# Learning by working in high-skill sectors

Paulo Bastos
World Bank

Erhan Artuc
World Bank

1 February, 2023

# Motivation

➢ Rapid industrial development was key for catch-up with the west observed in East Asia (Rodrik, 2016; Buera and Oberfield, 2020)

➢ Initially led by growth of exports in labor intensive manufacturing sectors (labor movements away from agriculture)

➢ This structural transformation yielded rapid productivity growth, as manufacturing tends to exhibit strong unconditional convergence in labor productivity (Rodrik, 2013)

➢ Better jobs in manufacturing also facilitated rapid increases in schooling by younger generations in East Asia (but not in Mexico Atkin, 2016)

# Motivation

➢ Less clear if this development path can still be observed in other parts of the developing world

➢ Evidence that manufacturing employment peaks at lower levels than before (Rodrik, 2016)

➢ Automation need not reduce exports in the South, but can reduce manufacturing employment (Artuc, Bastos and Rijkers, 2023)

➢ As employment shifts more rapidly towards services, important to study alternative mechanisms by which this structural transformation can lead to productivity growth

➢ One such mechanisms is **learning by working**, broadly defined as human capital accumulation through experience in the labor market (Krugman, 1987; Lucas, 1988; Redding, 1999)

## This paper

➤ Looks for evidence of learning by working in different sectors in Brazil

➤ Highly detailed longitudinal worker-firm panel data for Brazil covering both manufacturing and services, 2003-2015

➤ Focus on sectors' skill intensity as a source of learning by working

➤ Comparison between manufacturing and services

➤ Methods analogous to Puga and De la Roca (2017, REStud), who study "Learning by working in big cities"

# Main takeaways

➢ There are sizable static and dynamic benefits for workers associated with employment in high-skill sectors (many of which are in services)

➢ In services, dynamic benefits of learning accrue to the worker even if she is not currently employed in the most skilled sectors (transferable learning)

➢ In manufacturing, these dynamic benefits accrue only if the worker is currently employed in the most skilled sectors (non-transferable learning)

➢ Learning effects vary with worker education but are relatively similar for males and females

# Data description

**Relacao Anual de Informacoes Sociais (RAIS), 2003-2015**

➢ Longitudinal worker-firm census gathering administrative social security records

➢ Worker-level information on demographics (age, gender, schooling)

➢ Worker-level information on job characteristics (occupation, wage, hours worked)

➢ Worker-level information on hiring and termination dates

➢ Firm/plant-level information on number of employees, location, industry code

# Data description

**Relacao Anual de Informacoes Sociais (RAIS), 2003-2015**

➢ Unique identifiers for workers and firms/plants

➢ Restrict analysis to manufacturing and services (exclude agriculture and public sector)

➢ Analysis based on 2% random sample of workers (keeping all yearly observations for sampled workers)

# Econometric method

Dynamic benefits of working in high-skilled sectors (analogous to Puga and De la Roca, 2017)

$$W_{imst} = \theta_i + \alpha_m + \beta_s + \gamma_t + X'_{it}\beta + \sum_{j=1}^{S} \delta_{js}e_{ijt} + \mu_{imst}$$

*i = individual*
*m = microregion*
*s = sector*
*t = year*

*e_{ijt}* = experience aquired by worker *i* in high-skill sector *j* until time *t*

Allowed to vary depending both the:
1. sector in which it was acquired
2. sector in which the worker is currently employed

# Summary statistics

| Variable | Mean | SD | Min | Max |
|---|---|---|---|---|
| log wages | 7.182 | 0.695 | 4.722 | 11.55 |
| Services dummy | 0.762 | 0.426 | 0 | 1 |
| Manufacturing dummy | 0.238 | 0.426 | 0 | 1 |
| Experience in years | 3.578 | 5.109 | 0 | 49.81667 |
| Firm tenure in months | 153.200 | 139.900 | 0 | 599 |
| Average education in the firm | 10.039 | 2.538 | 0 | 22.5 |
| Years of education | 10.040 | 3.392 | 0 | 22.5 |
| 5th grade incomplete | 0.032 | 0.176 | 0 | 1 |
| 5th grade complete | 0.046 | 0.210 | 0 | 1 |
| 9th grade incomplete | 0.088 | 0.283 | 0 | 1 |
| 9th grade complete | 0.143 | 0.351 | 0 | 1 |
| Secondary level incomplete | 0.088 | 0.284 | 0 | 1 |
| Secondary level complete | 0.439 | 0.496 | 0 | 1 |
| Higher education incomplete | 0.043 | 0.202 | 0 | 1 |
| Higher education complete | 0.113 | 0.316 | 0 | 1 |
| Masters | 0.002 | 0.047 | 0 | 1 |
| PhD | 0.001 | 0.034 | 0 | 1 |

# Static wage premium in manufacturing/services, worker fixed-effects

| | (1) log wages | (2) 3 digit industry F.E from (1) | (3) 3 digit industry F.E from (1) |
|---|---|---|---|
| Services dummy | | -0.0533*** | |
| | | (0.0156) | |
| Manufacturing dummy | | | 0.0533*** |
| | | | (0.0156) |
| Experience in months | 0.00178*** | | |
| | (5.94e-06) | | |
| Experience ^ 2 | -5.59e-06*** | | |
| | (2.32e-08) | | |
| Firm tenure in months | 0.000743*** | | |
| | (4.16e-06) | | |
| Firm tenure ^2 | -6.30e-07*** | | |
| | (9.35e-09) | | |
| 5th grade incomplete | 0.00180 | | |
| | (0.00245) | | |
| 5th grade complete | 0.00987*** | | |
| | (0.00245) | | |
| 9th grade incomplete | 0.00961*** | | |
| | (0.00241) | | |
| 9th grade complete | 0.00746*** | | |
| | (0.00240) | | |
| Secondary level incomplete | -0.0107*** | | |
| | (0.00242) | | |
| Secondary level complete | 0.0229*** | | |
| | (0.00240) | | |
| Higher education incomplete | 0.0853*** | | |
| | (0.00250) | | |
| Higher education complete | 0.228*** | | |
| | (0.00249) | | |
| Masters | 0.215*** | | |
| | (0.00361) | | |
| PhD | 0.237*** | | |
| | (0.00449) | | |
| Observations | 7,310,456 | 204 | 204 |
| R-squared | 0.902 | 0.055 | 0.055 |
| Microregion F.E | Y | Y | Y |
| Year F.E | Y | Y | Y |
| Industry F.E | Y | Y | Y |
| Worker F.E | Y | Y | Y |

# Static wage premium in manufacturing/services, worker fixed-effects

|  | (1) | (2) |
|---|---|---|
|  | 3 digit industry F.E | 3 digit industry F.E |
| Wholesale and retail trade; repair of motor vehicles and motorcycles | -0.0970*** | |
|  | (0.0152) | |
| Transportation and storage | 0.0161 | |
|  | (0.0329) | |
| Accomodation and food services | -0.117*** | |
|  | (0.0309) | |
| Information and communication | -0.0844*** | |
|  | (0.0240) | |
| Financial and insurance actvities | 0.0861 | |
|  | (0.0692) | |
| Real estate activities | -0.0576 | |
|  | (0.0416) | |
| Professional, scientific and technical activities | -0.0334 | |
|  | (0.0608) | |
| Administrative and support service activities | -0.102*** | |
|  | (0.0218) | |
| Education | -0.200*** | |
|  | (0.0249) | |
| Human health and social work activities | -0.122*** | |
|  | (0.0120) | |
| Arts, entertainment, and recreation | -0.105*** | |
|  | (0.0350) | |
| Other services | -0.107** | |
|  | (0.0415) | |
| Food, beverage, smoke | | 0.0235 |
|  | | (0.0178) |
| Textiles, clothing, leather, footwear | | -0.0300* |
|  | | (0.0177) |
| Wood, paper, printing, furniture, and recycling | | 0.0200 |
|  | | (0.0197) |
| Petroleum, chemicals, rubber, plastic, and non-metallic | | 0.121*** |
|  | | (0.0292) |
| Metals, machinery and electronics | | 0.0569*** |
|  | | (0.0182) |
| Automotive | | 0.168*** |
|  | | (0.0399) |
| Observations | 190 | 190 |
| R-squared | 0.260 | 0.195 |
| Microregion F.E | Y | Y |
| Year F.E | Y | Y |
| Indusrty F.E | Y | Y |
| Worker F.E | Y | Y |

# Static wage premium and avg. education in sector, worker fixed-effects

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
|  | log wages | 3 digit industry F.E from (1) (services) | 3 digit industry F.E from (1) (manufacturing) | 3 digit industry F.E from (1) |
| Average years of education in the industry |  | 0.0281*** | 0.0340*** | 0.0223*** |
|  |  | (0.00982) | (0.00941) | (0.00713) |
| Experience in months | 0.00178*** |  |  |  |
|  | (5.94e-06) |  |  |  |
| Experience ^ 2 | -5.59e-06*** |  |  |  |
|  | (2.32e-08) |  |  |  |
| Firm tenure in months | 0.000743*** |  |  |  |
|  | (4.16e-06) |  |  |  |
| Firm tenure ^2 | -6.30e-07*** |  |  |  |
|  | (9.35e-09) |  |  |  |
| 5th grade incomplete | 0.00180 |  |  |  |
|  | (0.00245) |  |  |  |
| 5th grade complete | 0.00987*** |  |  |  |
|  | (0.00245) |  |  |  |
| 9th grade incomplete | 0.00961*** |  |  |  |
|  | (0.00241) |  |  |  |
| 9th grade complete | 0.00746*** |  |  |  |
|  | (0.00240) |  |  |  |
| Secondary level incomplete | -0.0107*** |  |  |  |
|  | (0.00242) |  |  |  |
| Secondary level complete | 0.0229*** |  |  |  |
|  | (0.00240) |  |  |  |
| Higher education incomplete | 0.0853*** |  |  |  |
|  | (0.00250) |  |  |  |
| Higher education complete | 0.228*** |  |  |  |
|  | (0.00249) |  |  |  |
| Masters | 0.215*** |  |  |  |
|  | (0.00361) |  |  |  |
| PhD | 0.237*** |  |  |  |
|  | (0.00449) |  |  |  |
| Observations | 7,310,456 | 100 | 104 | 204 |
| R-squared | 0.902 | 0.178 | 0.217 | 0.110 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Indusrty F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Static wage premium and avg. education in sector, firm-level controls

| | (1) | (2) |
|---|---|---|
| | log wages | 3 digit industry F.E (Services and Manufacturing) |
| Average years of education in the industry | | 0.0168** |
| | | (0.00689) |
| Firm size | -4.24e-07*** | |
| | (1.92e-08) | |
| Average years of education in the firm | 0.00922*** | |
| | (0.000105) | |
| Experience top 1-10 most educated industries | 0.0165*** | |
| | (0.000703) | |
| Experience top 1-10 most educated indus x experience | -8.71e-05*** | |
| | (1.00e-05) | |
| Experience in months | 0.00174*** | |
| | (6.19e-06) | |
| Experience ^ 2 | -5.45e-06*** | |
| | (2.54e-08) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00220*** | |
| | (0.000730) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 4.01e-05*** | |
| | (1.01e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -1.06e-05* | |
| | (5.80e-06) | |
| Firm tenure in months | 0.000737*** | |
| | (4.26e-06) | |
| Firm tenure ^2 | -6.26e-07*** | |
| | (9.70e-09) | |
| 5th grade incomplete | 0.000279 | |
| | (0.00255) | |
| 5th grade complete | 0.00419 | |
| | (0.00256) | |
| 9th grade incomplete | -0.00237 | |
| | (0.00252) | |
| 9th grade complete | -0.0100*** | |
| | (0.00251) | |
| Secondary level incomplete | -0.0330*** | |
| | (0.00254) | |
| Secondary level complete | -0.00628** | |
| | (0.00252) | |
| Higher education incomplete | 0.0466*** | |
| | (0.00263) | |
| Higher education complete | 0.180*** | |
| | (0.00263) | |
| Masters | 0.156*** | |
| | (0.00373) | |
| PhD | 0.173*** | |
| | (0.00461) | |
| Observations | 6,906,352 | 204 |
| R-squared | 0.906 | 0.066 |
| Microregion F.E | Y | Y |
| Year F.E | Y | Y |
| Indusrty F.E | Y | Y |
| Worker F.E | Y | Y |

# Dynamic benefits of working in high-skilled sectors, worker fixed-effects

$$W_{imst} = \theta_i + \alpha_m + \beta_s + \gamma_t + X'_{it}\beta + \sum_{j=1}^{S} \delta_{js} e_{ijt} + \mu_{imst}$$

*i = individual*
*m = microregion*
*s = sector*
*t = year*

$e_{ijt}$= experience aquired by worker *i* in high-skill sector *j* until time *t*

allowed to vary depending both the:
1. sector in which it was acquired
2. sector in which the worker is currently employed

# Avg. years of education by sector

| Rank | Industry | Average years of education |
|---|---|---|
| **Overall** | | |
| 1 | Space transport | 16,00 |
| 2 | Central bank | 15,32 |
| 3 | Monetary intermediation | 14,74 |
| 4 | Non-monetary intermediation | 14,60 |
| 5 | Higher education | 14,34 |
| 6 | Life and non-life insurance | 14,07 |
| 7 | Supplementary pension | 14,07 |
| 8 | Software consultancy | 14,02 |
| 9 | Database activities and online distribution of electronic content | 13,81 |
| 10 | Hardware consultancy | 13,73 |
| **Services** | | |
| 1 | Space transport | 16,00 |
| 2 | Central bank | 15,32 |
| 3 | Monetary intermediation | 14,74 |
| 4 | Non-monetary intermediation | 14,60 |
| 5 | Higher education | 14,34 |
| 6 | Life and non-life insurance | 14,07 |
| 7 | Supplementary pension | 14,07 |
| 8 | Software consultancy | 14,02 |
| 9 | Database activities and online distribution of electronic content | 13,81 |
| 10 | Hardware consultancy | 13,73 |
| **Manufacturing** | | |
| 1 | Manufacture of petroleum products | 13,58 |
| 2 | Development of nuclear fuels | 12,61 |
| 3 | Aircraft construction | 12,35 |
| 4 | Manufacture of pesticides | 12,19 |
| 5 | Manufacture and assembly of trucks and buses | 12,18 |
| 6 | Manufacture of pharmaceutical products | 12,18 |
| 7 | Manufacture of automobiles, vans and utilities | 11,85 |
| 8 | Manufacture of machines and equipment of electronic systems for data processing | 11,72 |
| 9 | Manufacture of telephony and radiotelephony apparatus and equipment and television and radio transmitters | 11,69 |
| 10 | Edition; editing and printing | 11,62 |

# Dynamic benefits of working in high-skilled sectors

|  | (1) | (2) |
|---|---|---|
|  | Log Wages | 3 digit industry F.E (Services and Manufacturing) |
| Average years of education in the industry |  | 0.0207*** |
|  |  | (0.00688) |
| Experience top 1-10 most educated industries | 0.0163*** |  |
|  | (0.000703) |  |
| Experience top 1-10 most educated indus x experience | -7.54e-05*** |  |
|  | (1.00e-05) |  |
| Experience in months | 0.00172*** |  |
|  | (6.19e-06) |  |
| Experience ^ 2 | -5.47e-06*** |  |
|  | (2.54e-08) |  |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00197*** |  |
|  | (0.000731) |  |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 2.82e-05*** |  |
|  | (1.01e-05) |  |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -1.61e-05*** |  |
|  | (5.80e-06) |  |
| Firm tenure in months | 0.000719*** |  |
|  | (4.25e-06) |  |
| Firm tenure ^2 | -6.10e-07*** |  |
|  | (9.59e-09) |  |
| 5th grade incomplete | 0.00153 |  |
|  | (0.00256) |  |
| 5th grade complete | 0.00937*** |  |
|  | (0.00256) |  |
| 9th grade incomplete | 0.00967*** |  |
|  | (0.00252) |  |
| 9th grade complete | 0.00765*** |  |
|  | (0.00251) |  |
| Secondary level incomplete | -0.00984*** |  |
|  | (0.00253) |  |
| Secondary level complete | 0.0226*** |  |
|  | (0.00250) |  |
| Higher education incomplete | 0.0816*** |  |
|  | (0.00260) |  |
| Higher education complete | 0.219*** |  |
|  | (0.00259) |  |
| Masters | 0.196*** |  |
|  | (0.00370) |  |
| PhD | 0.215*** |  |
|  | (0.00459) |  |
| Observations | 6,906,352 | 204 |
| R-squared | 0.906 | 0.098 |
| Microregion F.E | Y | Y |
| Year F.E | Y | Y |
| Indusrty F.E | Y | Y |
| Worker F.E | Y | Y |

# Dynamic benefits of working in high-skilled sectors, manufacturing vs. services

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Log Wages | 3 digit industry F.E (Services) | Log Wages | 3 digit industry F.E (Manufacturing) |
| Average years of education in the industry | | 0.0266*** | | 0.0270*** |
| | | (0.00948) | | (0.00917) |
| Experience top 1-10 most educated industries | 0.0149*** | | -0.00980*** | |
| | (0.000742) | | (0.00120) | |
| Experience top 1-10 most educated indus x experience | -6.37e-05*** | | 2.09e-05 | |
| | (1.03e-05) | | (1.40e-05) | |
| Experience in months | 0.00147*** | | 0.00200*** | |
| | (7.42e-06) | | (1.04e-05) | |
| Experience ^ 2 | -4.71e-06*** | | -6.53e-06*** | |
| | (3.09e-08) | | (4.03e-08) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00295*** | | 0.0223*** | |
| | (0.000767) | | (0.00125) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 1.14e-05 | | -0.000107*** | |
| | (1.04e-05) | | (1.42e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -1.52e-05** | | -8.99e-05*** | |
| | (5.93e-06) | | (8.62e-06) | |
| Firm tenure in months | 0.000659*** | | 0.000760*** | |
| | (5.14e-06) | | (9.30e-06) | |
| Firm tenure ^2 | -4.95e-07*** | | -8.12e-07*** | |
| | (1.18e-08) | | (1.97e-08) | |
| 5th grade incomplete | -0.00654** | | 0.00861** | |
| | (0.00328) | | (0.00394) | |
| 5th grade complete | -0.00243 | | 0.0199*** | |
| | (0.00326) | | (0.00406) | |
| 9th grade incomplete | -0.00111 | | 0.0155*** | |
| | (0.00321) | | (0.00398) | |
| 9th grade complete | -0.00445 | | 0.0154*** | |
| | (0.00319) | | (0.00397) | |
| Secondary level incomplete | -0.0197*** | | -0.00343 | |
| | (0.00322) | | (0.00403) | |
| Secondary level complete | 0.00934*** | | 0.0245*** | |
| | (0.00319) | | (0.00397) | |
| Higher education incomplete | 0.0658*** | | 0.0726*** | |
| | (0.00329) | | (0.00428) | |
| Higher education complete | 0.203*** | | 0.176*** | |
| | (0.00328) | | (0.00423) | |
| Masters | 0.171*** | | 0.231*** | |
| | (0.00434) | | (0.00840) | |
| PhD | 0.198*** | | 0.163*** | |
| | (0.00517) | | (0.0126) | |
| Observations | 5,198,376 | 100 | 1,572,219 | 104 |
| R-squared | 0.904 | 0.173 | 0.944 | 0.172 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Industry F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Dynamic benefits of working in high-skilled sectors, robustness firm attributes

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | log wages | 3 digit industry F.E (Services) | log wages | 3 digit industry F.E (Manufacturing) |
| Average years of education in the industry | | 0.0232** | | 0.0225** |
| | | (0.00949) | | (0.00896) |
| Firm size | -7.57e-07*** | | 1.36e-06*** | |
| | (2.22e-08) | | (4.51e-08) | |
| Average years of education in firm | 0.00816*** | | 0.0111*** | |
| | (0.000125) | | (0.000237) | |
| Experience top 1-10 most educated industries | 0.0154*** | | -0.00958*** | |
| | (0.000741) | | (0.00120) | |
| Experience top 1-10 most educated indus x experience | -7.47e-05*** | | 1.37e-05 | |
| | (1.03e-05) | | (1.40e-05) | |
| Experience in months | 0.00148*** | | 0.00203*** | |
| | (7.41e-06) | | (1.04e-05) | |
| Experience ^ 2 | -4.70e-06*** | | -6.57e-06*** | |
| | (3.08e-08) | | (4.02e-08) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00319*** | | 0.0221*** | |
| | (0.000766) | | (0.00125) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 2.29e-05** | | -9.84e-05*** | |
| | (1.04e-05) | | (1.41e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -1.09e-05* | | -8.31e-05*** | |
| | (5.93e-06) | | (8.61e-06) | |
| Firm tenure in months | 0.000679*** | | 0.000790*** | |
| | (5.15e-06) | | (9.31e-06) | |
| Firm tenure ^2 | -4.79e-07*** | | -9.45e-07*** | |
| | (1.20e-08) | | (1.99e-08) | |
| 5th grade incomplete | -0.00775** | | 0.00754* | |
| | (0.00327) | | (0.00393) | |
| 5th grade complete | -0.00731** | | 0.0168*** | |
| | (0.00326) | | (0.00405) | |
| 9th grade incomplete | -0.0122*** | | 0.00656* | |
| | (0.00322) | | (0.00398) | |
| 9th grade complete | -0.0206*** | | 0.000680 | |
| | (0.00320) | | (0.00398) | |
| Secondary level incomplete | -0.0408*** | | -0.0227*** | |
| | (0.00323) | | (0.00404) | |
| Secondary level complete | -0.0168*** | | 0.000384 | |
| | (0.00321) | | (0.00400) | |
| Higher education incomplete | 0.0333*** | | 0.0457*** | |
| | (0.00333) | | (0.00431) | |
| Higher education complete | 0.168*** | | 0.147*** | |
| | (0.00333) | | (0.00427) | |
| Masters | 0.133*** | | 0.198*** | |
| | (0.00438) | | (0.00841) | |
| PhD | 0.159*** | | 0.133*** | |
| | (0.00520) | | (0.0126) | |
| Observations | 5,198,376 | 100 | 1,572,219 | 104 |
| R-squared | 0.904 | 0.137 | 0.944 | 0.128 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Industry F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Dynamic benefits of working in high-skilled sectors, avg. educ measured in 2003

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | log wages | 3 digit industry F.E (Services) | log wages | 3 digit industry F.E (Manufacturing) |
| Average years of education in the industry | | 0.0266*** | | 0.0272*** |
| | | (0.00947) | | (0.00910) |
| Experience top 1-10 most educated industries | 0.0149*** | | -0.00980*** | |
| | (0.000742) | | (0.00120) | |
| Experience top 1-10 most educated indus x experience | -6.37e-05*** | | 2.09e-05 | |
| | (1.03e-05) | | (1.40e-05) | |
| Experience in months | 0.00147*** | | 0.00200*** | |
| | (7.42e-06) | | (1.04e-05) | |
| Experience ^ 2 | -4.71e-06*** | | -6.53e-06*** | |
| | (3.09e-08) | | (4.03e-08) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00295*** | | 0.0223*** | |
| | (0.000767) | | (0.00125) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 1.14e-05 | | -0.000107*** | |
| | (1.04e-05) | | (1.42e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -1.52e-05** | | -8.99e-05*** | |
| | (5.93e-06) | | (8.62e-06) | |
| Firm tenure in months | 0.000659*** | | 0.000760*** | |
| | (5.14e-06) | | (9.30e-06) | |
| Firm tenure ^2 | -4.95e-07*** | | -8.12e-07*** | |
| | (1.18e-08) | | (1.97e-08) | |
| 5th grade incomplete | -0.00654** | | 0.00861** | |
| | (0.00328) | | (0.00394) | |
| 5th grade complete | -0.00243 | | 0.0199*** | |
| | (0.00326) | | (0.00406) | |
| 9th grade incomplete | -0.00111 | | 0.0155*** | |
| | (0.00321) | | (0.00398) | |
| 9th grade complete | -0.00445 | | 0.0154*** | |
| | (0.00319) | | (0.00397) | |
| Secondary level incomplete | -0.0197*** | | -0.00343 | |
| | (0.00322) | | (0.00403) | |
| Secondary level complete | 0.00934*** | | 0.0245*** | |
| | (0.00319) | | (0.00397) | |
| Higher education incomplete | 0.0658*** | | 0.0726*** | |
| | (0.00329) | | (0.00428) | |
| Higher education complete | 0.203*** | | 0.176*** | |
| | (0.00328) | | (0.00423) | |
| Masters | 0.171*** | | 0.231*** | |
| | (0.00434) | | (0.00840) | |
| PhD | 0.198*** | | 0.163*** | |
| | (0.00517) | | (0.0126) | |
| | | | | |
| Observations | 5,198,376 | 100 | 1,572,219 | 104 |
| R-squared | 0.904 | 0.174 | 0.944 | 0.177 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Industry F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Dynamic benefits of working in high-skilled sectors, now in sector
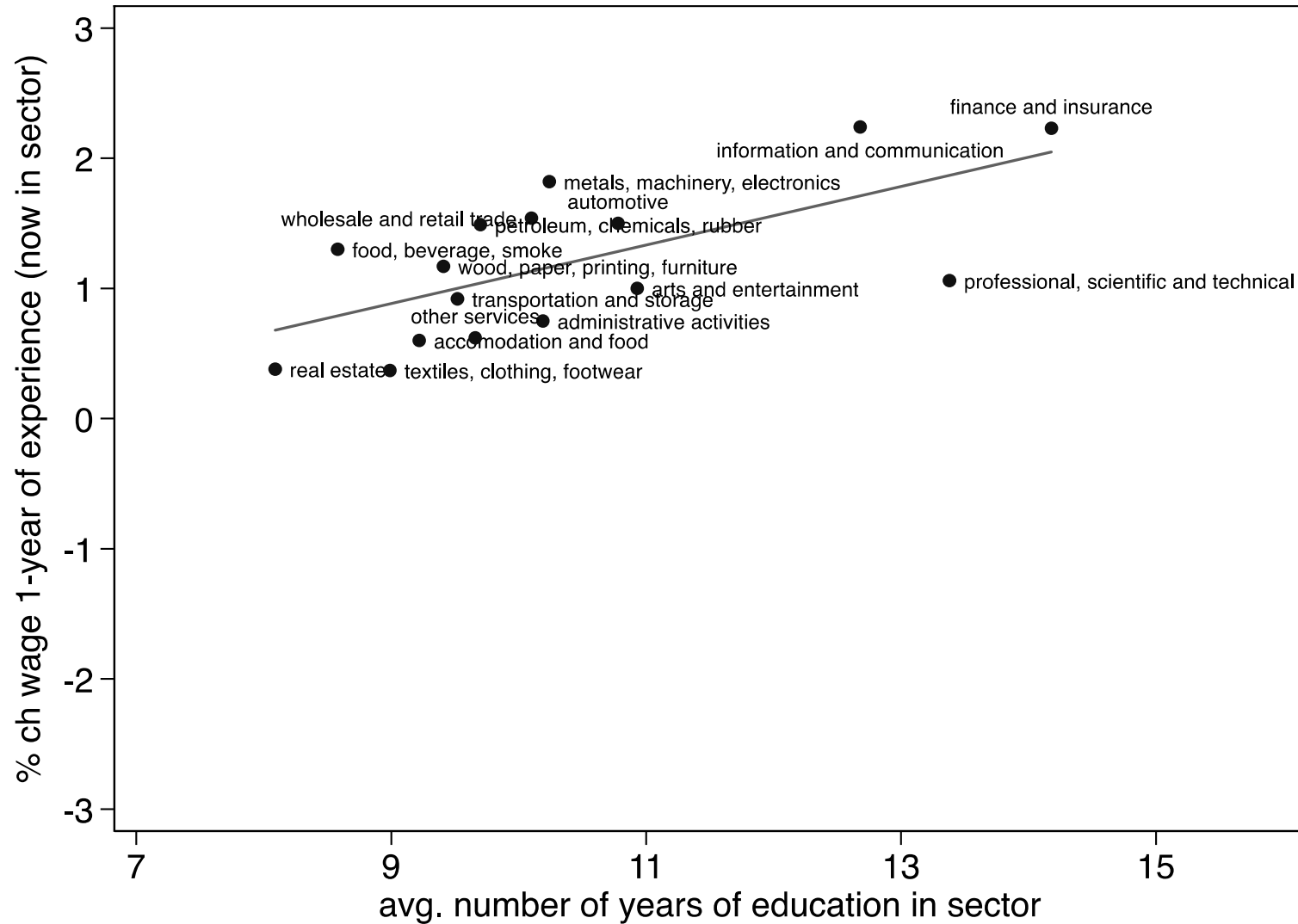
# Dynamic benefits of working in high-skilled sectors, now in other sector
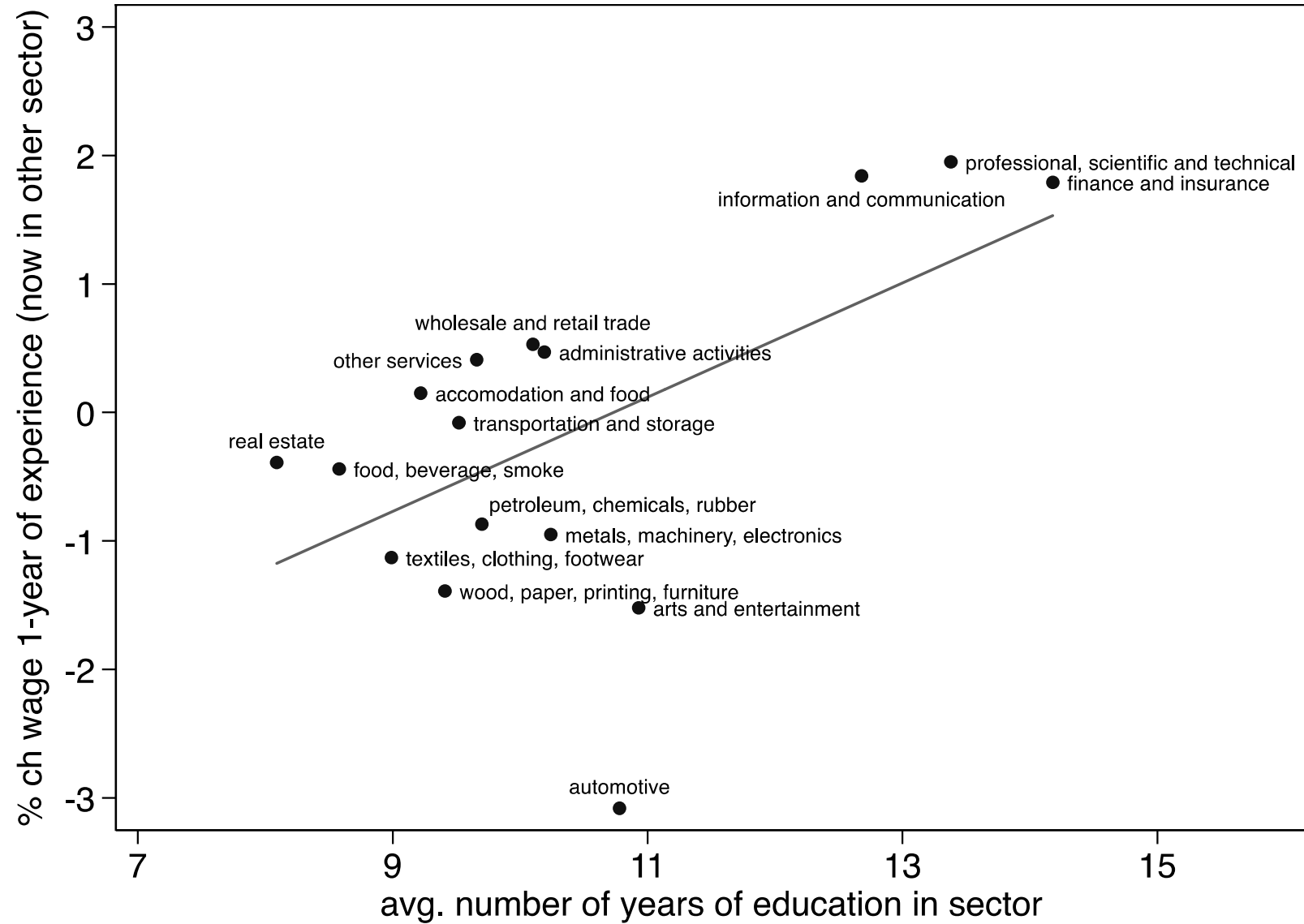
# Dynamic benefits of working in high-skilled sectors, high-skill workers

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | log wages | 3 digit industry F.E (Services) | log wages | 3 digit industry F.E (Manufacturing) |
| Average years of education in the industry | | 0.131*** | | 0.267*** |
| | | (0.0491) | | (0.0543) |
| Experience top 1-10 most educated industries | 0.00945*** | | -0.00595** | |
| | (0.00121) | | (0.00249) | |
| Experience top 1-10 most educated indus x experience | -0.000169*** | | -0.000102*** | |
| | (1.52e-05) | | (3.37e-05) | |
| Experience in months | 0.00162*** | | 0.00170*** | |
| | (1.96e-05) | | (3.03e-05) | |
| Experience ^ 2 | -4.50e-06*** | | -5.66e-06*** | |
| | (7.04e-08) | | (1.03e-07) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.00546*** | | 0.00779*** | |
| | (0.00122) | | (0.00254) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | 9.69e-05*** | | 1.48e-05 | |
| | (1.52e-05) | | (3.38e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | -5.09e-05*** | | -8.66e-05*** | |
| | (9.42e-06) | | (1.73e-05) | |
| Firm tenure in months | 0.00114*** | | 0.00107*** | |
| | (1.69e-05) | | (3.74e-05) | |
| Firm tenure ^2 | -9.98e-07*** | | -1.26e-06*** | |
| | (3.40e-08) | | (7.43e-08) | |
| Higher education complete | -0.152*** | | -0.0941*** | |
| | (0.00530) | | (0.0144) | |
| Masters | 0.0104** | | 0.0129 | |
| | (0.00504) | | (0.0141) | |
| PhD | -0.0336*** | | 0.0439*** | |
| | (0.00547) | | (0.0151) | |
| Observations | 898,612 | 100 | 181,592 | 104 |
| R-squared | 0.913 | 0.144 | 0.955 | 0.239 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Industry F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Dynamic benefits of working in high-skilled sectors, low skill workers

| | (1)<br>log wages | (2)<br>3 digit industry F.E (Services) | (3)<br>log wages | (4)<br>3 digit industry F.E (Manufacturing) |
|---|---|---|---|---|
| Average years of education in the industry | | 0.0165 | | 0.0174* |
| | | (0.0121) | | (0.0102) |
| Experience top 1-10 most educated industries | -0.00884*** | | -0.0204*** | |
| | (0.00135) | | (0.00148) | |
| Experience top 1-10 most educated indus x experience | 0.000107*** | | 7.44e-05*** | |
| | (2.00e-05) | | (1.57e-05) | |
| Experience in months | 0.00137*** | | 0.00206*** | |
| | (7.78e-06) | | (1.10e-05) | |
| Experience ^ 2 | -4.92e-06*** | | -6.82e-06*** | |
| | (3.41e-08) | | (4.41e-08) | |
| Experience top 1-10 most educated indus x now in top 10 most educated indus | 0.0181*** | | 0.0348*** | |
| | (0.00143) | | (0.00154) | |
| Experience top 1-10 most educated indus x experience x now in top 10 most educat | -0.000112*** | | -0.000157*** | |
| | (2.01e-05) | | (1.59e-05) | |
| Experience outside top 10 x experience x now in top 10 mos educated indus | 2.03e-05** | | -9.64e-05*** | |
| | (9.31e-06) | | (1.03e-05) | |
| Firm tenure in months | 0.000618*** | | 0.000684*** | |
| | (5.34e-06) | | (9.54e-06) | |
| Firm tenure ^2 | -6.47e-07*** | | -6.93e-07*** | |
| | (1.29e-08) | | (2.04e-08) | |
| 5th grade incomplete | -0.00407 | | 0.00935** | |
| | (0.00293) | | (0.00378) | |
| 5th grade complete | -0.00136 | | 0.0194*** | |
| | (0.00292) | | (0.00389) | |
| 9th grade incomplete | 0.000151 | | 0.0167*** | |
| | (0.00288) | | (0.00381) | |
| 9th grade complete | -0.00421 | | 0.0177*** | |
| | (0.00286) | | (0.00381) | |
| Secondary level incomplete | -0.0166*** | | 0.00235 | |
| | (0.00288) | | (0.00387) | |
| Secondary level complete | 0.0135*** | | 0.0334*** | |
| | (0.00286) | | (0.00382) | |
| Observations | 4,238,040 | 99 | 1,380,390 | 104 |
| R-squared | 0.864 | 0.023 | 0.921 | 0.038 |
| Microregion F.E | Y | Y | Y | Y |
| Year F.E | Y | Y | Y | Y |
| Industry F.E | Y | Y | Y | Y |
| Worker F.E | Y | Y | Y | Y |

# Summary

➢ Is there learning by working in high-skilled services? How does it compare with learning by working in high-skilled manufacturing?

➢ We used detailed worker-firm panel data from Brazil to answer these questions

➢ Evidence of sizable static manufacturing wage premium, even when accounting for observable worker-firm attributes and worker fixed-effects

➢ But this wage premium varies widely across sub-sectors within manufacturing and services

➢ Wage premium is higher in high-skilled sectors, both in manufacturing and services

# Summary

➢ Evidence of dynamic benefits of working in high skilled sectors

➢ In services, these dynamic benefits of learning accrue to the worker even if she is not currently employed in the most skilled sectors (transferable learning)

➢ In manufacturing, these dynamic benefits accrue only if the worker is currently employed in the most skilled sectors (non-transferable learning)