Drivers of medium-and-high-technology manufacturing in African countries

Rex Asiama (PhD) & Elvis K. Avenyo (PhD)

SARCHI Industrial Development - University of Johannesburg

August 2, 2023

IN ASSOCIATION WITH

TIPS FORUM 2023

IP IN AN ERA OF GLOBAL STRUCTURAL CHANGE – IMPLICATIONS FOR SOUTHERN AFRICA

Outline

Introduction

Why the focus on Technology-based Industrialization?

- Despite the fact that emerging nations must pursue an industrialised path, current studies indicate that these nations should concentrate on catching up in an innovative, sustainable, and environmentally friendly way.
- Previous research on the engine of growth hypothesis argues that the manufacturing sector is at the heart of industrialization (Szirmai, 2012; Szirmai and Verspagen, 2015; Su and Yao, 2017).
- Next, studies arguing that export composition, specifically, manufacturing exports are key to industrial development (Fosu, 1990a,b, 1996; Xu, 2000).
- Additionally, academics contend that exports of technologically advanced goods are more important for industrial development and are essential for structural change (Hausmann et al., 2007; Szirmai and Verspagen, 2015; Cantore et al., 2017).

Technology-based Industrialization

- Recent studies have argued in favour of technology-intensive manufacturing as a pathway to industrial development.
- This is because technology-intensive manufacturing improves factor productivity and enhances competitiveness, especially in developing countries (Chen and Lee, 2020; Hu et al., 2020; Rijesh, 2020).
- Existing studies examine determinants of industrialization broadly (Haraguchi et al., 2019a,b). However, to the best of our knowledge, not many studies examine determinants of technology-intensive manufacturing in developing economies, especially those in Africa.
- This knowledge gap is what our paper addresses.

Objectives

- The paper has two objectives.
- Determine countries in Africa that have a relative probability of success at medium-and-high-technology manufacturing. We extend the methodology of Haraguchi et al. (2019b) to analyse growth episodes of MHT manufacturing and determine the relative probability of success or otherwise.
- Identify the drivers (macroeconomic, social, political, institutional, etc.) of the relative probability of success of MHT manufacturing in African countries.

Data & Methodology

Data & Methodology

- Data for 33 African countries for the period 1990 - 2018 was analysed.
- The data was sourced from WDI, Competitive Industrial Performance (CIP) 2020 [UNIDO], Penn World Tables (PWT Version 9.1) and Chinn and Ito (2006).
- The choice of the sample period was motivated by data availability.

Data & Methodology

- Haraguchi et al. (2019b) uses a five-step-methodology which identifies growth episodes of manufacturing *MVAg* in developing countries.
- We extend the method to identify growth episodes of technology-intensive manufacturing and *MVAg* in African countries.
- We use the Medium-and-high-technology value added share of total manufacturing value added (*MHVAsh*) as a measure of technology-intensive manufacturing.
- The methodology finally groups countries into two main categories: those likely to succeed at industrialisation (1) or otherwise (0), based on the growth episodes of tech-intensive manufacturing.

Data & Methodology

- Furthermore, we adapt the model of Haraguchi et al. (2019a) to identify drivers of the relative probability of success of MHT manufacturing in African countries.
- We are guided by the following studies in selecting determinants: Hausmann et al. (2005); Haraguchi and Rezonja (2013); Mensah et al. (2016); Weiss and Clara (2016); Martorano et al. (2017); Rapetti et al. (2012); Sepehrdoust et al. (2019); Haraguchi et al. (2019a,b); Tregenna et al. (2021).
- The selected determinants include economic, social, institutional, resource and political factors.
- Specifically, economic determinants include GDP per capita, share of gross fixed capital in GDP, human capital, share of trade and FDI in GDP, capital account openness and inflation.

Data & Methodology

- Political and institutional factors include political stability (number of years under current regime), share of domestic credit given to the private sector, the real exchange rate.
- Resource factors include the share of mineral rents in GDP.
- We also include initial conditions - MVA share in GDP in each country relative to the U.S. in 1990.

Model specification

$$Pr(mvag > 0) = \beta \sum W_{it} + \gamma_t + \delta_{it} \quad (1)$$

- $Pr(mvag > 0)$ is a dummy variable that groups countries in the sample into successful and unsuccessful industrializers.
- $Pr(mvag > 0)$ is first estimated using MVAg and later using the medium-and-high tech variables.
- W_{it} captures the control variables selected following the literature.
- γ_t captures time fixed effects.
- δ_{it} represents stochastic error term.
- Following Haraguchi et al. (2019a), we use standard probit estimation technique to estimate Equation (1).

Summary of Key Findings

Key Findings

- Our results show the following countries with a relative probability of success in industrialization, where industrialization is measured using *MVAg*.
- Cameroon, Ivory Coast, Egypt, Eswatini, Ethiopia, Gabon Senegal, Tunisia, Uganda.
- However, we find very few countries with a relatively probability of successful MHT industrialization (*MHVAsh*).
- Ethiopia, Morocco, Senegal, Tunisia, Zambia.

Key Findings - Using *MHVAsh*

- Economic factors like GDP per capita (+/-), share of FDI and trade in GDP (+), share of fixed capital investment in GDP (+), and human capital (-/+) show significant influence of the relative probability of success of MHT manufacturing in African countries. We do not find any influence from inflation.
- The dual signs on factors like GDP per capita indicate non-linearities. This confirms evidence of convergence in manufacturing, meaning that low-income countries have to grow faster in order to catch up (see Rodrik (2013)).
- Similarly, dual signs on human capital suggest non-linearities. The results suggest that more education and skills training eventually improve relative probability of success of MHT manufacturing.
- MHT manufacturing is capital intensive and is expected to be associated with more capital investments, trade and FDI.

Key Findings - Using *MHVAsh*

- Political and institutional factors like political stability (+), domestic credit given to private sector (+), the real exchange rate (-) significantly influence relative success of medium-and-high tech manufacturing in African countries.
- Resource factors like share of mineral rents in GDP (+) significantly influence relative success of medium-and-high tech manufacturing in African countries, as well as initial manufacturing conditions.
- These results are similar to Haraguchi et al. (2019a,b); Sepehrdoust et al. (2019); Tregenna et al. (2021); Magud and Sosa (2013); Rajan and Subramanian (2011); Rodrik (2013).

Concluding Remarks

Concluding Remarks

- Technological progress is fundamental to industrial development.
- However, we do not find many Southern African countries with a relative probability of success in MHT industrialization. South Africa, which has been struggling with power crisis for some time, is also missing.
- The African Industrialisation Index (AII) 2022 shows similar results suggesting that progress on industrialisation in Southern Africa has slowed down, especially for South Africa, which appears to be the most industrialized country in this region.
- Nevertheless, policymakers in Southern African countries may adapt some of the determinants, as part of their active industrial policies, to accelerate progress in technology-intensive manufacturing.

Thank You!!

the dtic
Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA

References I

Cantore, N., Clara, M., Lavopa, A., and Soare, C. (2017). Manufacturing as an engine of growth: Which is the best fuel? *Structural Change and Economic Dynamics*, 42:56–66.

Chen, Y. and Lee, C.-C. (2020). Does technological innovation reduce CO2 emissions? Cross-country evidence. *Journal of Cleaner Production*, 263:121550.

Chinn, M. D. and Ito, H. (2006). What Matters for Financial Development? Capital Controls, Institutions, and Interactions. *Journal of Development Economics*, 81(1):163–192.

Cuaresma, J. C. and Wörz, J. (2005). On Export Composition and Growth. *Review of World Economics*, 141(1):33–49.

Fosu, A. K. (1990a). Export Composition and the Impact of Exports on Economic Growth of Developing Economies. *Economics Letters*, 34(1):67–71.

Fosu, A. K. (1990b). Exports and Economic Growth: the African case. *World Development*, 18(6):831–835.

Fosu, A. K. (1996). Primary Exports and Economic Growth in Developing Countries. *World Economy*, 19(4):465–475.

Gallagher, K. P., Ocampo, J. A., Zhang, M., and Yongding, Y. (2014). Capital account liberalization in China: A cautionary tale. *GEGI Exchange, Global Economic Governance Initiative Policy Brief*, 2(1):1–6.

Guzman, M., Ocampo, J. A., and Stiglitz, J. E. (2018). Real exchange rate policies for economic development. *World Development*, 110:51–62.

Haraguchi, N., Cheng, C. F. C., and Smeets, E. (2017). The importance of manufacturing in economic development: Has this changed? *World Development*, 93:293–315.

Haraguchi, N., Martorano, B., and Sanfilippo, M. (2019a). What factors drive successful industrialization? Evidence and implications for developing countries. *Structural Change and Economic Dynamics*, 49:266–276.

Haraguchi, N., Martorano, B., Sanfilippo, M., and Shingal, A. (2019b). Manufacturing growth accelerations in developing countries. *Review of Development Economics*, 23(4):1696–1724.

Haraguchi, N. and Rezonja, G. (2013). Emerging patterns of structural change in manufacturing.

Hausmann, R., Hwang, J., and Rodrik, D. (2007). What you export matters. *Journal of Economic Growth*, 12(1):1–25.

Hausmann, R., Pritchett, L., and Rodrik, D. (2005). Growth accelerations. *Journal of Economic Growth*, 10(4):303–329.

Hu, Y., Fisher-Vanden, K., and Su, B. (2020). Technological spillover through industrial and regional linkages: Firm-level evidence from China. *Economic Modelling*, 89:523–545.

Magud, N. and Sosa, S. (2013). When and why worry about real exchange rate appreciation? The missing link between Dutch disease and growth. *Journal of International Commerce, Economics and Policy*, 4(02):1350009.

Martorano, B., Park, D., and Sanfilippo, M. (2017). Catching-up, structural transformation, and inequality: industry-level evidence from Asia. *Industrial and Corporate Change*, 26(4):555–570.

McAuliffe, M. C., Saxena, M. S. C., and Yabara, M. M. (2012). *The East African Community: prospects for sustained growth*. International Monetary Fund.

References II

Mensah, J. T., Adu, G., Amoah, A., Abrokwa, K. K., and Adu, J. (2016). What drives structural transformation in sub-Saharan Africa? *African Development Review*, 28(2):157–169.

Rajan, R. G. and Subramanian, A. (2011). Aid, Dutch Disease, and Manufacturing Growth. *Journal of Development Economics*, 94(1):106–118.

Rapetti, M., Skott, P., and Razmi, A. (2012). The real exchange rate and economic growth: are developing countries different? *International Review of Applied Economics*, 26(6):735–753.

Rijesh, R. (2020). Trade liberalisation, technology import, and Indian manufacturing exports. *Global Economic Review*, 49(4):369–395.

Rodrik, D. (2013). Unconditional convergence in manufacturing. *The Quarterly Journal of Economics*, 128(1):165–204.

Sepehrdoust, H., Davarikish, R., and Setarehie, M. (2019). The knowledge-based products and economic complexity in developing countries. *Heliyon*, 5(12):e02979.

Su, D. and Yao, Y. (2017). Manufacturing as the key engine of economic growth for middle-income economies. *Journal of the Asia Pacific Economy*, 22(1):47–70.

Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 1950–2005. *Structural change and economic dynamics*, 23(4):406–420.

Szirmai, A. and Verspagen, B. (2015). Manufacturing and Economic Growth in developing countries, 1950–2005. *Structural Change and Economic Dynamics*, 34:46–59.

Tregenna, F., Nell, K., and Callaghan, C. (2021). Determinants of Industrial Development. In *New Perspectives on Structural Change: Causes and Consequences of Structural Change in the Global Economy*, pages 378–427. Oxford University Press.

Weiss, M. and Clara, M. (2016). Unlocking domestic investment for industrial development.

Xu, Z. (2000). Effects of Primary exports on Industrial Exports and GDP: Empirical evidence. *Review of Development Economics*, 4(3):307–325.

Table 7: List of sample countries using modal income category.

Income	Countries
Low Income	Burundi, Central African Republic, Cote d'Ivoire, Eritrea, Ethiopia, The Gambia, Ghana, Kenya, Madagascar, Malawi, Mozambique, Niger, Nigeria, Rwanda, Senegal, Tanzania, Uganda, Zambia, Zimbabwe.
Lower-Middle-Income	Algeria, Angola, Cape Verde, Cameroon, Congo Republic, Egypt (Arab Republic), Eswatini, Morocco, Namibia, Tunisia.
Upper-Middle-Income	Botswana, Gabon, Mauritius, South Africa.

Source: Authors' compilation

Table 8: List of countries identified as successful industrializers.

Relative Probability of success (*MVAg*)	Relative Probability of success (*MHTvash*)
Cameroon, Côte d'Ivoire, Egypt, Eswatini, Ethiopia, Gabon, Senegal, Tunisia, Uganda,	Ethiopia, Morocco, Senegal, Tunisia, Zambia.

Source: Authors' compilation

	(1)	(2)
Dependent Variable:	Relative success in MHT manuf. (MHTVAsh)	
$GDPpc_{it}$	1.211***	0.837***
	(0.245)	(0.238)
$GDPpc_{it}^2$	-0.0992***	-0.0726***
	(0.0174)	(0.017)
MIN_{it}	0.0511***	0.0487***
	(0.006)	(0.006)
PS_{it}	0.00154**	0.00178***
	(0.0006)	(0.0006)
FDI_{it}	-0.0142***	-0.0136***
	(0.004)	(0.004)
$TRADE_{it}$	0.00452***	0.00384***
	(0.0007)	(0.0006)
KAP_{it}	0.00528	0.0146
	(0.0103)	(0.0105)
$GFCF_{it}$	0.00457***	0.00562***
	(0.0018)	(0.0016)
DC_{it}	0.00768***	0.00663***
	(0.0008)	(0.0008)
RER_{it}	-0.400**	-0.309**
	(0.156)	(0.148)
HCI_{it}	-0.878***	-0.888***
	(0.309)	(0.300)
HCI_{it}^2	0.157*	0.171**
	(0.088)	(0.0865)
INF_{it}	-0.000711	-0.00004
	(0.0017)	(0.00155)
IC_{it}		0.121***
		(0.0167)
N	598	598
Year FE	Yes	Yes

Robust t statistics in parentheses; $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. All reported values are marginal effects.

Source: Authors' estimates