



# On GVC and Innovation: Evidence from Firm-Level Data

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# Outline

- Introduction
- Firm Data
- Empirical Strategy
- Empirical Results
- Conclusion

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# Motivation

- Most developing countries are lagging behind the technological frontier (UNCTAD 2021).
- Widening technological gap reduces labor-cost competitiveness in developing countries.
- Traditional development processes  moving to more productive economic activities are upended by frontier technologies.
- Upscaling of global value chains.
- The learning effect of international trade: Product cycle trade model Krugman (1979).
- Association between firms' *productivity* and **exporting** (De Loecker 2013), **importing** (Martínez-Zarzozo et. Al 2021) and **GVC** (Del Prete et al. 2017).

# Motivation ctd.

- **Outsourcing** activities transmit **foreign knowledge** and incentivize innovation: Grossman and Helpman (1991), Keller (2004), Aghion et al. (2021), Eissa and Zaki (2023) among others.
- **GVC learning effect** mirrored in **technological** and **auxiliary services** innovation.
- The learning effect varies in accordance with **firms' position** along the GVC.
- The heterogeneity of the GVC learning effect can be revealed from **sectoral** classifications.
- Sectors differ in terms of **factor**, **skill level**, and **technological** intensities.
- **Sectoral heterogeneity** learning effect unveils reasons behind the widening divergence paradox between advanced and developing countries in terms of technology production.

# What we *do*?

- ⇒ What is the effect of **GVC participation** on **firms' innovation performance**?
- ⇒ Does the learning effect differ in accordance with **sectoral heterogeneity**?
- Relying on the WBES recent dataset
  - We distinguish between **technological** and **auxiliary services** innovation.
  - We estimate the effect of GVC participation on each type.
  - We capture the heterogeneous learning effect at different factor, skill, and technology insensitive sectors.
- We control for GVC endogeneity using PSM and IV approaches.

# What we *find*?

**GVC learning effect** → firms located in developing countries.

- Positive effect of **GVC** on **technological innovation** strengthened by **capital-, skilled labor intensive** manufacturing, and **medium-high RD** intensive activities. .
- Positive effect of **GVC** and on **auxiliary services innovation**.

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# Definitions

## Overall Innovation

- Licensed foreign technology
- Newly introduced product / service
- Also new to firm's market
- Newly introduced process
- Having a website
- Communicates by email
- R&D spending

## Technological

- Licensed foreign technology
- Newly introduced product / service
- Also new to firm's market
- Newly introduced process
- R&D spending

## Auxiliary services

- Having a website
- Communicating by email

# Innovation

- Relying on the recent WBES comprehensive dataset and based on the OSLO manual definitions of innovation:

$$Technological_i = \begin{cases} 1, & \text{if tech, product, market, process, RD} = 1 \\ 0, & \text{otherwise} \end{cases}$$

$$Auxiliary\ services_i = \begin{cases} 1, & \text{if email, website} = 1 \\ 0, & \text{otherwise} \end{cases}$$

# Definitions ctd.

GVC 1  
=  
Importing  
+  
Exporting

GVC 4  
=  
Importing  
+  
Exporting  
+  
Foreign shares  
+  
Quality certification

# GVC

- Relying on the recent WBES comprehensive dataset we measure the least and most strict definitions of GVC participation (Dovis and Zaki 2020):

$$GVC_{1i} = \begin{cases} 1, & \text{if } X_i \text{ and } M_i > 0 \\ 0, & \text{otherwise} \end{cases}$$

$$GVC_{4i} = \begin{cases} 1, & \text{if } X_i, M_i, C_i, \text{ and } FS_i > 0 \\ 0, & \text{otherwise} \end{cases}$$

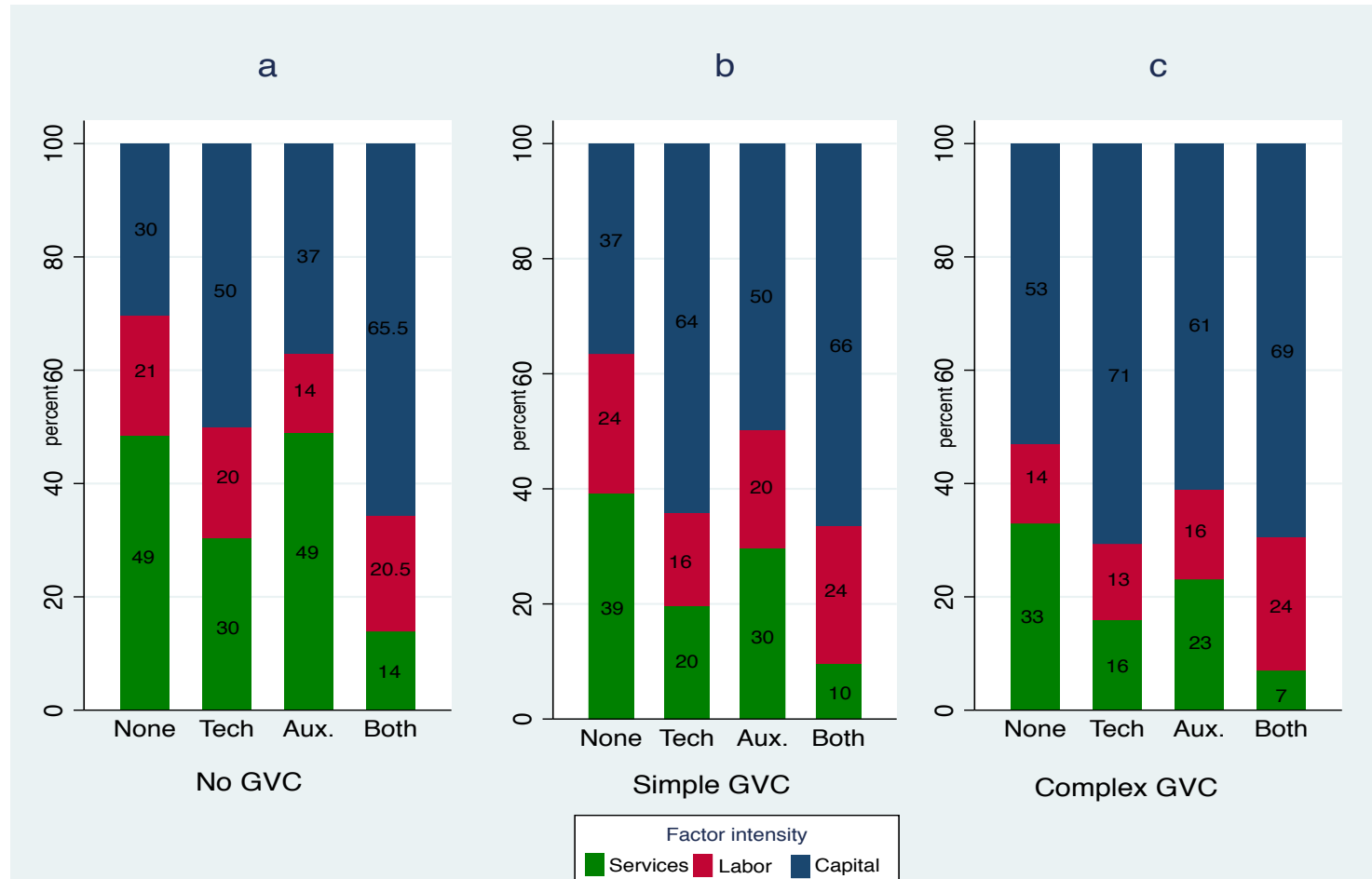
Where:  $X_i$  is the share of direct or indirect exports in total sales in firm  $i$

$M_i$  is the share of foreign inputs / supplies of foreign origin in total inputs in firm  $i$ .  $C_i$  is international quality certification provision in firm  $i$ .  $FS_i$  is foreign owned shares provision in firm  $i$ .

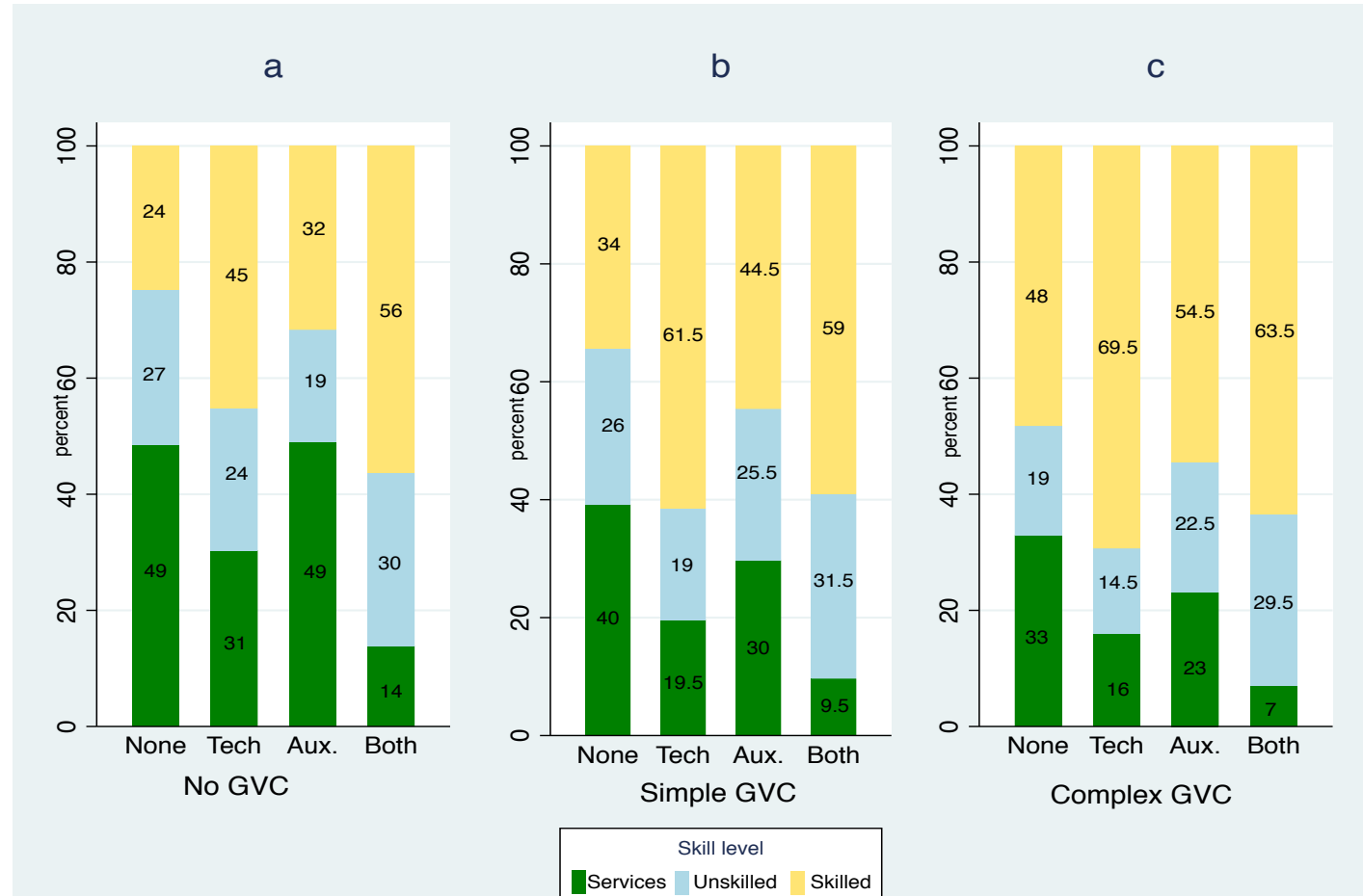
# Firms' GVC participation by region 2006-2021

<b>Region</b>	<b>No GVC</b>	<b>GVC 1</b>	<b>GVC 4</b>
Africa	87 %	11 %	2 %
EAP	85 %	12 %	3 %
ECA	73 %	23 %	4 %
LAC	77 %	20 %	3 %
MENA	80 %	18 %	2 %
South Asia	86 %	13 %	1 %

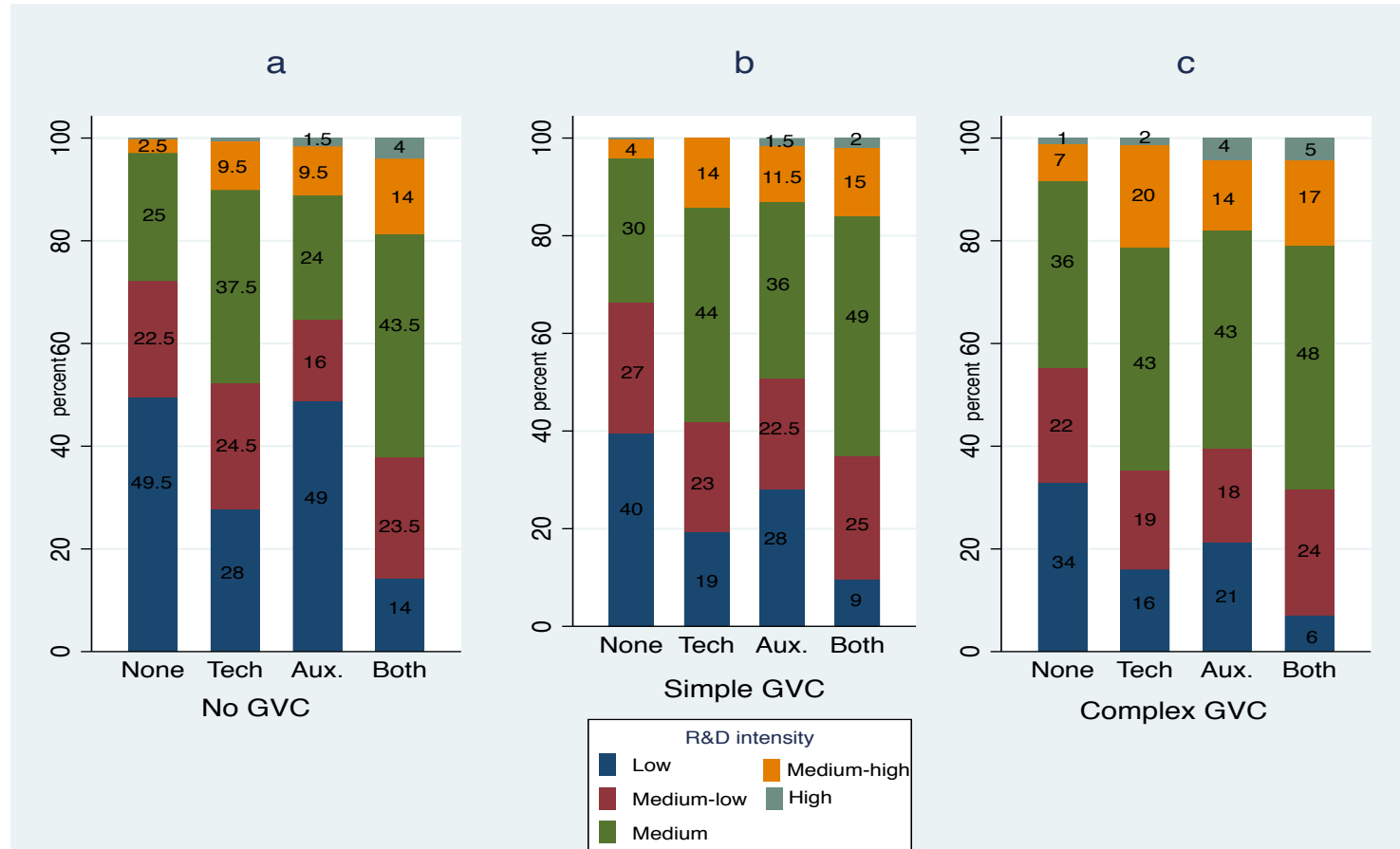
# Factor intensity within and across GVC



# Skill level vs innovation within and across GVC



# Technology within and across GVC





# Labor Market Characteristics

<b>Skill / technology</b>	<b>Jordan</b>	<b>Tunisia</b>	<b>Egypt</b>
No skill required	72 %	74 %	57 %
Skill required	28 %	26 %	43 %
Total	100	100	100
Low technology	90 %	93 %	90 %
Medium technology	10 %	7 %	10 %
Total	100	100	100

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# Econometric specification

$$Y_{ijst} = \alpha_0 + \alpha_1 GVC_{ijst} + \alpha_2 Z_{ijst} + \delta_j + \delta_s + \delta_t + \varepsilon_{ijst}$$

- $Y_{ijst}$  is the innovation type in firm  $i$  country  $j$  sector  $s$  at time  $t$ .
- $GVC_{ijst}$  is the likelihood of GVC participation.
- $Z_{ijst}$  is a vector of control variables including the firm size and fixed assets purchase to control for firm absorptive capacity.
- $\delta_j$ ,  $\delta_s$  and  $\delta_t$  are country, sector, and year fixed effects controlling for unobserved heterogeneity.
- $\varepsilon_{ijst}$  is a residual error term.

# Econometric specification

- To unveil the **sectoral heterogeneity** effect, each GVC definition is interacted with the three sectoral categorical variables separately.
- GVC endogeneity:
  - We employ **propensity score matching (PSM)** using the common support method. Common support covariates are firm size, buying physical capital, firm age, and government ownership.
  - We employ an **instrumental variables two stage least squares** methodology in which GVC measures are instrumented by firms' customs and trade obstacles.

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# Empirical results

- GVC positive effect on **technological** and **auxiliary services** innovation.
- GVC driven technological progress is strengthened with
  - **Capital intensive** manufacturing.
  - **Skilled labor-intensive** manufacturing.
  - **Medium/Medium-high RD** intensive activities.
- GVC 4 has a higher direct effect than GVC 1.
- Robust results using **PSM** and **IV** approaches.

# Empirical results

	Technological		Auxiliary services	
	GVC 1	GVC 4	GVC 1	GVC 4
GVC	.019*** (.001)	.057*** (.005)	.153*** (.003)	.152*** (.007)
Medium firms	.005*** (.001)	.006*** (.001)	.164*** (.003)	.173*** (.003)
Large firms	.022*** (.001)	.023*** (.001)	.341*** (.003)	.373*** (.003)
Physical capital	.01*** (.001)	.011*** (.001)	.072*** (.002)	.076*** (.002)
Contstant	-.021*** (.004)	-.021*** (.004)	-.015 (.016)	-.013 (.017)
No. of obdervations	137,202	132,386	145,447	139,533
R <sup>2</sup>	.035	.037	.311	.303
Fixed Effects	$j, s, t$	$j, s, t$	$j, s, t$	$j, s, t$

*Robust standard errors are in parentheses, \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . Fixed effects are removed for brevity. Physical capital is buying fixed assets like machinery, equipment, land, or buildings. Number of employees in small firms < 20, 20 < medium firms < 99, large firms > 100.*

# Skill level intensity

- Following the resource intensity classification of the Empirical Trade Analysis Center, sectors are classified to **unskilled-, skilled- labor intensive manufacturing**, and **services**.
- With respect to services, both unskilled and **skilled labor** intensive manufacturing exert a direct positive effect on technological innovation.
- With respect to services, **skilled labor** intensive manufacturing strengthen the positive GVC effect on technological innovation.



# Technology level intensity

- With respect to low-technology intensive activities, **medium-high** and **high** technology intensity exert a direct positive effect on both innovation types.
- GVC effect on **technological** innovation is strengthened with **medium** and **medium-high** RD intensive sectors.
- No interaction of high technology with GVC  $\longrightarrow$  “inappropriate” (Acemoglu and Zilibotti, 2001).

# Robustness Check 1: PSM

- Firms with same **size, age, physical capital, and government ownership** have positive probability of becoming treated and untreated (Heckman et al., 1999).
- Firms treated with GVC1 have higher technological and higher auxiliary services innovation than untreated firms.
- Firms treated with GVC4 have higher technological and higher auxiliary services innovation than untreated firms.

# Robustness Check 1: PSM ctd.

	Technological		Auxiliary services	
	GVC 1	GVC 4	GVC 1	GVC 4
Difference	.032*** (.001)	.079*** (.002)	.313*** (.003)	.393*** (.009)
Controls	.008*** (.001)	.012*** (.001)	.345*** (.001)	.387*** (.001)
No. of Observations	137,658	132,827	145,906	139,977
R <sup>2</sup>	.012	.012	.059	.015

*Standard errors are in parentheses \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$  Firm size, physical capital, government ownership, and firm age are the covariates for common support. PSM test shows a less than 5% bias for each mean value of the common support covariates.*

# Robustness Check 2: IV 2SLS

	Technological		Auxiliary services	
	GVC 1	GVC 4	GVC 1	GVC 4
GVC	.096*** (.008)	.768*** (.087)	.678*** (.028)	.482*** (.336)
Medium firms	-.003** (.001)	-.004*** (.001)	.12*** (.004)	.121*** (.006)
Large firms	0 (.003)	-.038*** (.008)	.188*** (.009)	.024 (.027)
Physical capital	.006*** (.001)	.003* (.001)	.044*** (.003)	.03*** (.006)
Contstant	-.013*** (.004)	-.004 (.006)	.012 (.019)	.015 (.023)
No. of obdervations	125,040	120,640	131,950	126,642
Fixed Effects	$j, s, t$	$j, s, t$	$j, s, t$	$j, s, t$

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# Conclusion

- Firms in developing countries have a **GVC learning opportunity** in terms of technological and auxiliary services **innovation**.
- Enhancing GVC participation in developing countries paves to **SDG9** aiming at fostering innovation and infrastructure.
- **Capital intensive, skilled labor intensive manufacturing** reinforces the positive GVC effect on technological innovation.
- **Medium** and **medium-high** RD intensive activities reinforces the positive GVC effect on technological innovation.
- Skilled labor and technology intensive activities exert a direct positive effect on technological and auxiliary services innovation.
- Enhancing skill level and fostering technology intensive activities are paramount to catching up to the fast-shifting technological frontier.

# Policy Recommendations

- From a policy standpoint, our study offers three main recommendations aiming at realizing a GVC driven innovation progress in developing countries.
  - **Trade policy: Facilitating trade** by eliminating unnecessary trade costs is necessary to encouraging **GVC engagement** being the latter a chief innovation input.
  - **Fiscal policy: Facilitating finance access** to the end of Investing in **physical and human capital** is key to enhancing firms' absorptive capacities and stimulating innovation.
  - Engaging in **medium** and **medium-high technology** intensive activities strengthens the GVC effect on auxiliary services innovation.

# References

- Aghion, P., Bergeaus, A., Gigout, T., Lequien, M., & Melitz, M. (2021). Exporting ideas: knowledge flows from expanding trade in goods. NBER.
- De Loecker, J. (2013). Detecting learning by exporting. *American Economic Journal: Microeconomics*, 5(3), 1–21.
- Del Prete, D., Giovannetti, G., & Marvasi, E. (2017). Global value chains participation and productivity gains for North American firms. *Rev World Econ*, 153:675-701.
- Dosis, M. & Zaki, C. (2020). Global value chains and local business environments: Which factors really matter in developing countries? *Review of Industrial Organization*, 57:481-583
- Eissa, Y., Zaki, C. On GVC and innovation: the moderating role of policy. *J. Ind. Bus. Econ.* (2023). <https://doi.org/10.1007/s40812-022-00255-9>
- Grossman, G., and Helpman, E. (1991). *Innovation and growth in the global economy*. Cambridge, MA: MIT Press.
- Keller, W. (2004) International Technology Diffusion. *Journal of Economic Literature*, 92, 752-782.



# References ctd.

- Krugman, P. (1979). A model of innovation, technology transfer and the world distribution of income. *Journal of Political Economy*, 87, 253–6.
- Martínéz-Zarzoso, I., Said, M., & Zaki, C. (2021). Trade policy and input liberalization: The effect on Egyptian firms' productivity. *Rev Dev Economics*, 00, 1-21 DOI: 10.1111/rode.12787.
- UNCTAD (2021), Technology and innovation report: catching technological waves innovation with equity. United Nations ISBN: 978-92-1-113012-6

Thank you for your attention