

# Automation and Inequality: How Robots Shift Income Between Workers and Owners\*

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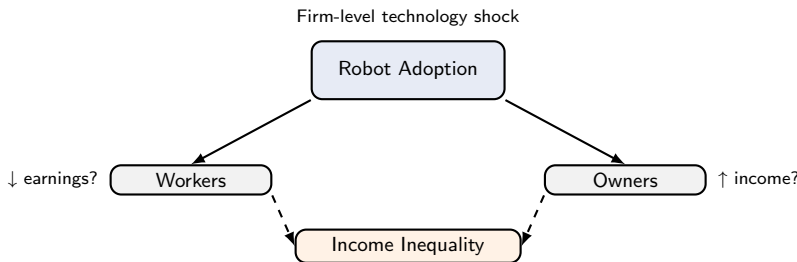
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\*Results in this paper have been screened by Statistics Canada to ensure that no confidential information has been released. The views expressed in this presentation are solely those of the authors and do not reflect those of the Bank of Canada nor Statistics Canada.

# Who Gains And Loses from Automation?

## Existing focus:

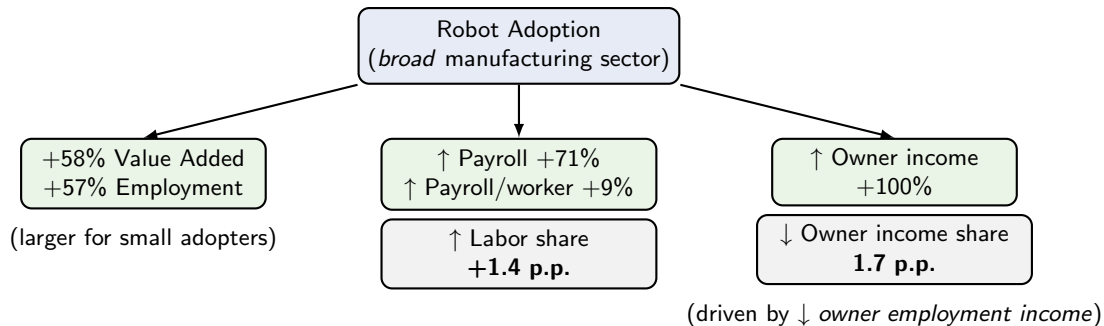
- Skill bias technological change
- Workers in adopting vs. non-adopting firms / sectors



## This paper:

- Novel channel: impact on workers vs. owners
  - Link [workers–owners–firms–robots](#)
  - Estimate effects for adopters and non-adopters
- Matters for (top) income inequality, market power, rent sharing...

# Preview of Main Results



**Measurement:** Treating owners “as workers” leads to different quantitative effects  
(still no labor share decrease)

# Contributions and Literature

First paper to estimate impacts of an automation technology on workers vs. individual owners

- Firm-level effects of robots/automation
  - Barth, Røed, Schøne, Umblijs (2020); Acemoglu, Lelarge, Restrepo (2020); Aghion, Antonin, Bunel, Jaravel (2021); Dixon, Hong, Wu (2021); Hirvonen, Stenhammar, Tuhkuri (2021); Humlum (2021); Koch, Manuylov, Smolka (2021); Acemoglu, Koster, Ozgen (2023); Bonfiglioli, Crino, Fadinger, Gancia (2024); Dinlersoz, Wolf (2024); Acemoglu et al. (2025);

We document substantial scale effects of automation and examine how these gains are distributed between workers and owners, leveraging direct measures of their respective incomes.

- Worker-level effects of robots/automation
  - Acemoglu, Koster, Ozgen (2023); Bessen, Goos, Salomons, van den Berge (2025)

We focus on labor share vs. owner income share.

- Rent sharing/rent dissipation and automation adoption
  - Acemoglu, Restrepo (2024); Firooz, Liu, Wang (2025)

Complementary results: labor share increases and owner income decreases in adopting firms.

# Data Description

# Canadian Data Environment

Robot adoption from firm-product-level imports data 2002–2018 (Dixon, Hong, Wu, 2021)

- Binary measure of first adoption event
- Continuous measure of robot stock

Comprehensive matched panel of individual-firm-level data for 2001–2018 (CEEDD)

- Firms' balance sheets and income statements from tax returns
  - 4-digit NAICS, HQ location, revenues, VA, net income, dividends, retained earnings, assets
- Individuals' annual employment income from each firm
- Individuals' annual income tax statements
- **Private corporations' list of owners (T2S50)**

What do we see in the T2S50?

- Identity of owners (individuals, corporations, partnerships, ~~trusts~~)
  - Own 10% or more of the firm's shares
- Direct + indirect ownership shares of individuals

# Baseline Sample and Variable Definitions

Like Acemoglu, Koster, Ozgen (2023), focus on broad manufacturing sector

- (narrow) manufacturing; mining, quarrying, oil and gas extraction; utilities; construction; transportation and warehousing; prof. scientific, and technical services; management of companies

Use T2S50 firms with individual ownership information as baseline

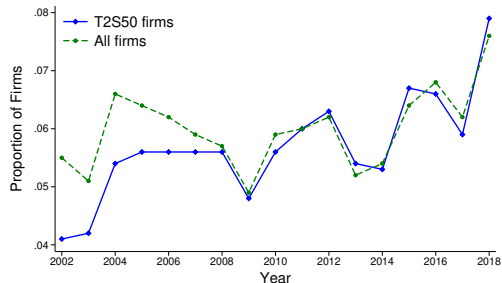
- A firm's owners are any individuals who ever have ownership shares  $> 0$ 
  - Owner income: **owner employment income** + dividends + (flow of) retained earnings
- Their workers are any other individual with employment income
  - Payroll: total employment income of workers
  - Employment: total number of workers

Keep firm-years with positive employment and revenues from 2002–2018

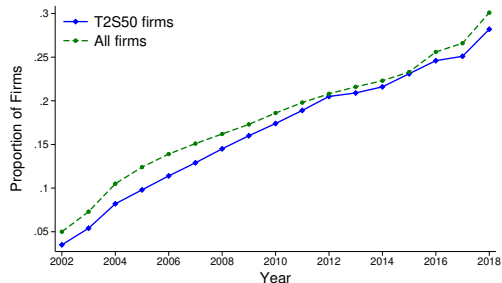
- T2S50 firms in broad manufacturing: 406,710
- Robot adopters: 865 (0.213%)

# Robot Adoption over Time

*A: Robot Import Events in Year*



*B: Past Robot Adoption up to Year*



**Figure 1:** Prevalence of Robot Adoption in the Broad Manufacturing Sector



# Summary Statistics

| Variables                      | Mean    | Std. dev. | 5 <sup>th</sup> perc. | Median  | 95 <sup>th</sup> perc. | Obs.      |
|--------------------------------|---------|-----------|-----------------------|---------|------------------------|-----------|
| <i>Panel A: Robot adopters</i> |         |           |                       |         |                        |           |
| Revenues (millions of \$)      | 124.739 | 1,395.585 | 0.467                 | 6.181   | 152.054                | 9,860     |
| Value added (millions of \$)   | 34.277  | 339.748   | 0.169                 | 2.269   | 43.404                 | 9,740     |
| Number of workers              | 394     | 4,058     | 4                     | 56      | 745                    | 9,860     |
| Payroll (millions of \$)       | 13.384  | 101.954   | 0.074                 | 1.423   | 28.117                 | 9,860     |
| Owner income (millions of \$)  | 13.068  | 179.050   | -0.534                | 0.383   | 8.610                  | 9,860     |
| Dividends (millions of \$)     | 11.422  | 164.329   | 0.000                 | 0.000   | 3.912                  | 9,860     |
| Payroll per worker (\$)        | 28,845  | 14,598    | 10,252                | 27,184  | 52,541                 | 9,860     |
| Value added per worker (\$)    | 61,848  | 509,739   | 14,491                | 42,953  | 119,503                | 9,740     |
| Assets per worker (\$)         | 198,626 | 1,439,779 | 21,786                | 79,394  | 381,601                | 9,860     |
| Revenues per worker (\$)       | 178,077 | 1,108,067 | 41,909                | 116,162 | 399,483                | 9,860     |
| Labor share (VA)               | 0.60    | 0.20      | 0.22                  | 0.63    | 0.91                   | 8,925     |
| Owner income share (VA)        | 0.28    | 0.18      | 0.04                  | 0.25    | 0.64                   | 8,405     |
| Dividends share (TP)           | 0.07    | 0.15      | 0.00                  | 0.00    | 0.42                   | 9,860     |
| Owner payout share (TP)        | 0.22    | 0.21      | 0.00                  | 0.16    | 0.66                   | 9,860     |
| Owner payout (millions of \$)  | 11.781  | 164.350   | 0.000                 | 0.210   | 5.368                  | 9,860     |
| <i>Panel B: Non-adopters</i>   |         |           |                       |         |                        |           |
| Revenues (millions of \$)      | 2.144   | 41.788    | 0.056                 | 0.431   | 6.797                  | 3,127,340 |
| Value added (millions of \$)   | 0.728   | 15.138    | 0.020                 | 0.175   | 2.242                  | 3,069,880 |
| Number of workers              | 17      | 182       | 1                     | 4       | 57                     | 3,127,340 |
| Payroll (millions of \$)       | 0.401   | 5.278     | 0.004                 | 0.070   | 1.378                  | 3,127,340 |
| Owner income (millions of \$)  | 0.223   | 13.472    | -0.030                | 0.061   | 0.620                  | 3,127,340 |
| Dividends (millions of \$)     | 0.094   | 8.263     | 0.000                 | 0.000   | 0.190                  | 3,127,340 |
| Payroll per worker (\$)        | 19,870  | 27,010    | 2,579                 | 16,621  | 45,960                 | 3,127,340 |
| Value added per worker (\$)    | 68,467  | 646,234   | 7,479                 | 37,207  | 174,829                | 3,069,880 |
| Assets per worker (\$)         | 221,254 | 3,924,327 | 5,161                 | 47,940  | 547,767                | 3,127,340 |
| Revenues per worker (\$)       | 178,387 | 980,980   | 21,293                | 95,593  | 496,737                | 3,127,340 |
| Labor share (VA)               | 0.46    | 0.26      | 0.05                  | 0.45    | 0.89                   | 2,846,800 |
| Owner income share (VA)        | 0.44    | 0.24      | 0.06                  | 0.43    | 0.85                   | 2,734,535 |
| Dividends share (TP)           | 0.11    | 0.20      | 0.00                  | 0.00    | 0.61                   | 3,127,340 |
| Owner payout share (TP)        | 0.41    | 0.29      | 0.00                  | 0.39    | 0.92                   | 3,127,340 |
| Owner payout (millions of \$)  | 0.176   | 8.282     | 0.000                 | 0.051   | 0.450                  | 3,127,340 |

# Summary Statistics

| Variables                      | Mean    | Std. dev. | 5 <sup>th</sup> perc. | Median  | 95 <sup>th</sup> perc. | Obs.      |
|--------------------------------|---------|-----------|-----------------------|---------|------------------------|-----------|
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| Revenues (millions of \$)      | 124.739 | 1,395.585 | 0.467                 | 6.181   | 152.054                | 9,860     |
| Value added (millions of \$)   | 34.277  | 339.748   | 0.169                 | 2.269   | 43.404                 | 9,740     |
| Number of workers              | 394     | 4,058     | 4                     | 56      | 745                    | 9,860     |
| Payroll (millions of \$)       | 13.384  | 101.954   | 0.074                 | 1.423   | 28.117                 | 9,860     |
| Owner income (millions of \$)  | 13.068  | 179.050   | -0.534                | 0.383   | 8.610                  | 9,860     |
| Dividends (millions of \$)     | 11.422  | 164.329   | 0.000                 | 0.000   | 3.912                  | 9,860     |
| Payroll per worker (\$)        | 28,845  | 14,598    | 10,252                | 27,184  | 52,541                 | 9,860     |
| Value added per worker (\$)    | 61,848  | 509,739   | 14,491                | 42,953  | 119,503                | 9,740     |
| Assets per worker (\$)         | 198,626 | 1,439,779 | 21,786                | 79,394  | 381,601                | 9,860     |
| Revenues per worker (\$)       | 178,077 | 1,108,067 | 41,909                | 116,162 | 399,483                | 9,860     |
| Labor share (VA)               | 0.60    | 0.20      | 0.22                  | 0.63    | 0.91                   | 8,925     |
| Owner income share (VA)        | 0.28    | 0.18      | 0.04                  | 0.25    | 0.64                   | 8,405     |
| Dividends share (TP)           | 0.07    | 0.15      | 0.00                  | 0.00    | 0.42                   | 9,860     |
| Owner payout share (TP)        | 0.22    | 0.21      | 0.00                  | 0.16    | 0.66                   | 9,860     |
| Owner payout (millions of \$)  | 11.781  | 164.350   | 0.000                 | 0.210   | 5.368                  | 9,860     |
| <i>Panel B: Non-adopters</i>   |         |           |                       |         |                        |           |
| Revenues (millions of \$)      | 2.144   | 41.788    | 0.056                 | 0.431   | 6.797                  | 3,127,340 |
| Value added (millions of \$)   | 0.728   | 15.138    | 0.020                 | 0.175   | 2.242                  | 3,069,880 |
| Number of workers              | 17      | 182       | 1                     | 4       | 57                     | 3,127,340 |
| Payroll (millions of \$)       | 0.401   | 5.278     | 0.004                 | 0.070   | 1.378                  | 3,127,340 |
| Owner income (millions of \$)  | 0.223   | 13.472    | -0.030                | 0.061   | 0.620                  | 3,127,340 |
| Dividends (millions of \$)     | 0.094   | 8.263     | 0.000                 | 0.000   | 0.190                  | 3,127,340 |
| Payroll per worker (\$)        | 19,870  | 27,010    | 2,579                 | 16,621  | 45,960                 | 3,127,340 |
| Value added per worker (\$)    | 68,467  | 646,234   | 7,479                 | 37,207  | 174,829                | 3,069,880 |
| Assets per worker (\$)         | 221,254 | 3,924,327 | 5,161                 | 47,940  | 547,767                | 3,127,340 |
| Revenues per worker (\$)       | 178,387 | 980,980   | 21,293                | 95,593  | 496,737                | 3,127,340 |
| Labor share (VA)               | 0.46    | 0.26      | 0.05                  | 0.45    | 0.89                   | 2,846,800 |
| Owner income share (VA)        | 0.44    | 0.24      | 0.06                  | 0.43    | 0.85                   | 2,734,535 |
| Dividends share (TP)           | 0.11    | 0.20      | 0.00                  | 0.00    | 0.61                   | 3,127,340 |
| Owner payout share (TP)        | 0.41    | 0.29      | 0.00                  | 0.39    | 0.92                   | 3,127,340 |
| Owner payout (millions of \$)  | 0.176   | 8.282     | 0.000                 | 0.051   | 0.450                  | 3,127,340 |

# Summary Statistics (Unadjusted)

| Variables                      | Mean    | Std. dev. | 5 <sup>th</sup> perc. | Median  | 95 <sup>th</sup> perc. | Obs.      |
|--------------------------------|---------|-----------|-----------------------|---------|------------------------|-----------|
| <i>Panel A: Robot adopters</i> |         |           |                       |         |                        |           |
| Revenues (millions of \$)      | 124.739 | 1,395.585 | 0.467                 | 6.181   | 152.054                | 9,860     |
| Value added (millions of \$)   | 34.277  | 339.748   | 0.169                 | 2.269   | 43.404                 | 9,740     |
| Number of workers              | 396     | 4,058     | 5                     | 58      | 747                    | 9,860     |
| Payroll (millions of \$)       | 13.743  | 102.024   | 0.129                 | 1.686   | 28.891                 | 9,860     |
| Owner income (millions of \$)  | 12.709  | 179.020   | -0.732                | 0.183   | 7.635                  | 9,860     |
| Dividends (millions of \$)     | 11.422  | 164.329   | 0.000                 | 0.000   | 3.912                  | 9,860     |
| Payroll per worker (\$)        | 33,278  | 19,162    | 12,263                | 30,245  | 62,255                 | 9,860     |
| Value added per worker (\$)    | 56,742  | 508,944   | 13,648                | 40,298  | 104,287                | 9,740     |
| Assets per worker (\$)         | 183,733 | 1,425,176 | 20,000                | 73,809  | 345,908                | 9,860     |
| Revenues per worker (\$)       | 164,449 | 1,106,060 | 38,985                | 108,554 | 349,267                | 9,860     |
| Labor share (VA)               | 0.71    | 0.18      | 0.36                  | 0.74    | 0.95                   | 8,475     |
| Owner income share (VA)        | 0.18    | 0.14      | 0.02                  | 0.15    | 0.45                   | 7,615     |
| Dividends share (TP)           | 0.07    | 0.15      | 0.00                  | 0.00    | 0.42                   | 9,860     |
| <i>Panel B: Non-adopters</i>   |         |           |                       |         |                        |           |
| Revenues (millions of \$)      | 2.144   | 41.788    | 0.056                 | 0.431   | 6.797                  | 3,127,340 |
| Value added (millions of \$)   | 0.728   | 15.138    | 0.020                 | 0.175   | 2.242                  | 3,069,880 |
| Number of workers              | 18      | 182       | 1                     | 6       | 59                     | 3,127,340 |
| Payroll (millions of \$)       | 0.482   | 5.318     | 0.011                 | 0.121   | 1.635                  | 3,127,340 |
| Owner income (millions of \$)  | 0.141   | 13.456    | -0.067                | 0.016   | 0.357                  | 3,127,340 |
| Dividends (millions of \$)     | 0.094   | 8.263     | 0.000                 | 0.000   | 0.190                  | 3,127,340 |
| Payroll per worker (\$)        | 25,969  | 41,264    | 4,523                 | 20,933  | 57,923                 | 3,127,340 |
| Value added per worker (\$)    | 48,033  | 443,146   | 6,276                 | 28,959  | 110,334                | 3,069,880 |
| Assets per worker (\$)         | 164,958 | 3,544,545 | 4,021                 | 37,241  | 374,368                | 3,127,340 |
| Revenues per worker (\$)       | 130,108 | 759,730   | 17,569                | 72,775  | 351,200                | 3,127,340 |
| Labor share (VA)               | 0.67    | 0.24      | 0.19                  | 0.72    | 0.97                   | 2,502,735 |
| Owner income share (VA)        | 0.23    | 0.20      | 0.00                  | 0.18    | 0.64                   | 2,222,025 |
| Dividends share (TP)           | 0.11    | 0.20      | 0.00                  | 0.00    | 0.61                   | 3,127,340 |

# Firm-Level Effects of Robot Adoption

# Firm-level Panel Regressions

Estimate effects of robot adoption on firm-level outcomes

$$y_{f,t} = \beta r_{f,t} + \gamma_t X_{f,\tilde{t}(f)} + \alpha_f + \delta_{s(f),t} + \zeta_{l(f),t} + \epsilon_{f,t}.$$

Where  $r_{f,t}$  is 1 if firm  $f$  have imported robots up to  $t$  (binary), or is the (ihs) stock of robots (continuous)

Control for

- Firm ( $\alpha_f$ ), 4-digit NAICS $\times$ year ( $\delta_{s(f),t}$ ), and HQ SAC location $\times$ year fixed effects ( $\zeta_{l(f),t}$ )
- Time-varying effects of log initial-year characteristics ( $\gamma_t X_{f,\tilde{t}(f)}$ ):
  - Employment
  - Value added per worker
  - Assets per worker

Cluster standard errors at firm and year levels

# Firm-level Scale Effects - Panel Regressions

|  | log revenues<br>(1) | log value added<br>(2) | log employment<br>(3) | log payroll<br>(4)  | ihs owner income<br>(5) |
|--|---------------------|------------------------|-----------------------|---------------------|-------------------------|
| <i>Panel A: Robot adoption by present</i>  |                     |                        |                       |                     |                         |
| Robot adopter                              | 0.451***<br>(0.038) | 0.457***<br>(0.036)    | 0.449***<br>(0.038)   | 0.538***<br>(0.044) | 0.696*<br>(0.354)       |
| Adjusted $R^2$                             | 0.861               | 0.815                  | 0.868                 | 0.829               | 0.323                   |
| No. Obs.                                   | 3,137,200           | 3,075,020              | 3,137,200             | 3,137,200           | 3,137,085               |
| No. Firms                                  | 406,710             | 402,110                | 406,710               | 406,710             | 406,700                 |
| <i>Panel B: Continuous stock of robots</i> |                     |                        |                       |                     |                         |
| ihs robot stock                            | 0.043***<br>(0.004) | 0.043***<br>(0.003)    | 0.043***<br>(0.003)   | 0.051***<br>(0.004) | 0.065*<br>(0.033)       |
| Adjusted $R^2$                             | 0.861               | 0.815                  | 0.868                 | 0.829               | 0.323                   |
| No. Obs.                                   | 3,137,200           | 3,075,020              | 3,137,200             | 3,137,200           | 3,137,085               |
| No. Firms                                  | 406,710             | 402,110                | 406,710               | 406,710             | 406,700                 |

*Notes:* All regressions include firm fixed effects, 4-digit NAICS $\times$ year fixed effects, SAC location $\times$ year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

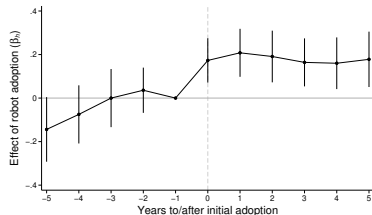
# Firm-level Scale Effects - Panel Regressions (Unadjusted)

|  | log revenues<br>(1) | log value added<br>(2) | log employment<br>(3) | log payroll<br>(4)  | ihs owner income<br>(5) |
|--|---------------------|------------------------|-----------------------|---------------------|-------------------------|
| <i>Panel A: Robot adoption by present</i>  |                     |                        |                       |                     |                         |
| Robot adopter                              | 0.451***<br>(0.038) | 0.457***<br>(0.036)    | 0.409***<br>(0.036)   | 0.481***<br>(0.039) | 0.807*<br>(0.427)       |
| Adjusted $R^2$                             | 0.861               | 0.815                  | 0.867                 | 0.823               | 0.271                   |
| No. Obs.                                   | 3,137,200           | 3,075,020              | 3,137,200             | 3,137,200           | 3,137,080               |
| No. Firms                                  | 406,710             | 402,110                | 406,710               | 406,710             | 406,700                 |
| <i>Panel B: Continuous stock of robots</i> |                     |                        |                       |                     |                         |
| ihs robot stock                            | 0.043***<br>(0.004) | 0.043***<br>(0.003)    | 0.039***<br>(0.003)   | 0.046***<br>(0.004) | 0.076*<br>(0.040)       |
| Adjusted $R^2$                             | 0.861               | 0.815                  | 0.867                 | 0.823               | 0.271                   |
| No. Obs.                                   | 3,137,200           | 3,075,020              | 3,137,200             | 3,137,200           | 3,137,080               |
| No. Firms                                  | 406,710             | 402,110                | 406,710               | 406,710             | 406,700                 |

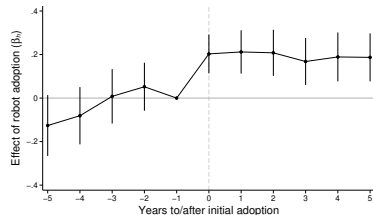
*Notes:* All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Firm-level Scale Effects - Event Studies

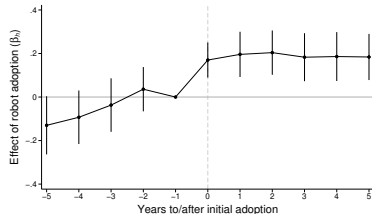
*log Revenues*



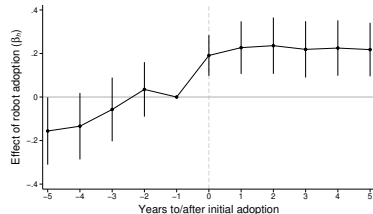
*log Value Added*



*log Employment*



*log Payroll*





# Firm-level Labor Productivity Effects - Panel Regressions

|  | log payroll per worker<br>(1) | log value added per worker<br>(2) | log revenues per worker<br>(3) |
|--|-------------------------------|-----------------------------------|--------------------------------|
| <i>Panel A: Robot adoption by present</i>  |                               |                                   |                                |
| Robot adopter                              | 0.089***<br>(0.013)           | 0.021<br>(0.016)                  | 0.002<br>(0.015)               |
| Adjusted $R^2$                             | 0.650                         | 0.674                             | 0.719                          |
| No. Obs.                                   | 3,137,200                     | 3,075,020                         | 3,137,200                      |
| No. Firms                                  | 406,710                       | 402,110                           | 406,710                        |
| <i>Panel B: Continuous stock of robots</i> |                               |                                   |                                |
| ihs robot stock                            | 0.009***<br>(0.001)           | 0.002<br>(0.001)                  | 0.000<br>(0.001)               |
| Adjusted $R^2$                             | 0.650                         | 0.674                             | 0.719                          |
| No. Obs.                                   | 3,137,200                     | 3,075,020                         | 3,137,200                      |
| No. Firms                                  | 406,710                       | 402,110                           | 406,710                        |

Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

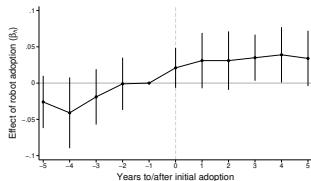
# Firm-level Labor Productivity Effects - Panel Regressions (Unadjusted)

|  | log payroll per worker<br>(1) | log value added per worker<br>(2) | log revenues per worker<br>(3) |
|--|-------------------------------|-----------------------------------|--------------------------------|
| <i>Panel A: Robot adoption by present</i>  |                               |                                   |                                |
| Robot adopter                              | 0.072***<br>(0.012)           | 0.061***<br>(0.015)               | 0.042**<br>(0.015)             |
| Adjusted $R^2$                             | 0.681                         | 0.659                             | 0.727                          |
| No. Obs.                                   | 3,137,200                     | 3,075,020                         | 3,137,200                      |
| No. Firms                                  | 406,710                       | 402,110                           | 406,710                        |
| <i>Panel B: Continuous stock of robots</i> |                               |                                   |                                |
| lhs robot stock                            | 0.007***<br>(0.001)           | 0.006***<br>(0.001)               | 0.004**<br>(0.001)             |
| Adjusted $R^2$                             | 0.681                         | 0.659                             | 0.727                          |
| No. Obs.                                   | 3,137,200                     | 3,075,020                         | 3,137,200                      |
| No. Firms                                  | 406,710                       | 402,110                           | 406,710                        |

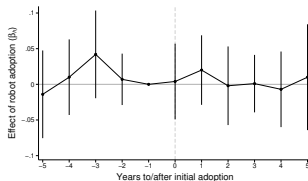
Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Firm-level Labor Productivity Effects - Event Studies

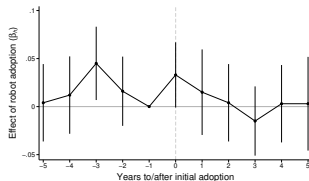
*log Payroll per Worker*



*log Value Added per Worker*



*log Revenues per Worker*



# Effect on Allocation of Surplus

|  | Labor share<br>(1) | Owner income share<br>(2) |
|--|--------------------|---------------------------|
| <i>Panel A: Robot adoption by present</i>  |                    |                           |
| Robot adopter                              | 0.014**<br>(0.006) | -0.017***<br>(0.006)      |
| Adjusted $R^2$                             | 0.681              | 0.666                     |
| No. Obs.                                   | 2,839,340          | 2,721,070                 |
| No. Firms                                  | 382,800            | 375,690                   |
| <i>Panel B: Continuous stock of robots</i> |                    |                           |
| ihs robot stock                            | 0.001**<br>(0.001) | -0.002***<br>(0.000)      |
| Adjusted $R^2$                             | 0.681              | 0.666                     |
| No. Obs.                                   | 2,839,340          | 2,721,070                 |
| No. Firms                                  | 382,800            | 375,690                   |

Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Effect on Allocation of Surplus (Unadjusted)

|  | Labor share<br>(1) | Owner income share<br>(2) |
|--|--------------------|---------------------------|
| <i>Panel A: Robot adoption by present</i>  |                    |                           |
| Robot adopter                              | 0.007<br>(0.006)   | -0.006<br>(0.005)         |
| Adjusted $R^2$                             | 0.601              | 0.556                     |
| No. Obs.                                   | 2,480,695          | 2,188,010                 |
| No. Firms                                  | 358,645            | 343,165                   |
| <i>Panel B: Continuous stock of robots</i> |                    |                           |
| ihs robot stock                            | 0.001<br>(0.001)   | -0.001<br>(0.000)         |
| Adjusted $R^2$                             | 0.601              | 0.556                     |
| No. Obs.                                   | 2,480,695          | 2,188,010                 |
| No. Firms                                  | 358,645            | 343,165                   |

Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Source Composition of Owner Income

|  | lhs dividends    | lhs Owner payout    | Dividend share<br>(TP) | Owner payout<br>share (TP) |
|--|------------------|---------------------|------------------------|----------------------------|
|  | (1)              | (2)                 | (3)                    | (4)                        |
| <i>Panel A: Robot adoption by present</i>  |                  |                     |                        |                            |
| Robot adopter                              | 0.286<br>(0.234) | 0.648***<br>(0.136) | -0.005<br>(0.005)      | -0.023***<br>(0.006)       |
| Adjusted $R^2$                             | 0.540            | 0.638               | 0.565                  | 0.715                      |
| No. Obs.                                   | 3,137,200        | 3,137,200           | 3,137,200              | 3,137,200                  |
| No. Firms                                  | 406,710          | 406,710             | 406,710                | 406,710                    |
| <i>Panel B: Continuous stock of robots</i> |                  |                     |                        |                            |
| lhs robot stock                            | 0.027<br>(0.022) | 0.061***<br>(0.013) | -0.001<br>(0.000)      | -0.002***<br>(0.001)       |
| Adjusted $R^2$                             | 0.540            | 0.638               | 0.565                  | 0.715                      |
| No. Obs.                                   | 3,137,200        | 3,137,200           | 3,137,200              | 3,137,200                  |
| No. Firms                                  | 406,710          | 406,710             | 406,710                | 406,710                    |

Notes: TP = dividends + payroll + owner employment income. All regressions include firm fixed effects, 4-digit NAICS  $\times$  year fixed effects, SAC location  $\times$  year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Comparison between T2S50 Firms and All Firms in Broad Manufacturing

|                             | log payroll<br>(1)  | ihs owner<br>income<br>(2) | log payroll per<br>worker<br>(3) | Labor share<br>(4) | Owner income<br>share<br>(5) |
|-----------------------------|---------------------|----------------------------|----------------------------------|--------------------|------------------------------|
| <i>Panel A: T2S50 Firms</i> |                     |                            |                                  |                    |                              |
| Robot adopter               | 0.481***<br>(0.039) | 0.807*<br>(0.427)          | 0.072***<br>(0.012)              | 0.007<br>(0.006)   | -0.006<br>(0.005)            |
| Adjusted $R^2$              | 0.823               | 0.271                      | 0.681                            | 0.601              | 0.556                        |
| No. Obs.                    | 3,137,200           | 3,137,080                  | 3,137,200                        | 2,480,695          | 2,188,010                    |
| No. Firms                   | 406,710             | 406,700                    | 406,710                          | 358,645            | 343,165                      |
| <i>Panel B: All firms</i>   |                     |                            |                                  |                    |                              |
| Robot adopter               | 0.472***<br>(0.034) | 1.312***<br>(0.333)        | 0.039***<br>(0.010)              | 0.012**<br>(0.005) | 0.001<br>(0.003)             |
| Adjusted $R^2$              | 0.820               | 0.273                      | 0.655                            | 0.598              | 0.659                        |
| No. Obs.                    | 5,506,105           | 5,505,080                  | 5,506,105                        | 4,295,045          | 3,839,410                    |
| No. Firms                   | 690,130             | 690,090                    | 690,130                          | 612,570            | 594,370                      |

Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .

# Comparison with Large Employers

|   | log payroll<br>(1)  | ihs owner<br>income<br>(2) | log payroll per<br>worker<br>(3) | Labor share<br>(4) | Owner income<br>share<br>(5) |
|---|---------------------|----------------------------|----------------------------------|--------------------|------------------------------|
| <i>Panel A: Firm-Years with one or more Employees</i> |                     |                            |                                  |                    |                              |
| Robot adopter   | 0.538***<br>(0.044) | 0.696*<br>(0.354)          | 0.089***<br>(0.013)              | 0.014**<br>(0.006) | -0.017***<br>(0.006)         |
| Adjusted $R^2$  | 0.829               | 0.323                      | 0.650                            | 0.681              | 0.666                        |
| No. Obs.  | 3,137,200           | 3,137,085                  | 3,137,200                        | 2,839,340          | 2,721,070                    |
| No. Firms   | 406,710             | 406,700                    | 406,710                          | 382,800            | 375,690                      |
| <i>Panel B: Firm-Years with 10 or more Employees</i>  |                     |                            |                                  |                    |                              |
| Robot adopter   | 0.299***<br>(0.032) | 0.518<br>(0.399)           | 0.034***<br>(0.010)              | 0.002<br>(0.006)   | -0.007<br>(0.005)            |
| Adjusted $R^2$  | 0.884               | 0.311                      | 0.846                            | 0.639              | 0.581                        |
| No. Obs.  | 956,890             | 956,780                    | 956,890                          | 863,590            | 819,840                      |
| No. Firms   | 127,400             | 127,390                    | 127,400                          | 118,400            | 115,575                      |

Notes: All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .



# Conclusion

Takeaways from preliminary firm-level analysis:

- Robot adoption associated with large  $\uparrow$  of firm scale and average pay per worker
  - 57% increase in employment, 9% increase in payroll per worker on average
- No evidence that it leads to  $\downarrow$  labor share of value added
  - If anything, labor share increases (1.4 p.p.), especially for smaller adopters
- Owner income share decreases (1.7 p.p)
  - Much of effect accounted for by owner employment income
- Measurement matters—different quantitative patterns when owners counted as workers

# Appendix

# Source Composition of Owner Income (Intensive Margin)

|  | log owner income<br>(baseline)<br>(1) | log dividends<br>(2) | log owner payout<br>(3) | log owner income<br>(unadjusted)<br>(4) |
|--|---------------------------------------|----------------------|-------------------------|---|
| <i>Panel A: Robot adoption by present</i>  |                                       |                      |                         |   |
| Robot adopter                              | 0.396***<br>(0.043)                   | 0.150<br>(0.088)     | 0.292***<br>(0.042)     | 0.375***<br>(0.048)                     |
| Adjusted $R^2$                             | 0.682                                 | 0.593                | 0.703                   | 0.642                                   |
| No. Obs.                                   | 2,707,175                             | 1,222,695            | 2,700,255               | 2,118,590                               |
| No. Firms                                  | 372,565                               | 209,400              | 358,515                 | 331,255                                 |
| <i>Panel B: Continuous stock of robots</i> |                                       |                      |                         |   |
| ihs robot stock                            | 0.037***<br>(0.004)                   | 0.014*<br>(0.008)    | 0.028***<br>(0.004)     | 0.035***<br>(0.004)                     |
| Adjusted $R^2$                             | 0.682                                 | 0.593                | 0.703                   | 0.642                                   |
| No. Obs.                                   | 2,707,175                             | 1,222,695            | 2,700,255               | 2,118,590                               |
| No. Firms                                  | 372,565                               | 209,400              | 358,515                 | 331,255                                 |

*Notes:* All regressions include firm fixed effects, 4-digit NAICS×year fixed effects, SAC location×year fixed effects, and time-varying effects of initially observed log employment, log value added per worker, and log assets per worker. Standard errors clustered at the firm and year levels are in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ .