wiiw

Wiener Institut für Internationale Wirtschaftsvergleiche

The Vienna Institute for International Economic Studies

www.wiiw.ac.at

Robotisation, Employment and Industrial Growth Intertwined across Global Value Chains

Informal Workshop on Digital Technologies: Limits and Opportunities for Economic Development

International Economic Association

12 October 2021

Mahdi Ghodsi
with Oliver Reiter, Robert Stehrer, and Roman Stöllinger

This is a background paper for the UNIDO Industrial Development Report 2020: 'The Future of Industrialization'

Introduction

- Following the recent empirical pioneers in the field (Graetz and Michaels, 2018; Abeliansky and Prettner, 2017; and Acemoglu and Restrepo, 2018) and extending the long-run distributed lag framework developed by Autor and Salomons (AS, 2018), this paper provides a comprehensive analysis of the **direct** and **indirect effects** of **industrial robots** on **employment** and **real value-added growth**.

  - The indirect effects capture both **domestic** and **international linkages** along the global value chains (GVCs) which were obtained from inter-country input-output tables.

  - The **expansion of value added of** a given sector could indirectly influence the employment in another sector through **backward** or **forward** linkages.

  - Example: **productivity gains in manufacturing** sectors (higher quality and less expensive products) **transmit to non-robotized services**

© wiiw

Data

- The econometric model draws on few major data sources:
  1. World Input-Output Database (**WIOD**) (Timmer et al., 2015) including data from accompanying Socio-Economic Accounts (SEA)
     - 44 economies (with the resto of the world), 56 industries over the period 2000-2014.
  2. Stocks of industrial multipurpose robots database collected from the International Federation of Robotics (**IFR**, 2018)
     - Industrial multipurpose robots are defined as: "automatically controlled, reprogrammable multipurpose manipulator programmable in three or more axes"
  3. World Development Indicator (**WDI**) of the World Bank augmented by the Penn World Table (Feenstra et al., 2015)

© wiiw

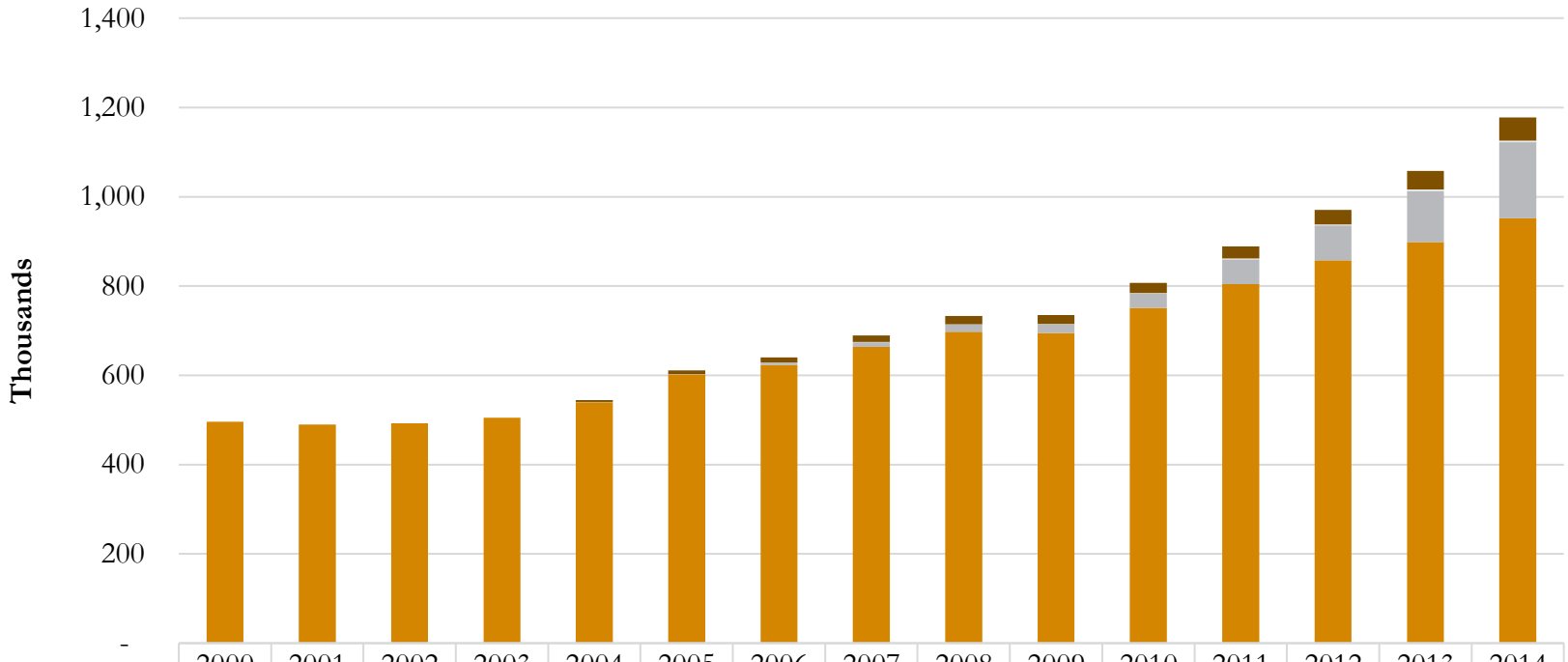
Countries included in the analysis

No.	Country	Group	No.	Country	Group
1	Australia	Advanced	22	Brazil	Emerging
2	Austria	Advanced	23	China	Emerging
3	Belgium	Advanced	24	Indonesia	Emerging
4	Canada	Advanced	25	India	Emerging
5	Denmark	Advanced	26	Mexico	Emerging
6	Finland	Advanced	27	Turkey	Emerging
7	France	Advanced	28	Bulgaria	Transition
8	Germany	Advanced	29	Romania	Transition
9	Greece	Advanced	30	Russian Federation	Transition
10	Ireland	Advanced	31	Croatia	Rest
11	Italy	Advanced	32	Cyprus	Rest
12	Japan	Advanced	33	Czech Republic	Rest
13	Luxemburg	Advanced	34	Estonia	Rest
14	Netherlands	Advanced	35	Hungary	Rest
15	Norway	Advanced	36	Latvia	Rest
16	Portugal	Advanced	37	Lithuania	Rest
17	Rep. of Korea	Advanced	38	Malta	Rest
18	Spain	Advanced	39	Poland	Rest
19	Sweden	Advanced	40	Slovakia	Rest
20	United Kingdom	Advanced	41	Slovenia	Rest
21	United States	Advanced	42	Switzerland	Rest
			43	Taiwan	Rest

© wiiw

Data

- **Stocks of industrial robots by country groups in thousands – 2000-2014**



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Rest	-	-	-	-	5	8	12	15	18	20	23	28	32	42	52
Transition	-	-	-	-	0	0	0	0	1	1	1	2	2	3	4
Emerging	-	-	-	-	0	1	5	10	16	19	32	55	78	114	171
Advanced	496	490	492	505	540	602	623	664	698	695	751	805	858	899	952

Source: IFR (2018), authors‘ elaboration.

© wiiw

Data

- **Average annual growth of stocks of industrial robots, 2000-2014**

Industry Description	World	Advanced	Emerging	Transition	Other
Primary	7.6%	6.7%	61.9%	34.7%	42.1%
Manufacturing	6.2%	4.7%	67.3%	52.6%	24.6%
Robotized Services	2.6%	1.0%	68.5%	32.6%	10.0%
Total	6.2%	4.7%	67.3%	50.9%	24.3%

- Note: Primary includes agriculture, fishing, forestry, and mining. Robotized services include electricity and water supply (DtE), construction (F) and Scientific research and development; Other professional, scientific and technical activities; veterinary activities; Education (MtN&P).
- Source: IFR (2018), WIOD; own calculations.

© wiiw

Data

- **Average annual growth of employment in %, 2000-2014**

Industry Description	World	Advanced	Emerging	Transition	Other
Primary	-0.7%	-1.2%	-0.6%	-3.3%	-3.3%
Manufacturing	2.1%	-1.5%	3.3%	-1.7%	0.3%
Robotized Services	3.1%	0.5%	4.2%	0.5%	1.2%
Non-robotized Services	3.0%	0.9%	4.5%	1.8%	1.5%
Total	1.7%	0.4%	2.2%	-0.1%	0.7%

- Note: Primary includes agriculture, fishing, forestry, and mining. Robotized services include electricity and water supply (DtE), construction (F) and Scientific research and development; Other professional, scientific and technical activities; veterinary activities; Education (MtN&P).
- Source: WIOD; own calculations.

© wiiw

Data

- **Average annual growth of real value added in %, 2000-2014**

Industry Description	World	Advanced	Emerging	Transition	Other
Primary	2.1%	1.3%	2.8%	1.9%	-0.2%
Manufacturing	3.1%	0.8%	9.3%	2.7%	4.3%
Robotized Services	1.4%	0.1%	6.0%	1.8%	1.1%
Non-robotized Services	2.3%	1.5%	6.1%	4.0%	2.4%
Total	2.3%	1.2%	6.2%	3.2%	2.5%

- Note: Primary includes agriculture, fishing, forestry, and mining. Robotized services include electricity and water supply (DtE), construction (F) and Scientific research and development; Other professional, scientific and technical activities; veterinary activities; Education (MtN&P).
- Source: WIOD; own calculations.

© wiiw

Methodology

- **Econometric model of TFP (AS, 2018):**

$$\Delta lnY_{cit} = \beta_0 + \sum_{k=0}^{5} \beta_6^k \Delta lnTFP^{*}_{ci,t-k} + \sum_{k=0}^{5} \beta_7^k \Delta lnTFP^{dom-BW}_{ci,t-k} + \sum_{k=0}^{5} \beta_8^k \Delta lnTFP^{dom-FW}_{ci,t-k} + \mu_{ct} + \mu_s + \varepsilon_{ict}$$

$$Y \in \{EMP, HEMP, LSH, VA^{real}, VA^{nominal}\}$$

- $\Delta lnTFP^{*}_{ci,t-k}$ is the own-industry other-countries' average TFP growth
- $\Delta lnTFP^{dom-BW}_{ci,t-k}$ is the TFP growth of domestic suppliers to industry i through domestic backward linkages
- $\Delta lnTFP^{dom-FW}_{ci,t-k}$ is the TFP growth of domestic buyers to industry i through domestic forward linkages

© wiiw

Methodology

- **TFP growth and direct own-industry TFP growth:**

$$\Delta lnTFP_{cit} = \Delta\, ln\, VA_{cit}^{real} - \left(\frac{W_{cit}}{VA_{cit}^{nominal}} * \Delta lnEMP_{cit}\right) - \left(\left(1 - \frac{W_{cit}}{VA_{cit}^{nominal}}\right) * \Delta lnK_{cit}^{real}\right)$$

$$\Delta lnTFP_{cit}^{*} = \frac{\sum_{f \neq c}^{F^X - 1} \Delta lnTFP_{fit}}{F^X - 1}, \qquad f \in \Phi^X \ \wedge\ X \in \{A\,, A'\}$$

© wiiw

Methodology

- **Extending the AS specification:**

1. Adding other **WIOD countries** to ensure a cross-country variation that can be econometrically generalised to the world economy.
2. Adding the change in the stock of **industrial multipurpose robots (R)** at the country-industry level as another proxy for technological change in addition to TFP growth.
3. Allowing for an **open-economy** setting in the sense that the indirect effects of industrial robots on labour market outcomes and value added also include linkages to industries of foreign countries along the GVC.
4. Due to the **time dimension** of the WIOD data, the lags are limited to three periods.
5. **Industry fixed effects** instead of aggregate sector fixed effects are used to control technological change at the global industry level.
6. Country-time fixed effects are used to control for **business cycles**.

© wiiw

Methodology

- **Benchmark econometric model of robots:**

$$\Delta lnY_{cit} = \beta_0 + \sum_{k=0}^{3} \beta_1^k \Delta lnR_{ci,t-k} + \sum_{k=0}^{3} \beta_2^k \Delta lnR_{ci,t-k}^{dom-BW} + \sum_{k=0}^{3} \beta_3^k \Delta lnR_{ci,t-k}^{dom-FW}$$

$$+ \sum_{k=0}^{3} \beta_4^k \Delta lnR_{ci,t-k}^{int-BW} + \sum_{k=0}^{3} \beta_5^k \Delta lnR_{ci,t-k}^{int-FW}$$

$$+ \sum_{k=0}^{3} \beta_6^k \Delta lnTFP_{ci,t-k}^{*} + \sum_{k=0}^{3} \beta_7^k \Delta lnTFP_{ci,t-k}^{dom-BW} + \sum_{k=0}^{3} \beta_8^k \Delta lnTFP_{ci,t-k}^{dom-FW}$$

$$+ \sum_{k=0}^{3} \beta_9^k \Delta lnTFP_{ci,t-k}^{int-BW} + \sum_{k=0}^{3} \beta_{10}^k \Delta lnTFP_{ci,t-k}^{int-FW} + \mu_{ct} + \mu_i + \varepsilon_{ict}$$

$$Y \in \{EMP, HEMP, LSH, VA^{real}, VA^{nominal}\}$$

© wiiw

Results

- **Benchmark econometric model of robots and TFP – WIOD countries: p1**

Dependent variable:	(1) $\Delta \ln EMP_{cit}$	(2) $\Delta \ln HEMP_{cit}$	(3) $\Delta \ln LSH_{cit}$	(4) $\Delta \ln VA_{cit}^{real}$	(5) $\Delta \ln VA_{cit}^{nominal}$
$\sum_{k=0}^{3} \beta_1^k \Delta \ln R_{ci,t-k}$	.011***	.01***	-.001	.023***	.009**
F-Test of joint significance	(.001)	(.003)	(.67)	(0)	(.031)
$\sum_{k=0}^{3} \beta_2^k \Delta \ln R_{ci,t-k}^{dom-BW}$	.024	.053*	.021	.007	.017
F-Test of joint significance	(.239)	(.051)	(.237)	(.801)	(.456)
$\sum_{k=0}^{3} \beta_3^k \Delta \ln R_{ci,t-k}^{int-BW}$	.055	.095**	-.064	.044	.19***
F-Test of joint significance	(.157)	(.022)	(.101)	(.478)	(0)
$\sum_{k=0}^{3} \beta_4^k \Delta \ln R_{ci,t-k}^{dom-FW}$	-.027*	-.037*	.016	-.039	-.054**
F-Test of joint significance	(.098)	(.079)	(.326)	(.173)	(.039)
$\sum_{k=0}^{3} \beta_5^k \Delta \ln R_{ci,t-k}^{int-FW}$	.037	.047	.083***	.1***	-.041
F-Test of joint significance	(.219)	(.122)	(.005)	(.006)	(.199)
R-sq.	.123	.139	.08	.187	.261
Obs	19500	19092	19500	19500	19500

Note: Sample includes countries as in AS (2018). P-values for the F-test that of joint significance ($\beta^0+ \beta^1+ \beta^2+ \beta^3=0$) in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. The size of the coefficients is obtained by summing up the estimated coefficients of the contemporaneous value and the five lagged values. All specifications include country-time fixed effects and *sector* fixed effects. Estimated with STATA using the *reghdfe* estimation command

© wiiw

Results

- **Benchmark econometric model of robots and TFP – WIOD countries: p2**

Dependent variable:	(1) $\Delta \ln EMP_{cit}$	(2) $\Delta \ln HEMP_{cit}$	(3) $\Delta \ln LSH_{cit}$	(4) $\Delta \ln VA_{cit}^{real}$	(5) $\Delta \ln VA_{cit}^{nominal}$
$\sum_{k=0}^{3} \beta_6^k \Delta lnTFP_{ci,t-k}^{*}$	.088	.072	-.087	.141**	.188***
F-Test of joint significance	(.19)	(.314)	(.178)	(.028)	(.002)
$\sum_{k=0}^{3} \beta_7^k \Delta lnTFP_{ci,t-k}^{dom-BW}$	.178	.334**	-.032	.47***	.374**
F-Test of joint significance	(.149)	(.016)	(.778)	(.001)	(.014)
$\sum_{k=0}^{3} \beta_9^k \Delta lnTFP_{ci,t-k}^{int-BW}$	.266	.353*	-.373*	.991***	.358
F-Test of joint significance	(.179)	(.086)	(.083)	(.001)	(.15)
$\sum_{k=0}^{3} \beta_8^k \Delta lnTFP_{ci,t-k}^{dom-FW}$	.061	.11	-.008	-.152	.036
F-Test of joint significance	(.405)	(.126)	(.927)	(.156)	-0.685
$\sum_{k=0}^{3} \beta_{10}^k \Delta lnTFP_{ci,t-k}^{int-FW}$	.252	.293*	-.4*	.605**	1.254***
F-Test of joint significance	(.123)	(.078)	(.082)	(.015)	(0)
R-sq.	.123	.139	.08	.187	.261
Obs	19500	19092	19500	19500	19500

Note: Sample includes countries as in AS (2018). P-values for the F-test that of joint significance ($\beta^0+ \beta^1+ \beta^2+ \beta^3=0$) in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. The size of the coefficients is obtained by summing up the estimated coefficients of the contemporaneous value and the five lagged values. All specifications include country-time fixed effects and *sector* fixed effects. Estimated with STATA using the *reghdfe* estimation command

© wiiw

Results

- **Potential explanations on positive direct impact of robots on employment growth:**

1. In the **Ricardo-Viner** model or the **Heckscher-Ohlin** framework (i.e. with capital mobile across industries) **an increase in capital would shift employment** to the capital-intensive industries.

2. **Old** vintages of **machineries** could also be **replaced** and upgraded by newer machineries (or **robots**) as a form of **process innovation**. Growth of capital and growth of stocks of robots are **not significantly correlated** with each other (including fixed FE).

3. Smart machines are replacing **unskilled labour**, while complementing skilled labour, which depends on all **substitution elasticities** across production factors.

© wiiw

Results

- **Potential explanations on negative impact of robots in domestic forward linkages on employment growth:**

1. One reason might be that the new machineries in the downstream industry require less demand for inputs from the upstream industries.

2. Another reason could be that digitalisation in a downstream industry allows industries to take over some tasks previously undertaken in the upstream industries.

© wiiw

Methodology

- **Quantitative implications based on model predictions – Destination perspective:**
- Estimation results are now used to retrieve the implied contribution of growth in robot stocks on changes of employment and real value-added

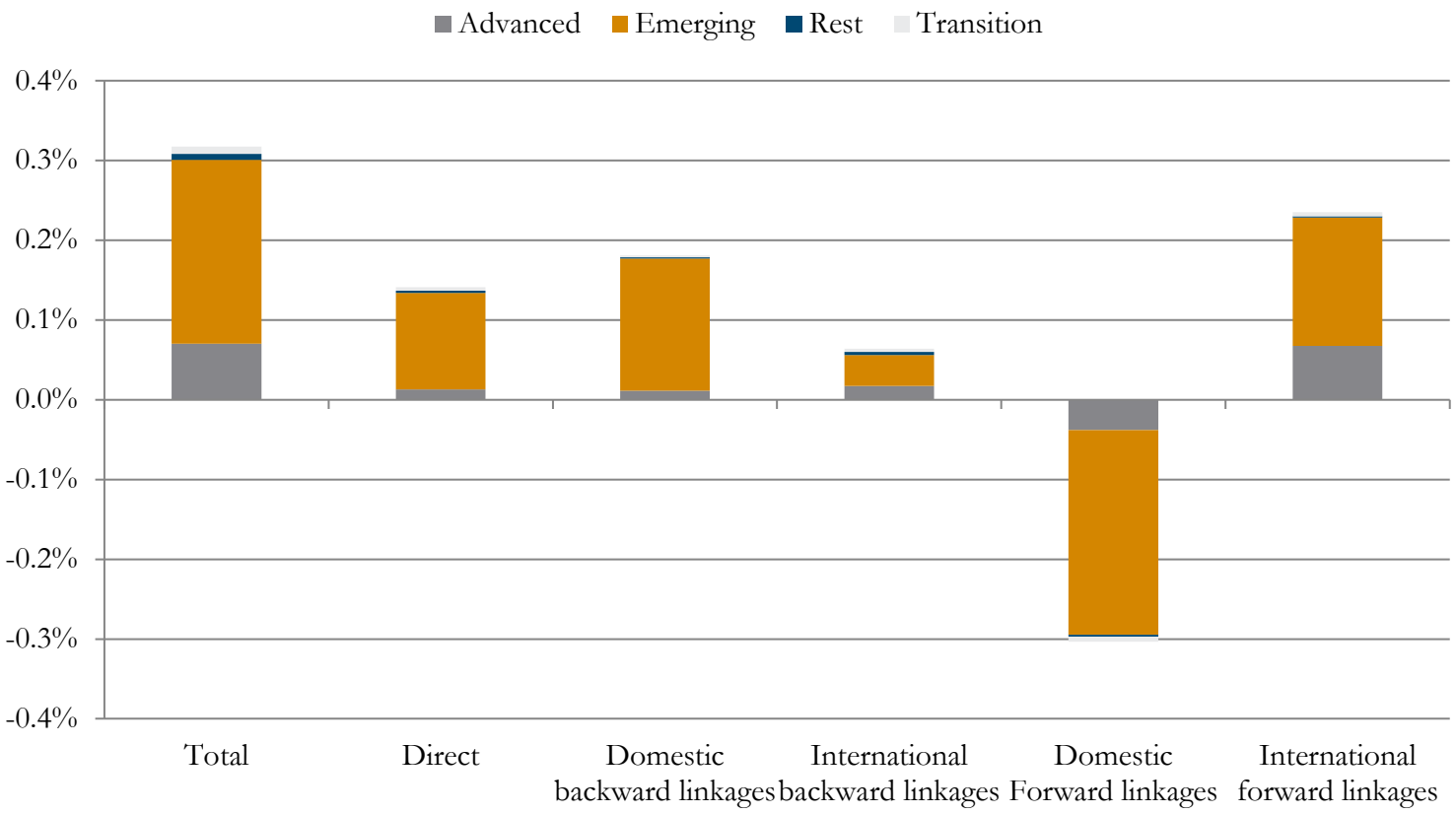
$$\widehat{\Delta lnY_t^{\mathrm{E}}} = \sum_{k=0}^{3} \hat{\beta}_1^{kY} \sum_{c}^{C} \sum_{i}^{I} \left[\left(\frac{1}{T} \cdot \sum_{t}^{T} \frac{Y_{cit}}{Y_t} \right) \Delta lnR_{cit}^{\mathrm{E}} \right]$$

$$Y \in \{\mathrm{EMP}, \mathrm{VA}^{\mathrm{real}}\}, \qquad \mathrm{E} \in \{\mathrm{Direct}, \mathrm{dom}-\mathrm{BW}, \mathrm{int}-\mathrm{BW}, \mathrm{dom}-\mathrm{FW}, \mathrm{int}-\mathrm{FW}\}$$

© wiiw

Results

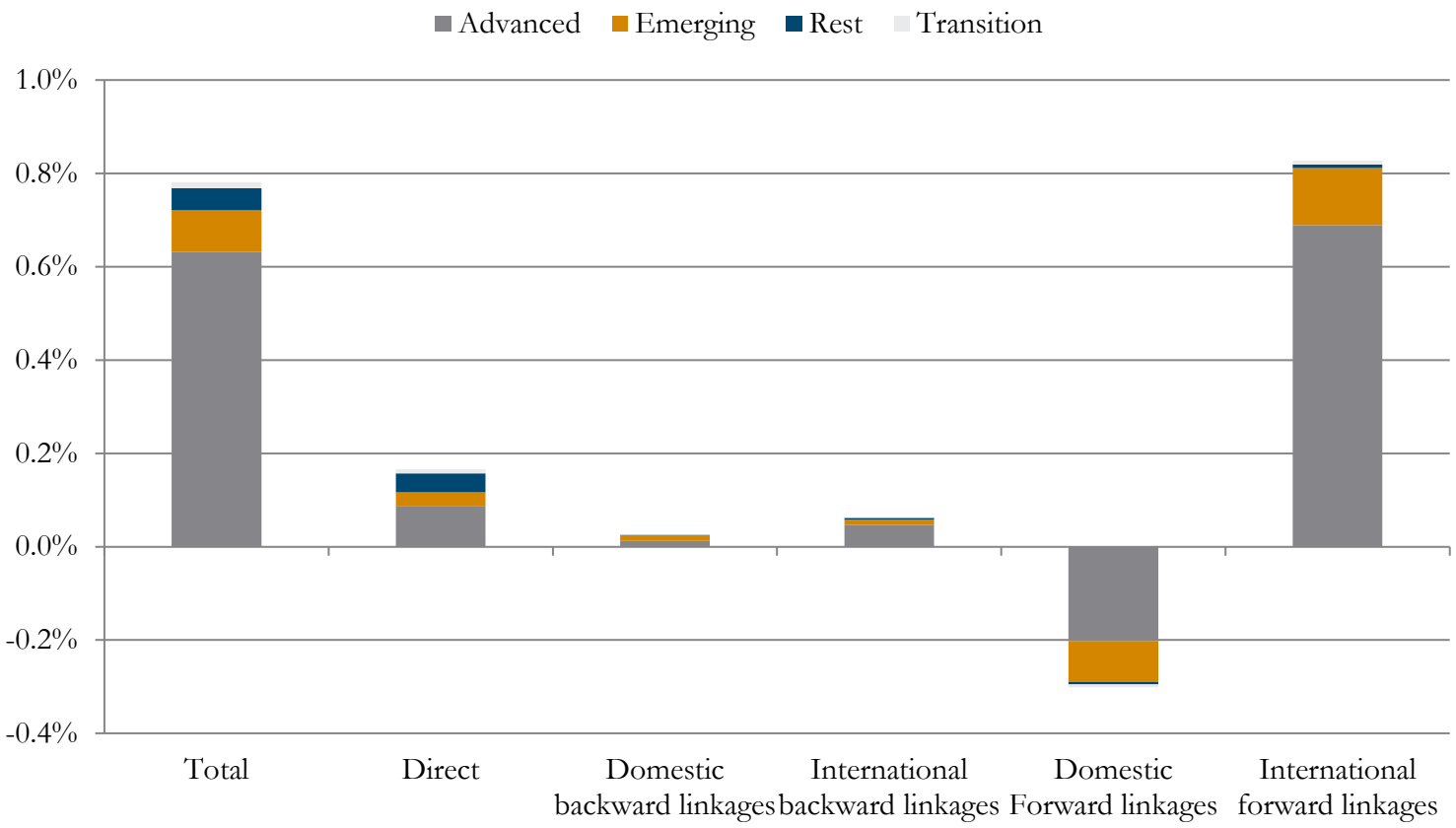
- **Predicted effects of the per annum growth of robots on economy-wide employment, Destination:**



© wiiw

Results

- **Predicted effects of the per annum growth of robots on economy-wide real value-added, Destination:**



© wiiw

Methodology

- **Quantitative implications based on model predictions – Origin perspective:**
- Which country or industry introduced new robots and is therefore originally responsible for the employment (or value added) that has been generated in the destination country or industry?

$$\Delta lnY_t^{\widehat{\mathrm{E_{dom}-origin}}} = \sum_{k=0}^{3} \hat{\beta}_1^{kY} \sum_{c}^{C} \sum_{j \neq i}^{J} \Delta lnR_{cjt} \left[\sum_{i}^{I} \left(\frac{1}{T} \cdot \sum_{t}^{T} \frac{Y_{cit}}{Y_t} \right) \Gamma_{cjt,cit} \right]$$

$$Y \in \{EMP, VA^{real}\}, \qquad \mathrm{E} \in \{dom - BW\ , dom - FW\}, \qquad \Gamma \in \{l, g\}$$

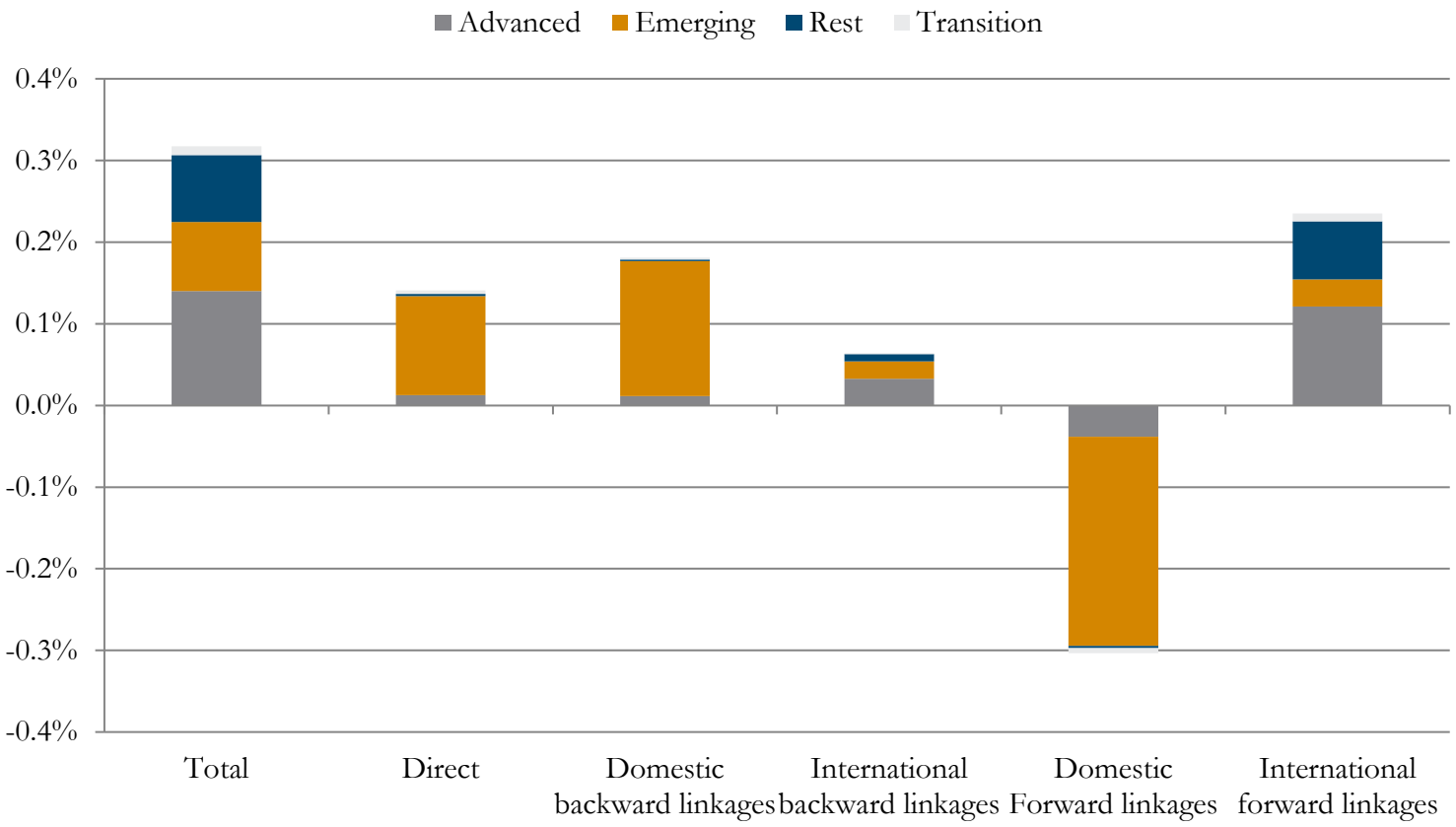
$$\Delta lnY_t^{\widehat{\mathrm{E_{int}-origin}}} = \sum_{k=0}^{3} \hat{\beta}_1^{kY} \sum_{c}^{C} \sum_{j \neq i}^{J} \Delta lnR_{cjt} \left[\sum_{i}^{I} \left(\frac{1}{T} \cdot \sum_{t}^{T} \frac{Y_{cit}}{Y_t} \right) \sum_{f \neq c}^{F} \Gamma_{fjt,cit} \right]$$

$$Y \in \{EMP, VA^{real}\}, \quad , \quad \mathrm{E} \in \{int - BW\ , int - FW\}, \qquad \Gamma \in \{l, g\}$$

© wiiw

Results

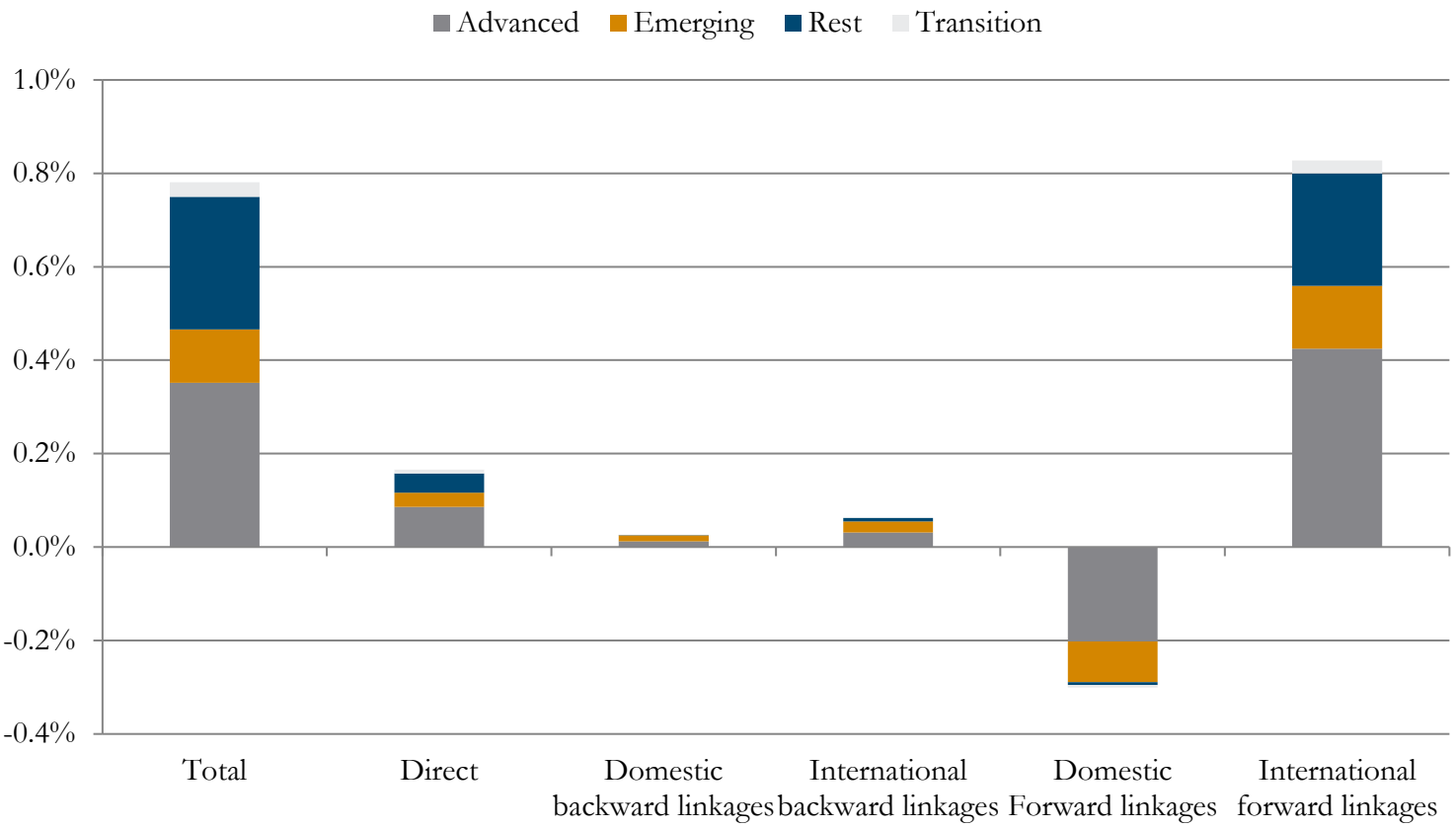
- **Predicted effects of the per annum growth of robots in the origin perspective, WIOD average**
- **Employment growth**



© wiiw

Results

- **Predicted effects of the per annum growth of robots in the origin perspective, WIOD average**
- **Real value-added growth**



© wiiw

Concluding Remarks

- This study analysed the **role of robotisation** in the **global economy** by taking the spillover effects of the impacts of TFP growth and robotisation on the **global value chains (GVCs)** into account.

- **Growth in stocks of industrial robots** in an industry **improves the employment growth** and **real value added growth** of the respective industry at a 1% level of significance.

- **Growth in the stocks of industrial robots in suppliers** of an industry that is accumulated along the **domestic supply chains** and the one that is accumulated along the **international backward linkages** improve **employment in hours**, while the **latter** improves also **real value added**.

- However, growth in the stocks of robots in **domestic forward linkages reduces employment and value added growth**. Moreover, growth in the stocks of **robots in international forward linkages reduces real value added growth**.

- Global robots adoption **contributed** mostly to the **real value added growth in advanced** economies, whereas it contributed mostly to the **employment growth of non-advanced** economies. However, the positive impact of robots adoption **originates mostly from advanced** economies.

© wiiw

Thank you for your attention

@MMGhodsi

Results

- **Econometric model of TFP (AS, 2018) – selected advanced countries**

Dependent variable:	(1) $\Delta \ln EMP_{cit}$	(2) $\Delta \ln HEMP_{cit}$	(3) $\Delta \ln LSH_{cit}$	(4) $\Delta \ln VA^{real}_{cit}$	(5) $\Delta \ln VA^{nominal}_{cit}$
$\sum_{k=0}^{5} \beta_6^k \Delta lnTFP^{*}_{ci,t-k}$	-.39***	-.34***	.092	.095	.022
F-Test of joint significance	(0)	(0)	(.767)	(.434)	(.831)
$\sum_{k=0}^{5} \beta_7^k \Delta lnTFP^{dom-BW}_{ci,t-k}$	.708***	.869**	.148	.467	.627*
F-Test of joint significance	(.008)	(.021)	(.65)	(.156)	(.085)
$\sum_{k=0}^{5} \beta_9^k \Delta lnTFP^{int-BW}_{ci,t-k}$	-.903**	-1.176***	-.126	.327	-1.529***
F-Test of joint significance	(.011)	(.003)	(.795)	(.673)	(.001)
$\sum_{k=0}^{5} \beta_8^k \Delta lnTFP^{dom-FW}_{ci,t-k}$	.03	.017	-.375*	-.103	.433*
F-Test of joint significance	(.742)	(.89)	(.068)	(.517)	(.097)
$\sum_{k=0}^{5} \beta_{10}^k \Delta lnTFP^{int-FW}_{ci,t-k}$	1.011***	1.093**	-.28	.615	2.251***
F-Test of joint significance	(.002)	(.017)	(.441)	(.207)	(0)
Weight	Employment	Hours worked	value added	value added	value added
R-sq.	.328	.35	.15	.242	.289
Obs	8036	8036	8036	8036	8036

Note: Sample includes countries as in AS (2018). P-values for the F-test that of joint significance ($\beta^0 + \beta^1 + \beta^2 + \beta^3 + \beta^4 + \beta^5 = 0$) in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. The size of the coefficients is obtained by summing up the estimated coefficients of the contemporaneous value and the five lagged values. All specifications include country-time fixed effects and *sector* fixed effects. Estimated with STATA using the *reghdfe* estimation command

© wiiw

Results

- **Extension to econometric model of TFP (AS, 2018) – WIOD countries:**

Dependent variable:	(1) $\Delta \ln EMP_{cit}$	(2) $\Delta \ln HEMP_{cit}$	(3) $\Delta \ln LSH_{cit}$	(4) $\Delta \ln VA_{cit}^{real}$	(5) $\Delta \ln VA_{cit}^{nominal}$
$\sum_{k=0}^{3} \beta_6^k \Delta lnTFP_{ci,t-k}^{*}$	.087	.076	-.066	.121*	.163***
F-Test of joint significance	(.167)	(.258)	(.284)	(.057)	(.008)
$\sum_{k=0}^{3} \beta_7^k \Delta lnTFP_{ci,t-k}^{dom-BW}$	.123	.235**	-.009	.238*	.209*
F-Test of joint significance	(.205)	(.037)	(.923)	(.05)	(.095)
$\sum_{k=0}^{3} \beta_9^k \Delta lnTFP_{ci,t-k}^{int-BW}$	.204	.293	-.475**	.909***	.37*
F-Test of joint significance	(.247)	(.114)	(.015)	(.001)	(.095)
$\sum_{k=0}^{3} \beta_8^k \Delta lnTFP_{ci,t-k}^{dom-FW}$	-.009	-.014	.004	-.152*	-.021
F-Test of joint significance	(.876)	(.817)	(.934)	(.072)	(.807)
$\sum_{k=0}^{3} \beta_{10}^k \Delta lnTFP_{ci,t-k}^{int-FW}$	.386***	.434***	-.375*	.647***	1.277***
F-Test of joint significance	(.005)	(.004)	(.069)	(.006)	(0)
R-sq.	0.118	0.135	0.079	0.174	0.246
Obs	20,609	20,191	20,609	20,609	20,609

Note: Sample includes countries as in AS (2018). P-values for the F-test that of joint significance ($\beta^0+ \beta^1+ \beta^2+ \beta^3=0$) in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. The size of the coefficients is obtained by summing up the estimated coefficients of the contemporaneous value and the five lagged values. All specifications include country-time fixed effects and *sector* fixed effects. Estimated with STATA using the *reghdfe* estimation command

© wiiw

Data

- **Effects by industry, employment per annum growth, origin perspective:**

Industry Description	Total	Direct	Domestic Supplier (BW)	International Supplier (BW)	Domestic Buyer (FW)	International Buyer (FW)
Primary	0.08%	0.06%	0.01%	0.01%	-0.02%	0.02%
Manufacturing	0.21%	0.05%	0.15%	0.05%	-0.26%	0.21%
Robotized Services	0.04%	0.03%	0.02%	0.00%	-0.03%	0.01%
Non-robotized Services						
Total	0.32%	0.14%	0.18%	0.06%	-0.30%	0.24%

© wiiw

Results

- **Effects by industry, employment per annum growth, destination perspective:**

Industry Description	Total	Direct	Domestic Supplier (BW)	International Supplier (BW)	Domestic Buyer (FW)	International Buyer (FW)
Primary	0.08%	0.06%	0.04%	0.01%	-0.08%	0.05%
Manufacturing	0.13%	0.05%	0.04%	0.02%	-0.05%	0.06%
Robotized Services	0.04%	0.03%	0.03%	0.01%	-0.11%	0.06%
Non-robotized Services	0.07%	0.00%	0.06%	0.02%	-0.07%	0.06%
Total	0.32%	0.14%	0.18%	0.06%	-0.30%	0.24%

© wiiw

Data

- **Effects by industry, real value-added per annum growth, origin perspective:**

Industry Description	Total	Direct	Domestic Supplier (BW)	International Supplier (BW)	Domestic Buyer (FW)	International Buyer (FW)
Primary	0.02%	0.01%	0.00%	0.00%	-0.02%	0.03%
Manufacturing	0.74%	0.14%	0.02%	0.06%	-0.25%	0.77%
Robotized Services	0.02%	0.02%	0.00%	0.00%	-0.03%	0.02%
Non-robotized Services						
Total	0.78%	0.17%	0.03%	0.06%	-0.30%	0.83%

© wiiw

Results

- **Effects by industry, real value added per annum growth, destination perspective:**

Industry Description	Total	Direct	Domestic Supplier (BW)	International Supplier (BW)	Domestic Buyer (FW)	International Buyer (FW)
Primary	0.02%	0.01%	0.00%	0.00%	-0.02%	0.02%
Manufacturing	0.36%	0.14%	0.01%	0.03%	-0.06%	0.25%
Robotized Services	0.12%	0.02%	0.00%	0.01%	-0.07%	0.16%
Non-robotized Services	0.28%	0.00%	0.01%	0.02%	-0.16%	0.40%
Total	0.78%	0.17%	0.03%	0.06%	-0.30%	0.83%

© wiiw