilon)}{\eta + \varepsilon} \,. \tag{B3}$$

For firms which have $v_i < v^*$, for some it will be optimal to accept all workers forthcoming at the minimum wage $w_{\mathrm{m}}$; these are supply-constrained firms. However for other firms with even lower $v_i$, it is not profitable to employ all the workers forthcoming at the minimum wage $w_{\mathrm{m}}$; these are the demand-constrained firms. To find the threshold value of $v_i$ which delineates these sets of firms, $v_1^*$, note that these firms set their wage at $w_{\mathrm{m}}$ but choose employment less than the potential supply at that wage so that $\mathrm{mrpl}_i = w_{\mathrm{m}}$. From Equations 1 and B1, we can resolve that

$$v_1^* = w_{\mathrm{m}} - \frac{\theta \eta w}{\eta + \varepsilon}\,. \tag{B4}$$

In order to find the equilibrium level of employment for supply-constrained firms, one can substitute $w_i = w_{\mathrm{m}}$ into the labour supply, Equation B1, which Manning (2003) shows can be expressed as:

$$n_i^{\mathrm{sc}} = n(w, a_i, b_i) + \frac{1}{\varepsilon}(v^* - v_i)\,, \tag{B5}$$

where $n(w, a_i, b_i)$ is the unconstrained employment level given in Equation B2. For our purposes it is useful to note that $a_i$ does not enter Equation B1, and therefore does not enter the expression for $n_i^{\mathrm{sc}}$, which reflects our main insight that equilibrium employment for supply-constrained firms is unaffected by local shifts in (revenue-) productivity, and in the special case where $b_i = 0$ all supply-constrained firms will have the same employment level, corresponding to the labour supplied at the minimum wage.[23]

To find the equilibrium employment for demand-constrained firms, again use that they will choose employment such that $\mathrm{mrpl}_i = w_{\mathrm{m}}$, and some rearranging leads to

$$n_i^{\mathrm{dc}} = n(w, a_i, b_i) + \frac{\ln(1+\varepsilon)}{\eta + \varepsilon} - \frac{1}{\eta}(v_1^* - v_i)\,. \tag{B6}$$

[23]While $v_i$ appears in Equation B5, expanding and simplifying necessarily causes the $a_i$ term to drop out, and it resolves to $n_i^{\mathrm{sc}} = (w_{\mathrm{m}} - \theta w - b_i)/\varepsilon$.

## Appendix C: Data appendix

This data appendix is created as per UNU-WIDER requirements for users of the National Treasury Secure Data Facility (NT-SDF). It reports on data directly used for the results presented in this paper, and does not include other variables and programs used in our ongoing research on this topic.

### Data Access

The data used for this research was accessed from the NT-SDF. Access was provided under a non-disclosure agreement, and our output was checked so that the anonymity of no firm or individual would be compromised. Our results do not represent any official statistics (NT or SARS). Similarly, the views expressed in our research are not necessarily the views of the NT or SARS.

Data used: CIT-IPR5 panel (`citirp5_v5_0`) and year-by-year IRP5 job-level data (`v5`). Date of first access for this project: 6 January 2023. Last accessed: 24 May 2024.

### Software

Our analysis was conducted using Stata 17. User-written programs and schemes used include `reghdfe` (Correia 2014), `gtools` (Bravo 2018), `prodest` (Rovigatti and Mollisi 2016), `loghockey` (Lunt nd), `ivreg2` (Baum et al. 2002), `ivreghdfe` (Correia 2018) and `plotplain` (Bischof 2017).

### Variables

Variables used from the raw IRP5 data include: `taxyear taxrefno payereferenceno dateofbirth idno passportno province_geo busprov_geo districtmunicip_geo busdistmuni_geo periodemployedfr periodemployedto totalperiodsinyearofassessment totalperiodsworked`.

Employment income was created from the following IRP5 amount codes: `amt3601 amt3605 amt3606 amt3607 amt3615 amt3616`. A record of employment-related allowances was created from the following IRP5 amount codes: `amt3701 amt3704 amt3710 amt3711 amt3712 amt3713 amt3715`.

IRP5 employment records were identified by records which had non-zero income or allowances; those with zero or missing income and allowances data are dropped from the analysis.

Variables used from the CIT-IRP5 data include: `taxyear finyear FYE taxrefno g_sales g_cos g_grossprofit g_grossloss k_ppe k_faother comp_prof_sic5_1d comp_prof_sic5_2d`.

Value-added was calculated by subtracting cost of sales from gross sales.

The "composite profit code" industry variables we use were created by Budlender and Ebrahim (2020). We merge in Bargaining Council variables created by Bassier (2022).

### Cleaning & sample notes

Our analysis is conducted at the CIT level; PAYE entities without CIT tax reference numbers are excluded from the sample. CIT entities not matched to PAYE entities are also excluded, as this is primarily an employment analysis. When matching firm ITR14/IT14 balance sheet information to the IRP5 data, we match on the basis of firm financial years which best overlap with the tax years used in the IRP5 data. Full-time equivalent employment is calculated using the "periods worked" variables. We use the unbalanced firm-level panel, which is only balanced after creating stacked events. When industry or location data is missing for a particular firm, we iteratively forwards and backwards impute these variables. These notes represent some particularly noteworthy data cleaning and sample construction decisions, but we cannot outline all such decisions here without reproducing our many thousands of lines of code; users are referred to our do-files which are available at the NT-SDF.