Minimum Wage, Financial Friction and the Life-cycle of Firms

Tomás R. Martinez

UnB

Introduction

- The popularity of the minimum wage is increasing among policymakers:
    - **U.S.** $\rightarrow$ proposals to raise the MW to up to $15/hour.
    - **Germany** $\rightarrow$ introduced a federal MW in 2015 of €8.50/hour.

- Nevertheless, the empirical evidence of its effect is mixed:
    - **Against** $\rightarrow$ adverse employment effects in low-wage workers (Neumark and Wascher, 2010).
    - **In favor** $\rightarrow$ null or even positive employment effects (Dube, Lester e Reich (2010)).

- Theoretically, the effect depends on how labor markets function:
    - **Monopsonistic labor markets** $\rightarrow$ MW could raise wages and employment.
    - **Competitive labor markets** $\rightarrow$ MW unambiguously decrease employment and workers' welfare.

Introduction

- **This project**: what is the impact of the minimum wage on the **firm life-cycle**?

    ► Do firms grow less?

    ► Does the minimum wage affects entry and exit?

- Does the answer depend on the firms characteristics such as size and age?
    ► Does labor reallocate between firms?

- What the results imply for the minimum wage effect on allocative efficiency?

Introduction

- **Empirics**:
  - ▶ Exploit the large increase in Brazilian real minimum wage in the 2000s.
  - ▶ In the same period, aggregate employment reallocated towards older establishments.

- Estimates suggest that, on average:
  - ▶ Exposed establishments to MW hikes decreased size.
  - ▶ Small and young establishments shrinked, large and old establishments grew.
  - ▶ No effect on entry of new establishments, but effects on exit.
  - ▶ Wages increase in both the formal and the informal sector.
  - ▶ Increase in informality.

Introduction

- **Theory**:
  - ▸ 2-period partial equilibrium model of heterogeneous firms.
  - ▸ Neoclassical monopsonistic competition and financial frictions.

- Model suggests rich interactions between minimum wage and financial frictions.
  - ▸ Without financial friction, no role for life-cycle.
  - ▸ Minimum wage reallocates labor from less productive to more productive firms.
  - ▸ With financial friction, large role for capital accumulation and life-cycle of firms.
  - ▸ Minimum wage reallocates labor from financially constrained to unconstrained firms.
  - ▸ It can increase the misallocation from financial friction.

Literature

- **Empirical Minimum Wage Literature**:
  - Card and Krueger (1994); Dustmann et al (2022); Harasztosi and Lidner (2019); Draca et al (2011).

- **Monopsony Models of the Labor Market**
  - Berger, Herkenhoff and Mongey (2022); Berger, Herkenhoff and Mongey (2022); Card et al (2018); Lamadon et al (2022); Engbom and Moser (2022); Haanwinckel (2020); Manning (2011).
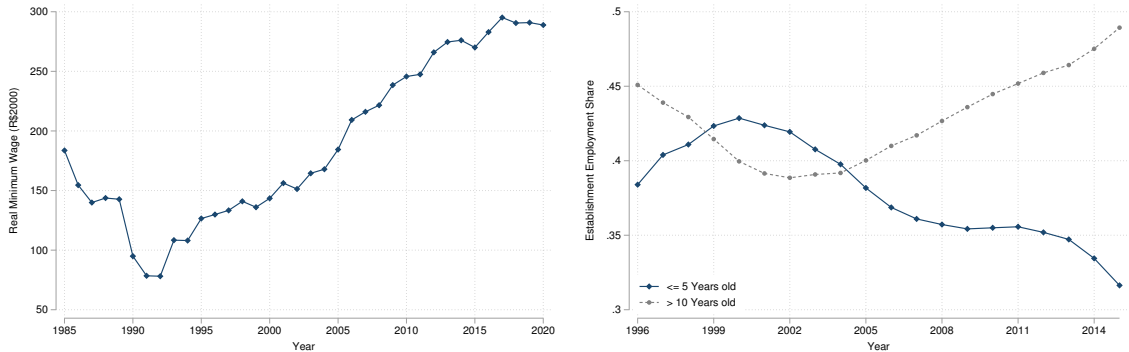
- **Financial Frictions and Misallocation**:
  - Midrigan and Xu (2014); Buera et al (2011); Moll (2014); Itskhoki and Moll (2019); Hsieh and Klenow (2014).

Empirical Evidence

Minimum Wage and Establishment's Employment Shares

Figure: Rise of Federal Minimum Wage (left) and Employment Shares by Establishment's Age (right)

Empirical Strategy

- **Cross-sectional variation**: exposure of firms and local labor markets to the MW increase.
  - ▶ Two approaches: firm-level and region-level.

- **Time variation**: large increase in the real federal minimum wage between 1999-2010.
  - ▶ Minimum wage was decided in a year-by-year base.
  - ▶ In 1999, it was unclear that Brazil would experience an increase in the real minimum wage $\Rightarrow$ Growth rates were low (0.3% and 0.5%) .
  - ▶ Only in 2008 the government passed a bill adhering the changes to the MW to real GDP growth.
  - ▶ The Brazilian economic growth in the 2000s is attributed to international demand shocks (i.e., China) and demographic supply shocks (increase in education attainment and in the labor force).

Empirical Strategy

Data:

- **RAIS (1995-2015)**:
  - ▸ Panel of formal private establishments (matched employer-employee);
  - ▸ Establishments characteristics: location, industry, size, wages, age..
  - ▸ Few multi-establishment firms.

- **Population Census (2000 & 2010)**:
  - ▸ Cross-section, representative at the municipality level.
  - ▸ Workers characteristics: education, gender, age, labor force status etc.
  - ▸ Employment and wages in the formal/informal sector, entrepreneurship, unemployment and labor force participation.

Firm-level Approach

- Define firm's j potential exposure as:

$$\text{GAP}_j = \frac{\sum_{i \in j} \max\{0, \text{MW}_{2010} - w_i\}}{\sum_{i \in j} w_i}, \tag{1}$$

  where w_i is the 1999 monthly wage of worker i in firm j, MW_{2010} is the real minimum wage in 2010.

- **Intuition**:
  - ▶ Firms with workers below the minimum wage will be more affected by a MW hike.
  - ▶ GAP_j: proportional increase in a firm's wage bill required to bring all of its workers up to the minimum wage in 2010.

- Include the firm's average wage as a control: variation will leverage the *wage distribution within the firm*.

Firm-level Approach

- Restrict to firm's that had at least one employee in 1999 and follow the outcomes in the subsequent years.
    - On average, smaller and younger firms tend to be more exposed.

	Avg. GAP	Observations
All Establishments	0.21	1,809,026
Age ≤ 5	0.24	1,070,155
Age > 5	0.16	738,871
Size ≤ 20	0.22	1,681,936
Size > 20	0.08	127,090

    - Pattern holds conditional on average wage.
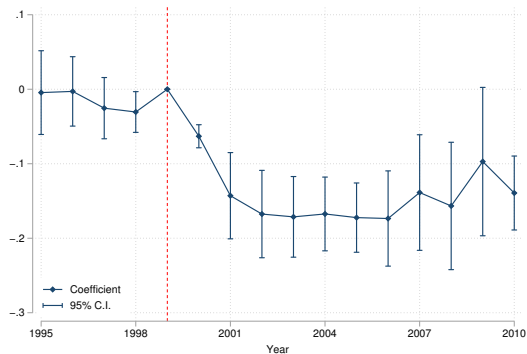
Firm-level Approach

- Specification:

$$\frac{y_{jt} - y_{j1999}}{y_{j1999}} = \alpha_t + \beta_t \mathsf{GAP}_j + \gamma_t X_{j1999} + \varepsilon_{jt} \qquad (2)$$

where y_{jt} is the outcome of firm j at time t (employment/wage), and X_{j1999} are firm-level characteristics in 1999.

- X_{j1999} includes:
  - Interaction of industry-time-region-size-age fixed effects.
  - Average wage (cubic polynomial).
  - Pre-1999 wage growth.

- The specification captures both the intensive (increase/decrease in employment) and the extensive margin (firm exit).
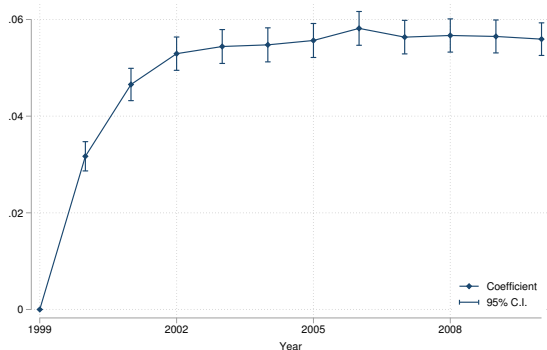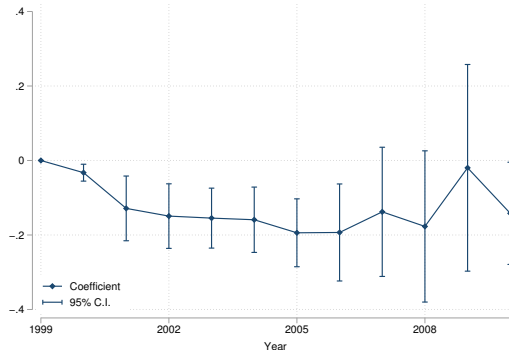
Firm-level Approach

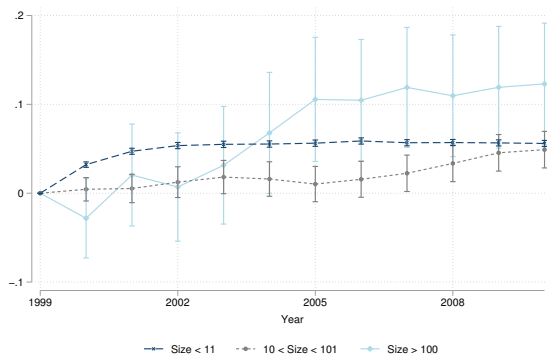Figure: Coefficients β_t: Employment and Wage Growth
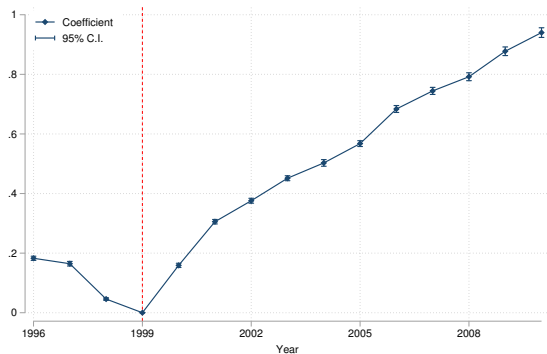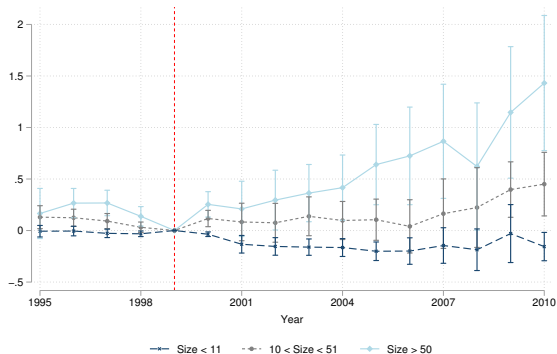
Firm-level Approach

Figure: Intensive vs Extensive Margin: Stayers Employment and Exit Probability

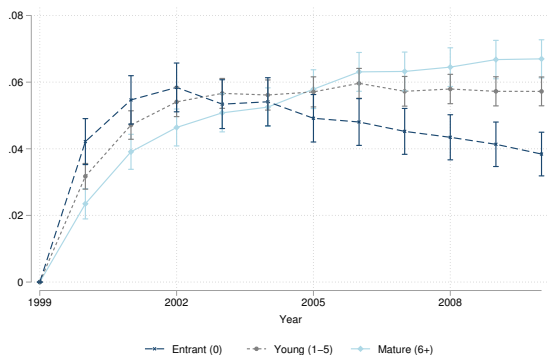Both margins are relevant!

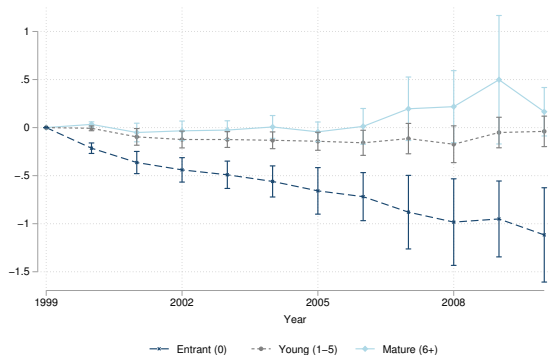# Firm-level Approach: Size

Figure: Intensive vs Extensive Margin: Stayers Employment and Exit Probability

Small firms shrink, large firms grow. Firms of all size exit.

Firm-level Approach: Age

Figure: Heterogeneity by Age: Stayers Employment and Exit Probability

Condition on surviving, entrants and young firms grow less. Less likely to exit in the future.

Firm-level Approach: Summary

- **Standard result:** Minimum wage causes an employment reallocation from small to large firms $\Rightarrow$ consistent with a monopsony model of the labor market.

- Wage growth is stronger in small firms.

- **New result**: Hikes in minimum wage stifle employment growth of entrant/young firms!
  - ▸ Also increase the probability of exit in the initial years, but once they survive they are less likely to exit.
  - ▸ Possible cause for the decrease in employment of young firms in the aggregate.

- Wages also increase more for entrants.

Region-level Approach

- Firm-level approach provides evidence on existing formal firms; but is mute regarding new firms (entrants).

- Moreover cannot uncover potentially relevant margins of adjustment:
  - Aggregate effects on wages and employment (local general equilibrium effects);
  - Reallocation to informality;
  - Other effects driven by workers not employed in the formal labor market;

- **Definition of local labor market**: A local labor market is a municipality. There are 5456 municipalities in Brazil.

Region-level Approach

- The potential exposure treatment is similar to the firm-level:

$$\mathsf{GAP}_m = \frac{\sum_{i \in m} \max\{0, \mathsf{MW}_{2010} - w_i^f\}}{\sum_{i \in m} w_i^f + \sum_{i \in m} w_i^i},$$

where w_i^f is the wage of formal worker, w_i^i is the wage of informal worker i in municipality m, and MW_{2010} is the real minimum wage in 2010.

- **Intuition:** Exposed regions have more low-earning workers in the formal sector $\Rightarrow$ non-trivial relationship with development.

- To compute GAP_m, we use both information of Census and RAIS.

Region-level Approach: Gap

- The measure has an average of 0.072.
  - ▸ If the wages of all workers in the formal sector were re-adjusted, the national wages would increase by 7.2%.

- Large cross-section variation in GAP_m.

- Important within-state variation.

[0.000, 0.018]
(0.018, 0.037]
(0.037, 0.061]
(0.061, 0.110]
(0.110, 1.088]
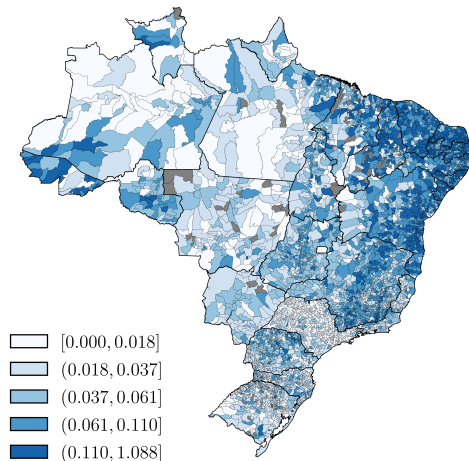
Region-level Approach

- Difference-in-differences specification:

$$y_{jmt} = \alpha_m + \alpha_t + \beta\mathsf{GAP}_m \times \alpha_t + \mathsf{controls} + \varepsilon_{jmt} \tag{3}$$

where y_{jmt} is the outcome of a firm/worker j, in municipality m, and time t, and α_m, α_r are fixed effects.

- Pre-period: $t = 2000$. Post: $t = 2010$.

- Controls include:
  - Time-varying firm/worker -level characteristics (industry and workers' demographic).
  - Municipality Income per capita in 2000 interacted with year FE.

Region-level Approach: Firm Results

	(1) Entrant	(2) Exiter	(3) Age > 5 years	(4) $\log$(size)
$GAP_m \times 2010$	-0.0188	0.155***	0.325***	-0.335***
	(0.0290)	(0.0198)	(0.0614)	(0.0918)
Observations	4,707,558	4,707,558	4,707,558	4,707,558
Municipality FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

SE Clustered at municipality
*** p<0.01, ** p<0.05, * p<0.1

Region-level Approach: Individual Results

	(1) Informal	(2) Employer	(3) Unemployed	(4) OLF	(5) $\log(earn)$ Formal	(6) $\log(earn)$ Informal	(7) $\log(earn)$ Employer
$\text{GAP}_m \times 2010$	0.159***	-0.00884***	0.0481***	0.0268	0.892***	0.503***	0.119
	(0.0236)	(0.00241)	(0.00825)	(0.0174)	(0.0713)	(0.0505)	(0.210)
Observations	7,981,170	7,981,170	13,030,226	13,030,226	3,357,422	2,003,671	175,035
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes

SE Clustered at municipality
*** p<0.01, ** p<0.05, * p<0.1

Summary

- **Firm-level approach**:
  - Large and old firms growth.
  - Small and Young firms shrink.
  - $\Rightarrow$ Reallocation from small to large firms. New firms grow less.

- **Region-level approach**:
  - No effect on entrants, increase exit.
  - Increase the share of old firms.
  - Decrease the size of firms.
  - Increase in informality, and earnings of both formal and informal workers.

Model

Model

- **Baseline (static) monopsony model with heterogeneous firms**:
  - ▶ Less efficient firms exit;
  - ▶ Small firms shrink;
  - ▶ Medium firms that would pay wages below the MW increase their wage and employment;
  - ▶ Large firms: ambiguous, depends on GE effects;
  - ▶ In general, reallocation from small to large firms.

- Baseline model **mute** about lifecycle, dynamics and interactions with capital accumulation.
  - ▶ Extend it with financial frictions $\Rightarrow$ Firms have to accumulate internal funds to grow.
  - ▶ Young constrained firms use too much labor $\Rightarrow$ ↑ MW $\Rightarrow$ Grow slower.

- **Today:** 2-period partial equilibrium.

2-period Model

- Firms are heterogeneous in their **productivity** z and **net worth** a, and have **labor market power**.
  - ▶ ⇒ Neoclassical monopsonistic labor market a la Berger, Herkenhoff and Mongey (2022, 2022).

- Unconstrained labor supply of the representative worker to firm j:

$$n_j = \left(\frac{w_j}{W}\right)^{\eta} N,$$

where $\eta > 0$ is the elasticity of substitution between firms, W aggregate wage index, and aggregate labor supply.

- As $\eta \to \infty$, the labor market tends to perfect competition.

2-period Model

- Entrepreneur j that lives for 2-periods and decides consumption-savings and production.

$$\max_{c,\ c',\ a'} \log(c) + \beta \log(c')$$

$$\text{s.t.} \quad c = \pi(a, z; \underline{w}) + (1 + r)a - a' \qquad \text{and} \qquad c' = \pi(a', z'; \underline{w}) + (1 + r)a'$$

- Where $\pi(a, z; \underline{w})$ is the optimal profit of her firm and $\underline{w}$ the minimum wage.
- F.O.C implies the Euler Equation:

$$\frac{1}{c(a, e)} = \beta \left(1 + r + \frac{\partial \pi(a', z'; \underline{w})}{\partial a'} \right) \frac{1}{c(a', e')}.$$

Firm's Problem

- Firm's j problem:

$$\pi(a, z) = \max_{k_j, n_j, w_j} \quad \left\{ z_j (k_j^\alpha n_j^{1-\alpha})^\theta - (r + \delta)k_j - w_j n_j \right\}$$

$$\text{s.t.} \quad k_j \leq \lambda a, \quad n_j \leq \left(\frac{w_j}{W}\right)^\eta N \qquad \text{and} \qquad w_j \geq \underline{w}.$$

- Solution equalizes marginal product to marginal cost:

$$mpk_j = \alpha\theta z_j k_j^{\alpha\theta-1} n_j^{(1-\alpha)\theta} = \underbrace{r + \delta + \mu_j(z, a)}_{\text{shadow cost of funds}}$$

$$mpl_j = (1-\alpha)\theta z_j k_j^{\alpha\theta} n_j^{(1-\alpha)\theta-1} = \underbrace{mc_j}_{\text{mc of additional worker}} .$$

where $\mu_j(z, a) \geq 0$ is the multiplier of the collateral constraint, and the mc_j depends on the constraints on labor and minimum wage.

Firm's Problem

- Solution for capital implies:

$$k_j = \left(\frac{z_j \alpha \theta}{r + \delta + \mu_j} n_j^{(1-\alpha)\theta} \right)^{\frac{1}{1-\alpha\theta}}$$

- If firm is unconstrained on capital $\mu_j = 0$. If firm is constrained, $\mu_j > 0$ and $k_j = \lambda a_j$.
- Solution for the problem is given by:

$$mpl(z_j, k_j, n_j) = mc_j.$$

  ▸ Changes in financial frictions or accumulation of internal funds $\Rightarrow$ shifts $mpl(k_j, n_j)$.
  ▸ Changes in minimum wage $\Rightarrow$ shifts mc_j.

Firm's Problem

- Static effects of the minimum wage.

- **Three cases**:

    (i) MW is not binding $\rightarrow \uparrow \underline{w}$ does nothing.

    (ii) MW is binding and n_j is giving by labor supply $\rightarrow \uparrow \underline{w}$ increases size of the firm.

    (iii) MW is binding and n_j is giving by labor demand $\rightarrow \uparrow \underline{w}$ decreases size of the firm.
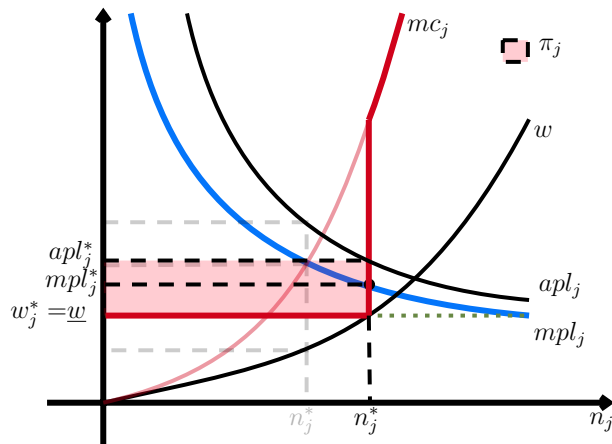
Case 1: MW is not binding
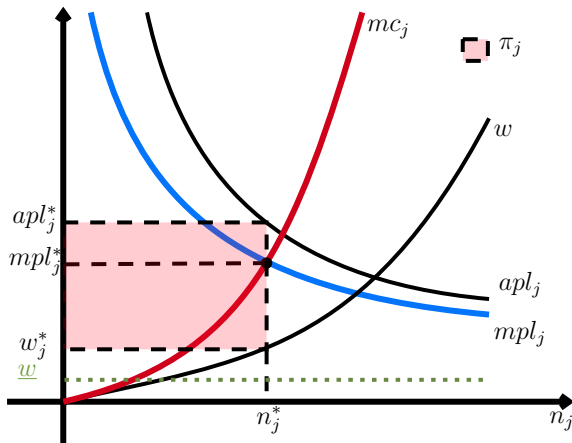
$$mc_j = w_j + \frac{\partial w_j}{\partial n_j} \times n_j$$

$$w_j = \underbrace{\left(\frac{\eta}{\eta + 1}\right)}_{\text{markdown}} mpl_j$$
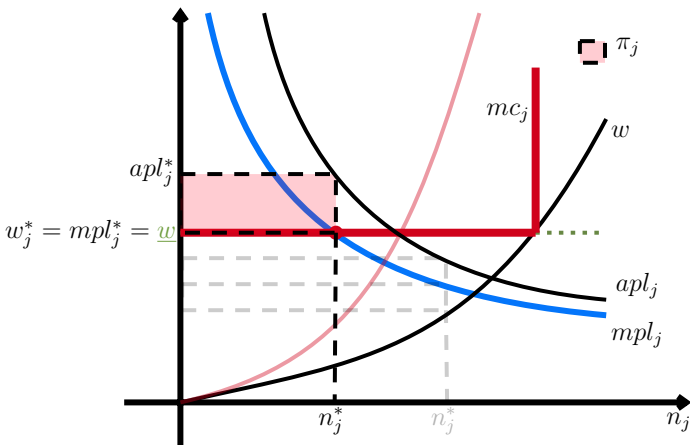
$$n_j = \left(\frac{w_j}{W}\right)^{\eta} N$$

$$mc_j = \underline{w}$$

$$\left(\frac{\eta}{\eta+1}\right) mpl_j < w_j = \underline{w} < mpl_j$$

$$n_j = \left(\frac{\underline{w}}{W}\right)^{\eta} N$$

$$mc_j = \underline{w}$$

$$w_j = \underline{w} = mpl_j$$

$$n_j < \left(\frac{\underline{w}}{W}\right)^{\eta} N$$

Absence of Financial Frictions

- In absence of financial friction (i.e. $\lambda \to \infty$):

  - Minimum wage reallocates labor from low wage (more likely to bind) to high wage firms (less likely to bind).

  - Because there is a direct relationship between z_j and w_j, MW reallocates from low to high productivity (in absence of GE effects).

  - $\pi_j(z, a) = \pi_j(z)$, firm size is independent of entrepreneurs net worth.

  - No effect of MW on firm's life-cycle $\Rightarrow$ firms achieve optimal scale (given MW) in period 1.

- A high minimum wage may bring allocative efficiency depending on the fraction of firms in case 2 and 3.

Financial Frictions

- **Static Effect**: Financially constrained firms operate with too little capital relative to labor.
    - Lower capital shifts $mpl(z, k, n)$ down $\Rightarrow$ makes the MW more likely to bind.
    - Distorts capital-labor ratio:

$$\frac{k_j}{n_j} = \frac{\alpha}{(1-\alpha)} \times \frac{mc_j}{r + \delta + \mu_j}$$

- The extent of the distortion is captured by the multiplier $\mu(z, a; \underline{w})$.

- Distorted firms receive lower profits, $\pi(z, a; \underline{w})$.
    - The distortion is potentially amplified depending the effect of $\underline{w}$ on μ.

Financial Frictions

- **Dynamic Effects**: firms "undo" financial frictions over time by accumulating internal funds a.

- MW affects firm growth and life-cycle, as it reduces profits and capital accumulation of entrepreneurs.

  - This is effect is **stronger** in financially constrained firms, since they are more labor intensive.

- Changes in MW $\Rightarrow$ changes the rate of return on capital:

$$\frac{1}{c(a,e)} = \beta \left(1 + r + \frac{\partial \pi(a', z'; \underline{w})}{\partial a'} \right) \frac{1}{c(a', e')}, \quad \text{where} \quad \frac{\partial \pi(a', z'; \underline{w})}{\partial a'} = \lambda \mu(a', z; \underline{w})$$
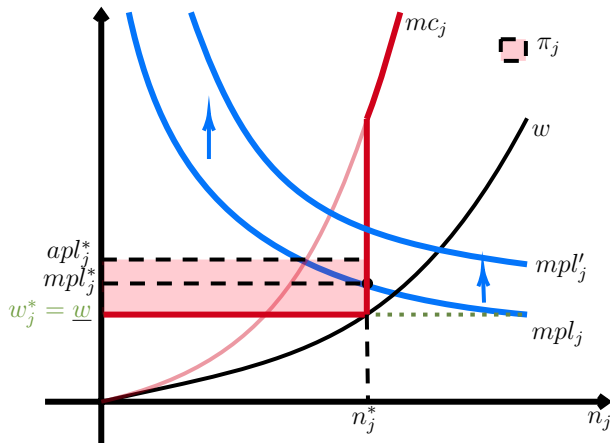
Case 2: MW is biding, n_j on labor supply

- If MW is binding and n_j is on the labor supply, firms are forced to hire more labor than optimal.

$$n_j = \left(\frac{\underline{w}}{W}\right)^\eta N, \qquad k_j = \lambda a_j, \qquad \text{and} \qquad \mu = mpk(z, k, n) - r - \delta$$

- Raise in the MW alleviate the effects of monopsony...
  - ...but it increases the distortions from financial frictions: $\uparrow \underline{w} \Rightarrow \uparrow n_j \Rightarrow \uparrow \mu$.

- **Intuition**: FF already distorts the k/n, minimum wage pushes in the same direction.

- **Dynamics:** As the firm accumulates a, it increases capital usage but **does not** increase size.

$$n_j = \left(\frac{\underline{w}}{W}\right)^{\eta} N$$

$$k_j = \lambda a_j$$
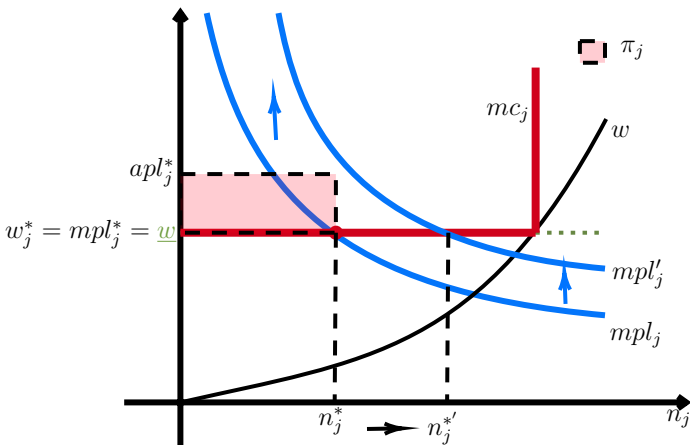
$$\mu = mpk(z, k, n) - r - \delta$$

Case 3: MW is biding, n_j on labor demand

- If MW is binding and n_j is on the labor demand, firms are forced to hire less labor than optimal.

$$n_j = \left(z\frac{(1-\alpha)\theta}{\underline{w}}k_j^{\alpha\theta}\right)^{\frac{1}{1-(1-\alpha)\theta}}, \qquad k_j = \lambda a_j, \qquad \text{and} \qquad \mu = mpk(z,k,n) - r - \delta$$

- Raise in the MW drives the k/n toward the optimal ratio: $\Rightarrow \downarrow n_j \Rightarrow \downarrow \mu$.
  - ▸ But reduces the demand of the firm far from its optimal scale $\Rightarrow$ increases misallocation.

- **Dynamics:** As the firm accumulates a, it increases capital and size.
  - ▸ Because $\downarrow \mu \Rightarrow$ less incentives to accumulate a and firms grow slower.

Case 3: MW is biding, n_j on labor demand

$$n_j = \left(z \frac{(1-\alpha)\theta}{\underline{w}} k_j^{\alpha\theta} \right)^{\frac{1}{1-(1-\alpha)\theta}}$$

$$k_j = \lambda a_j$$

$$\mu = mpk(z, k, n) - r - \delta$$

Presence of Financial Frictions

- In the presence of financial friction (i.e., $\lambda \to 1$):
  - Firm size depends of entrepreneurs net worth.
  - $\uparrow$ MW decreases profits and capital accumulation $\Rightarrow$ firms grow slower.

- $\uparrow$ MW reallocates labor from financially constrained to unconstrained firms (not necessarily the most productive).

- Optimal minimum wage is lower than without financial frictions.

Conclusion

- **Empirical evidence**: Minimum wage reallocates labor from small to large firms; and from young to mature firms.

- **Theory**: Baseline monopsonistic model mute about life-cycle effects. Extension with financial frictions accounts for the empirical evidence.

- Large MW hikes might increase distortions in a financial friction economy.

- **Future steps**
  - ▸ Empirical evidence on capital adjustment and financial constraints.
  - ▸ Quantitative model.