

The Indirect Effect of Minimum Wage Increases: Evidence from the Hungarian Firm Network

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Introduction

- **Objective:** Estimate both the direct and indirect effects of a minimum wage (MW) increase on firms.
- **General Question:** What is the transmission of cost shocks through firm networks?
- **Experiment:** 2017 MW increase in Hungary.
 1. Two separate MWs for skilled and unskilled workers, increasing at different rates.
 2. About 40% of Hungary's regular workforce was earning the MW at this time.
- **Data:** Linked Employer-Employee data from Social Security and Firm-to-Firm transactions from Value Added Taxes.
 - Allows us to estimate effect of indirect exposure to the minimum wage through upstream and downstream firms.

Contribution

We combine two literatures:

1. Transmission of shocks through firm network (Carvalho et al 2021). Contribution:
 - We have a continuous shock (not 0 or 1).
 - We study labor cost shock.
2. Firm level effect of MW increases (Harasztosi et al. 2019). Contribution:
 - We add the estimation of indirect effects.
 - We have a skill dependent MW.
 - We have monthly labor data.

Preview of Results

1. **Negative total effect, positive indirect effect:** For a firm with average exposure to MW, we get negative impact of -3.5% in employment.
 - Direct effect: -3.5% impact.
 - Indirect effect: 0.7% impact.
2. **Substitution effect:** Firms that are highly exposed to skilled (unskilled) MW, increase their employment of unskilled (skilled) workers.
3. **Workers flow downstream:** Indirect effect comes mainly through exposure of upstream firms.
 - Indirect effects are skill dependent: if firms upstream to you have high exposure to skilled (unskilled) minimum wage, you hire more skilled (unskilled) workers.

Data description

1. Employer-Employee Linked Data.

- Used to administer Social Security System.
- Includes all legal workers.
- Updates any event in real time.

2. Value-Added Taxes Data.

- Includes all Firm-to-Firm transactions.
- Different frequencies depending on the size of the firms.

3. Financial Statement Data.

- We use it to get profits, investment, and build controls.
- Annual frequency.

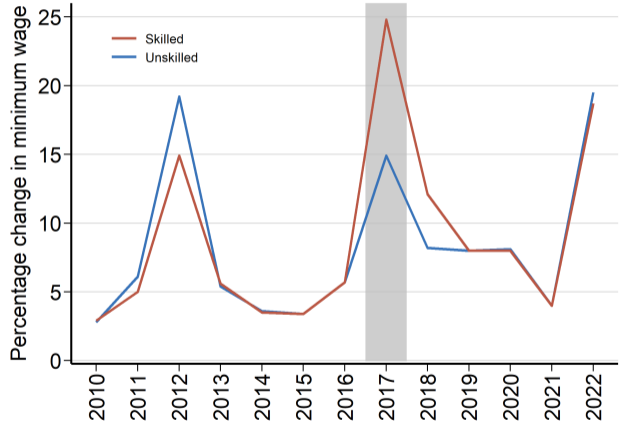
Filters

Table: Sample Filters

Number of Firms	Dropped	Number of Employees
With at least 4 regular employees at each month of 2016		
59,858	284,197	2,139,079
Reports CIT in 2016		
49,488	9,968	1,942,619
Specific industries excluded		
42,795	6,573	1,596,408
More than 50% state ownership excluded		
42,199	587	1,487,254
Founded after 2013 excluded		
41,192	910	1,465,711

Minimum wage shock

- We exploit the minimum wage change in Hungary in the year 2017.
- Different change by type of worker:
 - 24.8% for skilled workers
 - 14.9% for unskilled workers
- The minimum wage is set by a negotiation process between government, firms and unions.
- The agreement was announced in November 22, 2016.



Empirical Framework

Measuring direct exposure to minimum wage

- Minimum wage gap: *increase in firms' labor cost needed to comply to the new minimum wage.*
- Given that there are two MWs, we construct the **skilled** and **unskilled** MW gaps:

$$WG_{iy}^S = \frac{\sum_{l \in L^S} \max(w_{l,y-1}, MW_{l,y}^S)}{\sum_{l \in L} w_{l,y-1}} - 1$$

$$WG_{iy}^U = \frac{\sum_{l \in L^U} \max(w_{l,y-1}, MW_{l,y}^U)}{\sum_{l \in L} w_{l,y-1}} - 1$$

- We calculate the wage gap using the sum of wages from January 2016 to October 2016 (just before announcement).

Indirect exposure to minimum wage increase

1. For indirect exposure, we construct Cost Gaps instead of just Wage Gaps:

$$CG_j^{SK} = \frac{\sum_{l \in L^{SK}} \max(w_{l,y-1}, MW_{l,y}^{SK}) - MW}{TC_j}, \quad \text{for } SK \in S, U.$$

2. We build downstream and upstream weights based on the share of sales or purchases:

$$\alpha_{ij}^{Up} = \frac{x_{ij}}{TC_i} \qquad \alpha_{ij}^{Do} = \frac{x_{ji}}{TR_i}$$

x_{ij} represents sales from firm i to firm j .

3. We build sales- and purchase-weighted indirect exposure to minimum wage

$$CG_i^{SK,Up} = \sum_{j \in \text{Sell}} \alpha_{ij}^{Up} \cdot CG_j^{SK}, \quad CG_i^{SK,Do} = \sum_{j \in \text{Buy}} \alpha_{ij}^{Do} \cdot CG_j^{SK}$$

Descriptive statistics on wage gaps

Table: Direct and indirect wage gap

Variable	N	Mean	SD	p25	p50	p75	Min	Max
Direct Skilled Wage Gap	49488	6,85%	7,23%	0,35%	4,06%	12,21%	0,00%	24,12%
Direct Unskilled Wage Gap	49488	1,85%	3,16%	0,00%	0,26%	2,17%	0,00%	13,89%
Downstream Skilled Cost Gap	49488	0,58%	1,75%	0,00%	0,00%	0,27%	0,00%	12,47%
Downstream Unskilled Cost Gap	49488	0,16%	0,52%	0,00%	0,00%	0,04%	0,00%	3,75%
Upstream Skilled Cost Gap	49488	0,08%	0,21%	0,00%	0,00%	0,06%	0,00%	1,32%
Upstream Unskilled Cost Gap	49488	0,02%	0,08%	0,00%	0,00%	0,01%	0,00%	0,53%

Empirical Specification I: Monthly

$$\begin{aligned}\Delta Y_{it} = & \beta_t^S \cdot \text{MW gap}_i^S + \theta_t^{S,U^p} \cdot \text{C gap}^{S,U^p} + \theta_t^{S,D^o} \cdot \text{C gap}^{S,D^o} \\ & + \beta_t^U \cdot \text{MW gap}_i^U + \theta_t^{U,U^p} \cdot \text{C gap}^{U,U^p} + \theta_t^{U,D^o} \cdot \text{C gap}^{U,D^o} \\ & + X_i' \gamma + \alpha_s + \epsilon_i\end{aligned}$$

- **Outcomes:** ΔY_{it} for $t \in [-6, 12]$ where Y is headcount or hours (total, skilled, unskilled).

$$\Delta Y_{it} = \frac{Y_{it} - Y_{it,2016}}{Y_{it,2016}}$$

- Baseline $Y_{i-7,2016}$: average monthly outcome between January 2016 and June 2016 (just before announcement).

Empirical Specification II: Regression Details

$$\begin{aligned}\Delta Y_{it} = & \beta_t^S \cdot \text{MW gap}_i^S + \theta_t^{S,U_p} \cdot \text{C gap}^{S,U_p} + \theta_t^{S,D_o} \cdot \text{C gap}^{S,D_o} \\ & + \beta_t^U \cdot \text{MW gap}_i^U + \theta_t^{U,U_p} \cdot \text{C gap}^{U,U_p} + \theta_t^{U,D_o} \cdot \text{C gap}^{U,D_o} \\ & + X_i' \gamma + \alpha_s + \epsilon_i\end{aligned}$$

- X_i' : Firm level controls: export share, profit, amortization rate, and labor share.
- α_s : 3-digit industry fixed effects.
- Observations are weighted by $\log(\text{headcount})$.
- Robustness: different baselines, no controls, different weighting, 2-digit fixed effects.

Empirical Specification III: Annual Regressions

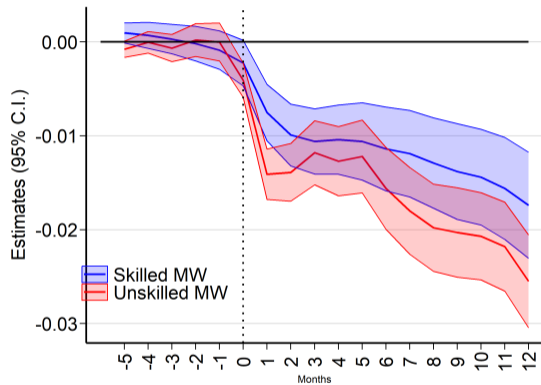
We also run regressions with outcomes variables that we observe annually.

$$\begin{aligned}\Delta Y_{i12} &= \beta^S \cdot \text{MW gap}_i^S + \theta^{S,Up} \cdot \text{C gap}^{S,Up} + \theta^{S,Do} \cdot \text{C gap}^{S,Do} \\ &+ \beta^U \cdot \text{MW gap}_i^U + \theta^{U,Up} \cdot \text{C gap}^{U,Up} + \theta^{U,Do} \cdot \text{C gap}^{U,Do} \\ &+ X_i' \gamma + \alpha_s + \epsilon_i\end{aligned}$$

- **Outcomes:** ΔY_{i12} where Y is N of purchase links, purchases, N of sale links, sales, Operational Profits, and Investment.

Results

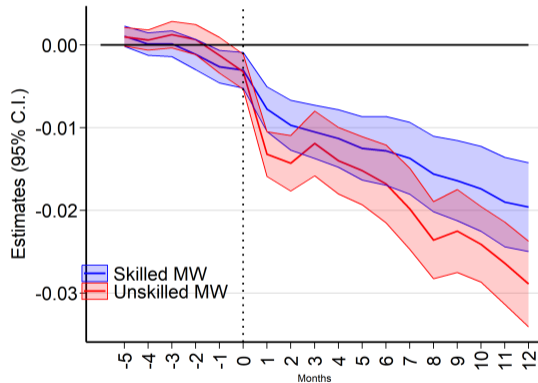
Result 1: Negative direct effect on hours



- For the average firm (with $MW\ gap_i^S = 6.85\%$ and $MW\ gap_i^U = 1.85\%$) we get a -3.1% direct impact in hours after a year.

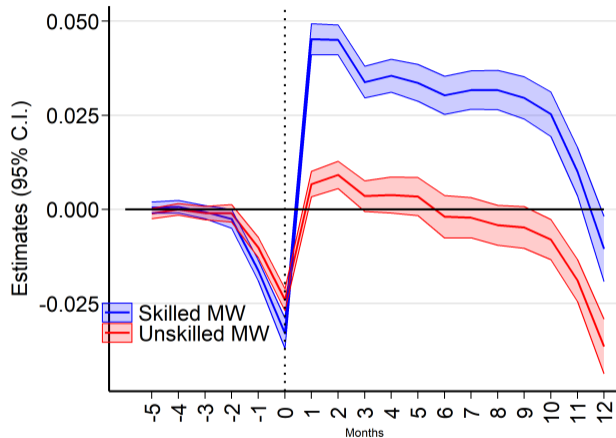
Same negative effect on total headcount

Figure: Direct Impact on Headcount



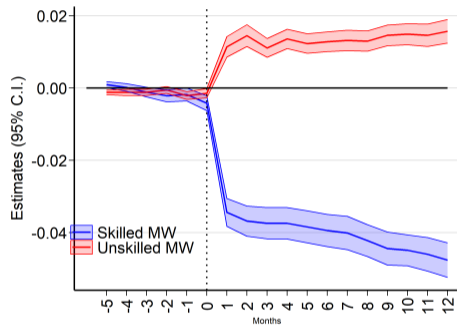
- For the average firm, we get a -3.5% direct impact in headcount after a year. Larger impact than for hours.

Direct effect on Total wagebill

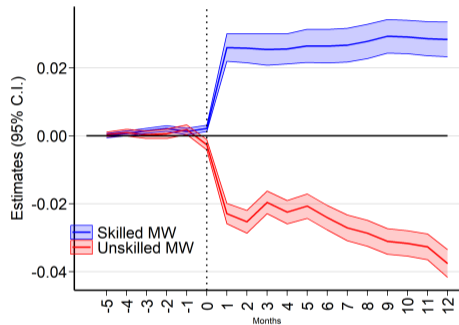


- The wage bill decreases first, then reaches a pass-through of 63.2%, and then decrease again.

Result 2: Substitution direct effects on skilled and unskilled hours



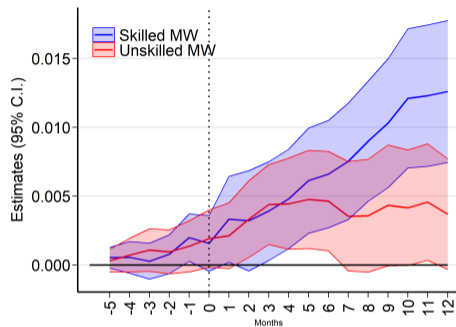
(a) Direct effect on skilled hours



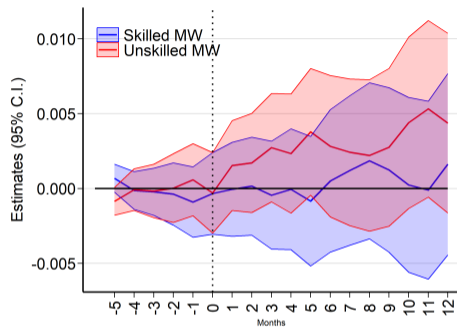
(b) Direct effect on unskilled hours

- We observe a striking pattern of substitution between two skill categories.

Result 3: positive indirect effects from upstream firms



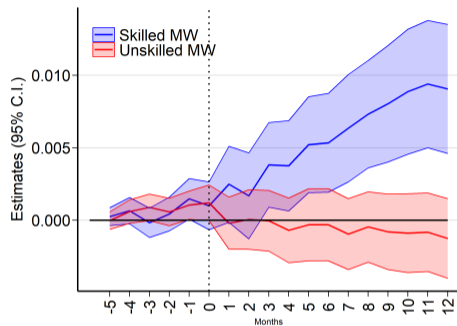
(a) Indirect effect from upstream firms



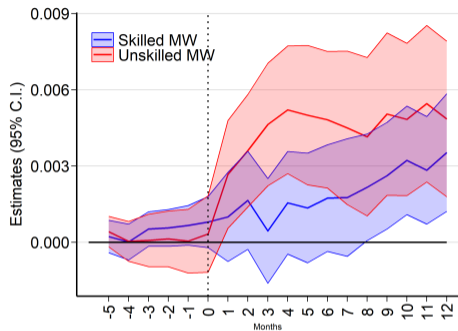
(b) Indirect effect from downstream firms

- We get significant and positive indirect effects coming from upstream firms, especially for skilled exposure.
- For the average firm, indirect effects increase hours by 0.75%, which is a 24% compensation of the direct effect.

Upstream indirect effect is skill dependent



(a) Effect on skilled from upstream



(b) Effect on unskilled from upstream

- Indirect effect from upstream exposure is skill dependent. When upstream firms have high skilled (unskilled) MW gap, you hire more skilled (unskilled) workers.
- Suggest that indirect effect is related to the increase of supply of workers coming from connected firms.

Annual Regressions

	N Purchase Links	Purchases	N Sale Links	Sales	Profits	Investment
MW Gap Skilled	-0.0123*** (0.00379)	-0.0152** (0.00703)	-0.0135*** (0.00306)	-0.00827 (0.00966)	-0.0734*** (0.0238)	0.0151 (0.155)
MW Gap Unskilled	-0.00980*** (0.00315)	-0.0179*** (0.00628)	-0.0134*** (0.00374)	-0.0186*** (0.00704)	-0.0449 (0.0289)	0.151* (0.0835)
Up. MW Gap Skilled	-0.000983 (0.00482)	-0.00295 (0.00845)	-0.0182*** (0.00386)	-0.0152** (0.00710)	0.0208 (0.0313)	-0.184** (0.0756)
Up. MW Gap Unskilled	0.00639 (0.00496)	0.00295 (0.00930)	-0.00257 (0.00328)	-0.0218*** (0.00693)	0.0114 (0.0313)	0.0591 (0.0762)
Down MW Gap Skilled	-0.00387 (0.00430)	0.0118 (0.00727)	0.0114*** (0.00366)	0.00866 (0.00877)	0.0571** (0.0237)	-0.146** (0.0734)
Down MW Gap Unskilled	-0.000916 (0.00410)	0.00639 (0.00653)	0.00132 (0.00296)	0.0116 (0.00857)	0.0273 (0.0236)	-0.00240 (0.0644)

- Negative impact of direct exposure on commercial trade both upwards and downwards.
- Mostly Positive impact of indirect exposure on commercial trade.
- Negative effect on Profits (for skilled exposure), positive effect on Investment (for unskilled exposure).

Conclusions

- We have analyzed the impact of a minimum wage increase on firms, accounting for both direct and indirect exposure.
- We find large negative impact of direct exposure on employment, and small positive impact of indirect exposure.
 - Positive indirect impact propagates downstream, and it is skill dependent.
- We see strong substitution between skill levels, and some evidence of substitution between unskilled workers and capital.