One step forward, two steps back: How poor infrastructure and weak human capital constrain industrial development in Africa

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## *L2C – Learning to Compete: Industrial Development and Policy in Africa*

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Purpose of the study

1. Review the experiences of Mauritius and Madagascar, over the last three decades .

   - Currently at significantly different levels of economic transformation (in spite of similar export promotion strategies, primarily by targeting manufacturing and focusing on EPZs)

2. Empirical analysis of factors affecting 6 indicators of industrial development
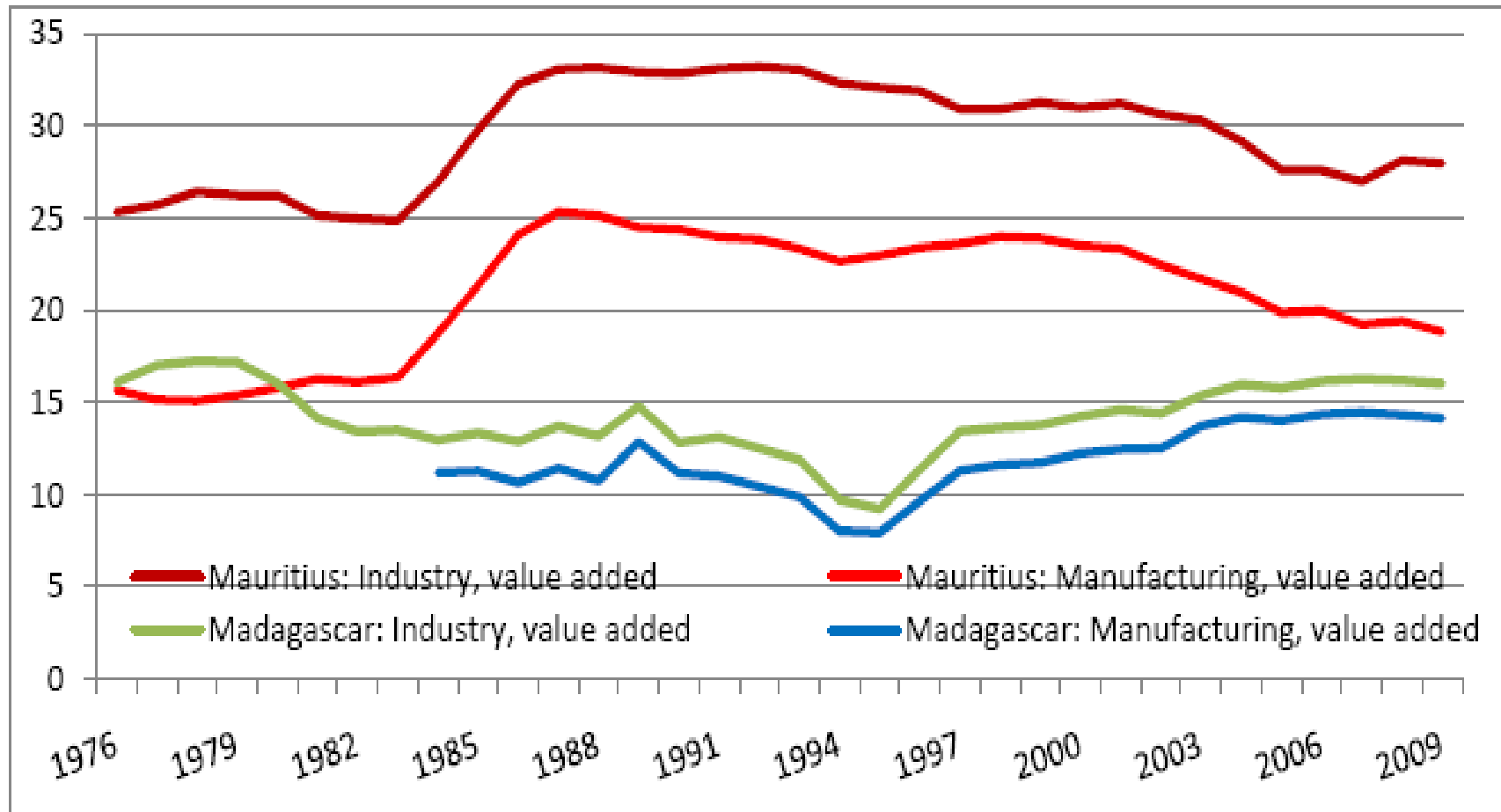
Export promotion: A tale of two islands

Figure 1

GDP per capita, PPP (constant 2005 international $) and growth (right axis, %): 1981-2011
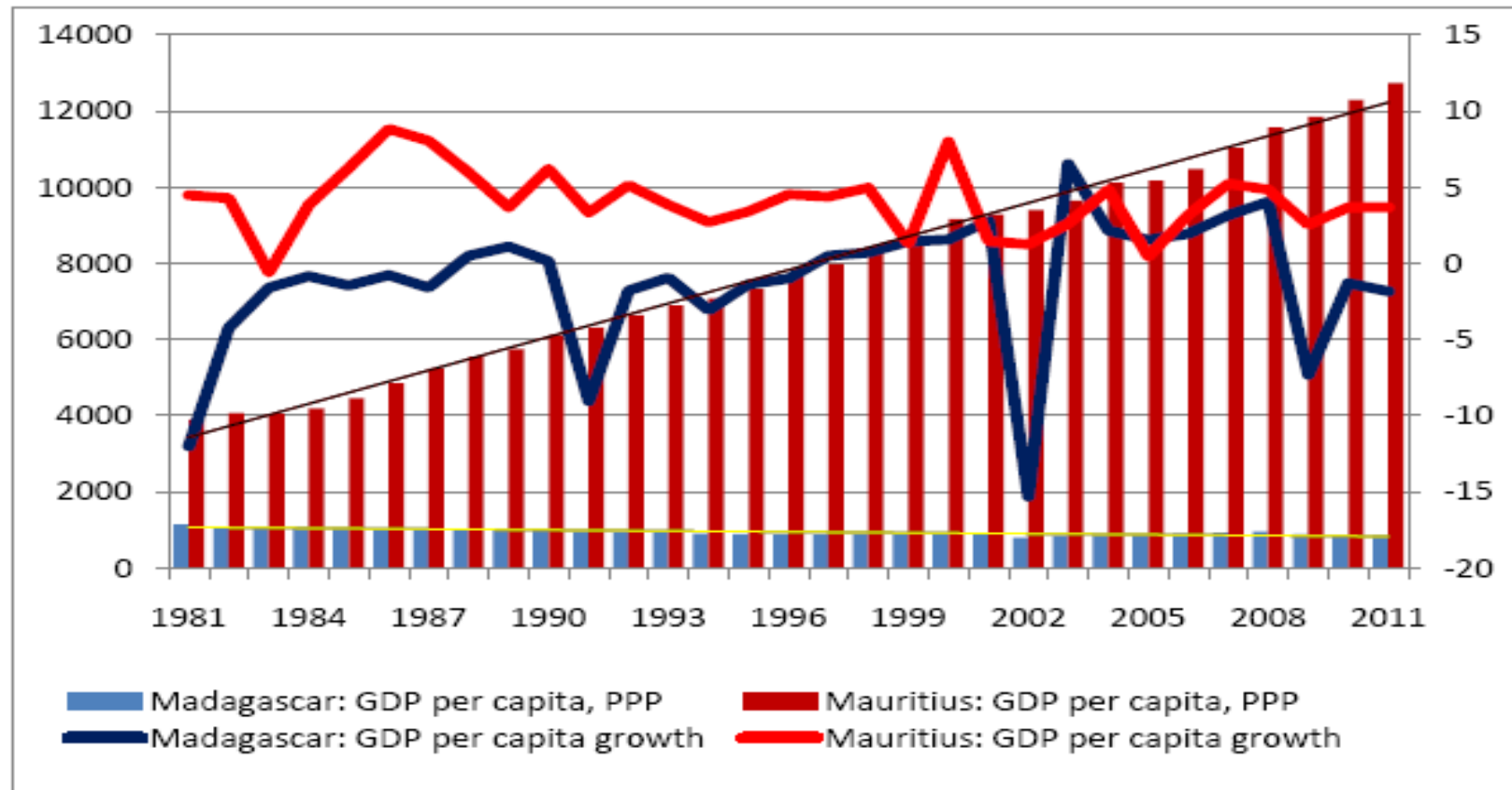
Source of data: World Development Indicators database online (World Bank, 2013)
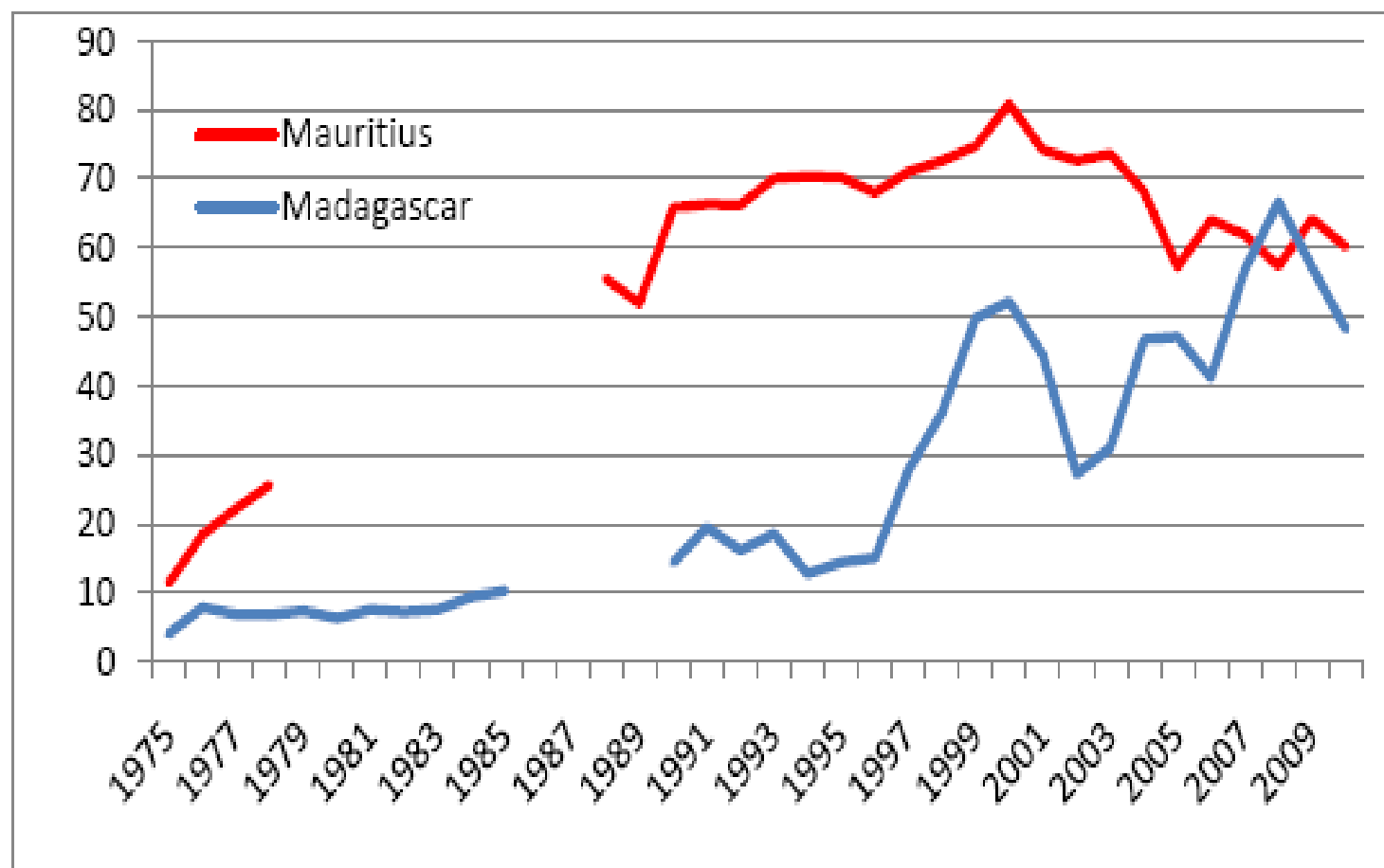
Figure 2

Industry and manufacturing (value added, % GDP)

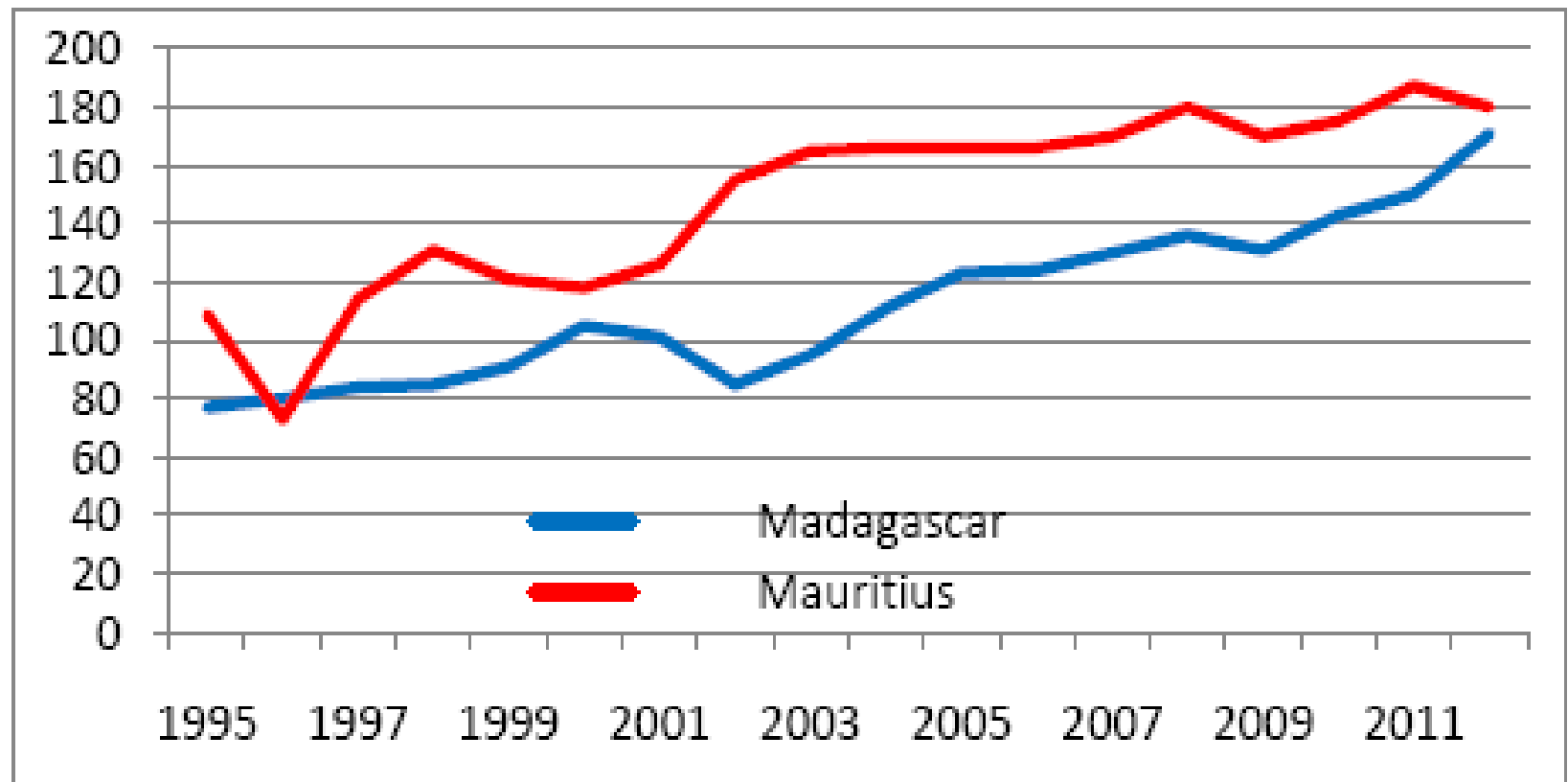Source of data: World Development Indicators database online (World Bank, 2013)

Manufactures exports (% of merchandise exports)

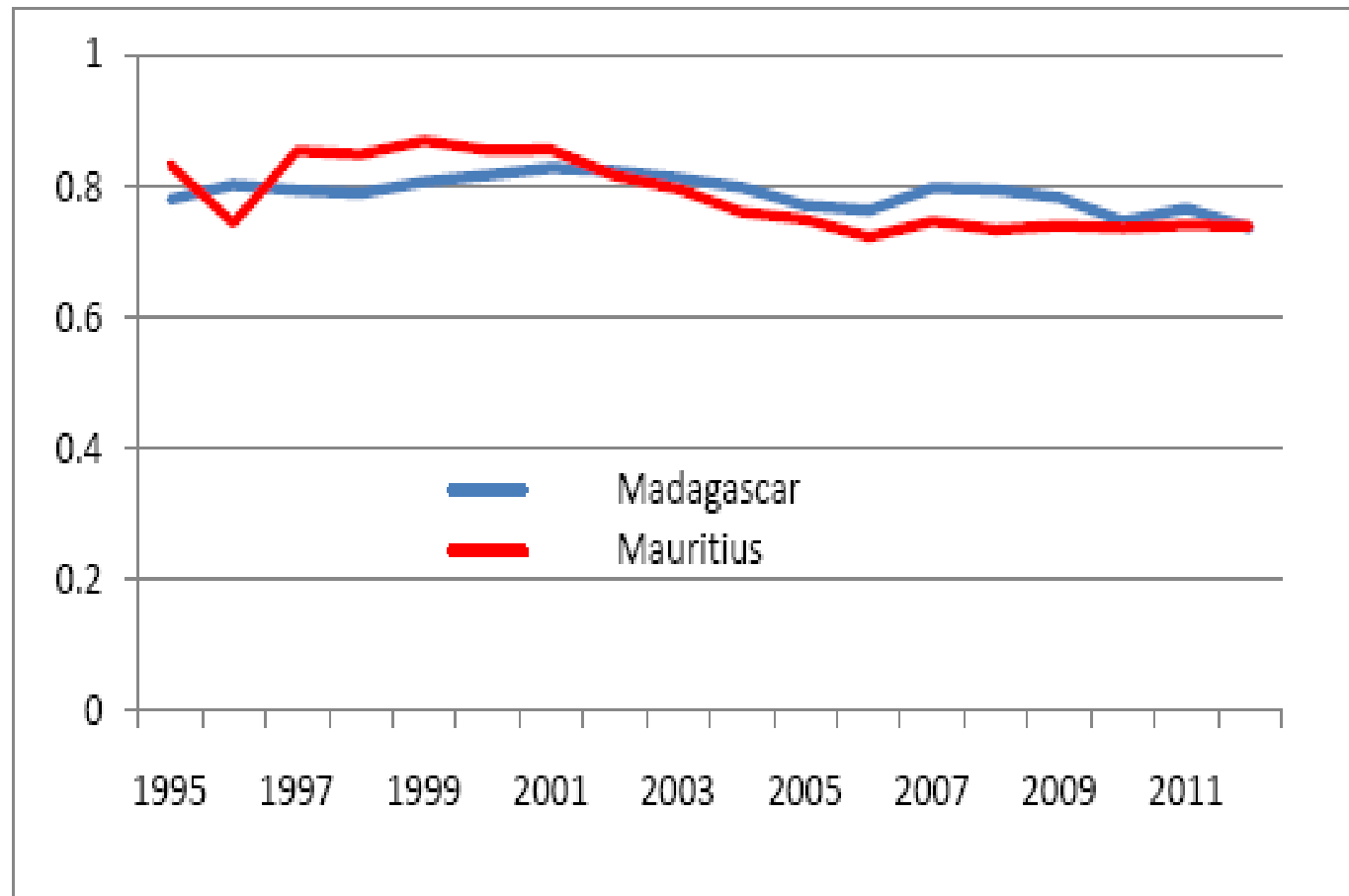Source of data: World Development Indicators database online (World Bank, 2013)

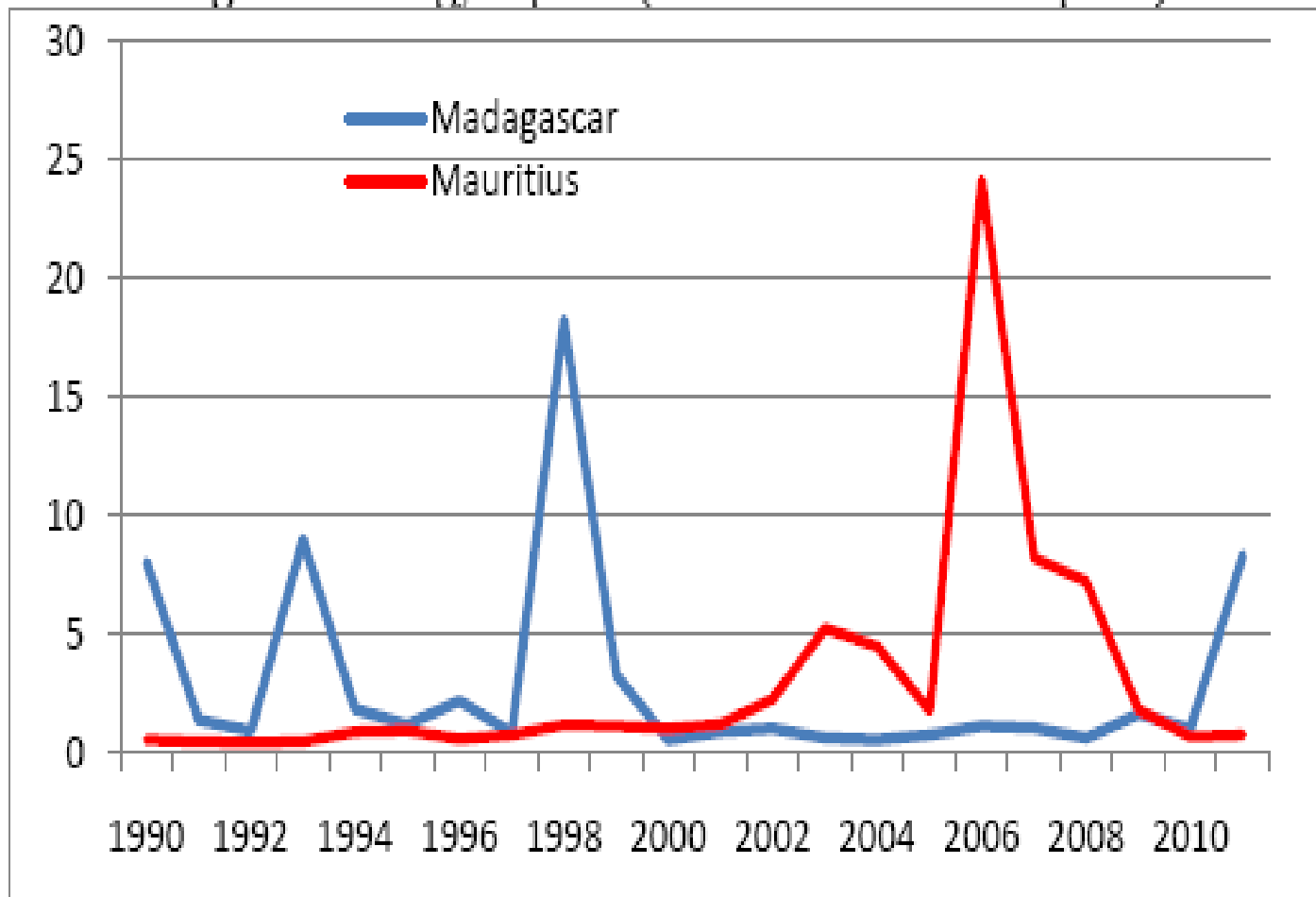Fig. 4a Number of products

Source of data: UNCTADSTAT (2013)

Figure 5a

Sophistication of exports: Export dissimilarity with developed economies (as trade partners)

Source of data: UNCTADSTAT (2013)

Figure 5b
High-technology exports (% of manufactured exports)

Source of data: World Development Indicators database online (World Bank, 2013)

Table 1

Global competitiveness: selected indicators (2012)

	Madagascar		Mauritius	
	Score	Rank/144	Score	Rank/144
Global Competitiveness Index	3.38	130	4.35	54
Technological readiness	2.5	135	4.0	63
Business sophistication	3.3	122	4.3	41
Nature of competitive advantage	3.1	99	4.0	38
Value chain breadth	3.0	112	4.4	28
Control of international distribution	3.1	134	4.6	23
Production process sophistication	2.7	125	4.1	47

Source: The Global Competitiveness Report 2012–2013.

Figure 6

Selected infrastructure indicators
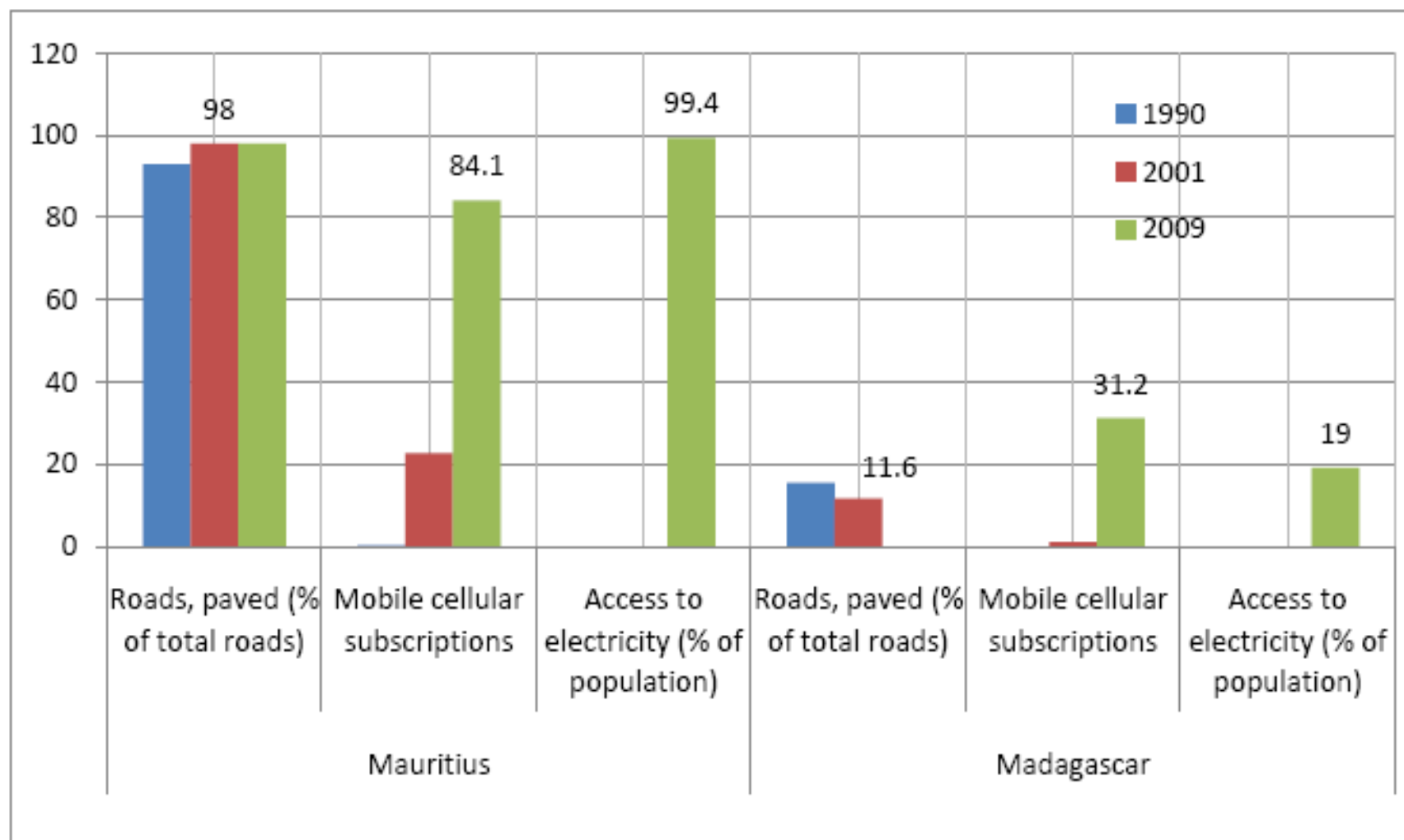
Source of data: World Development Indicators database online (World Bank, 2013)

Figure 7

Urban population (% of total population)

Source of data: World Development Indicators database online (World Bank, 2013)

Figure 8

School enrolment (% of gross)
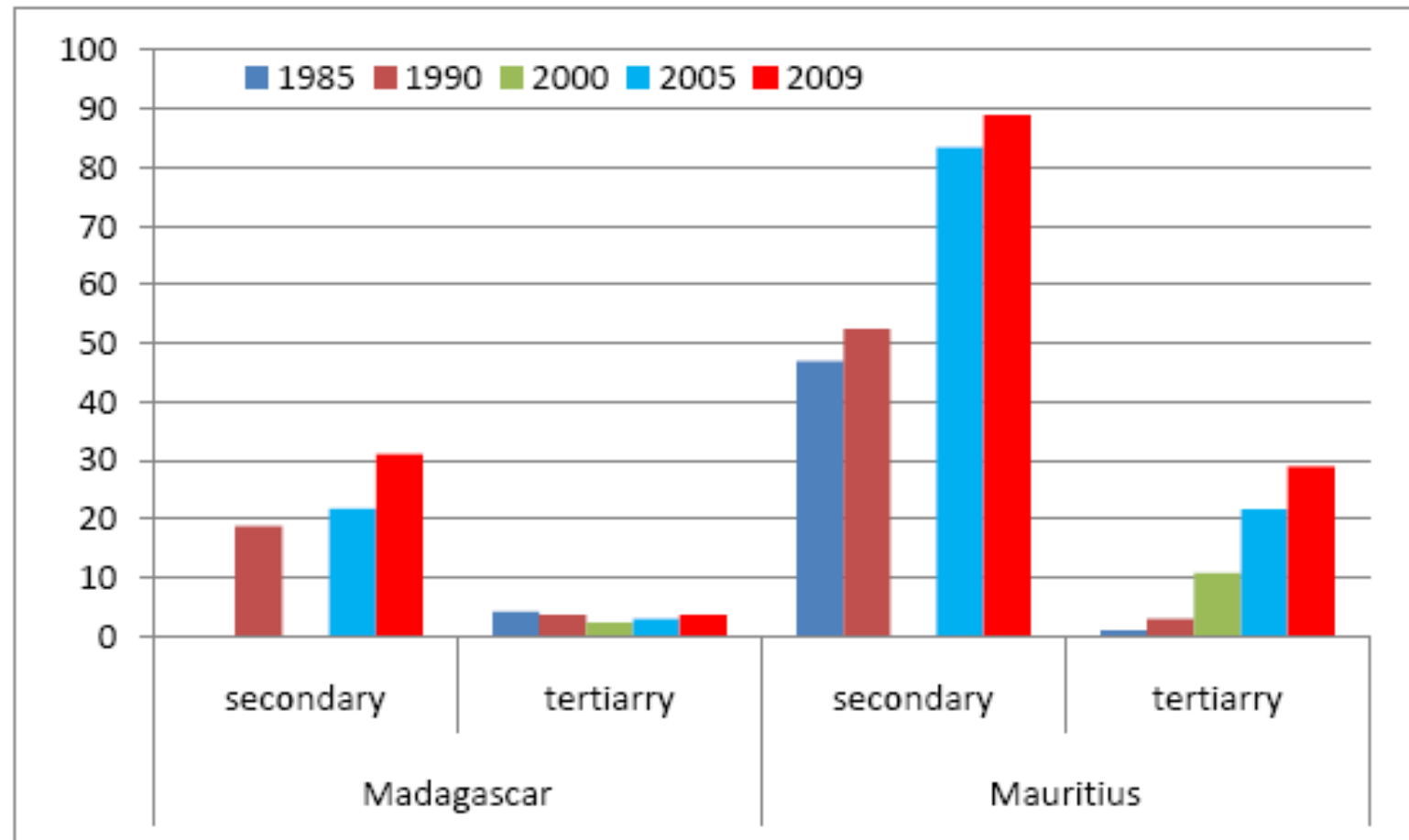
Source of data: World Development Indicators database online (World Bank, 2013)

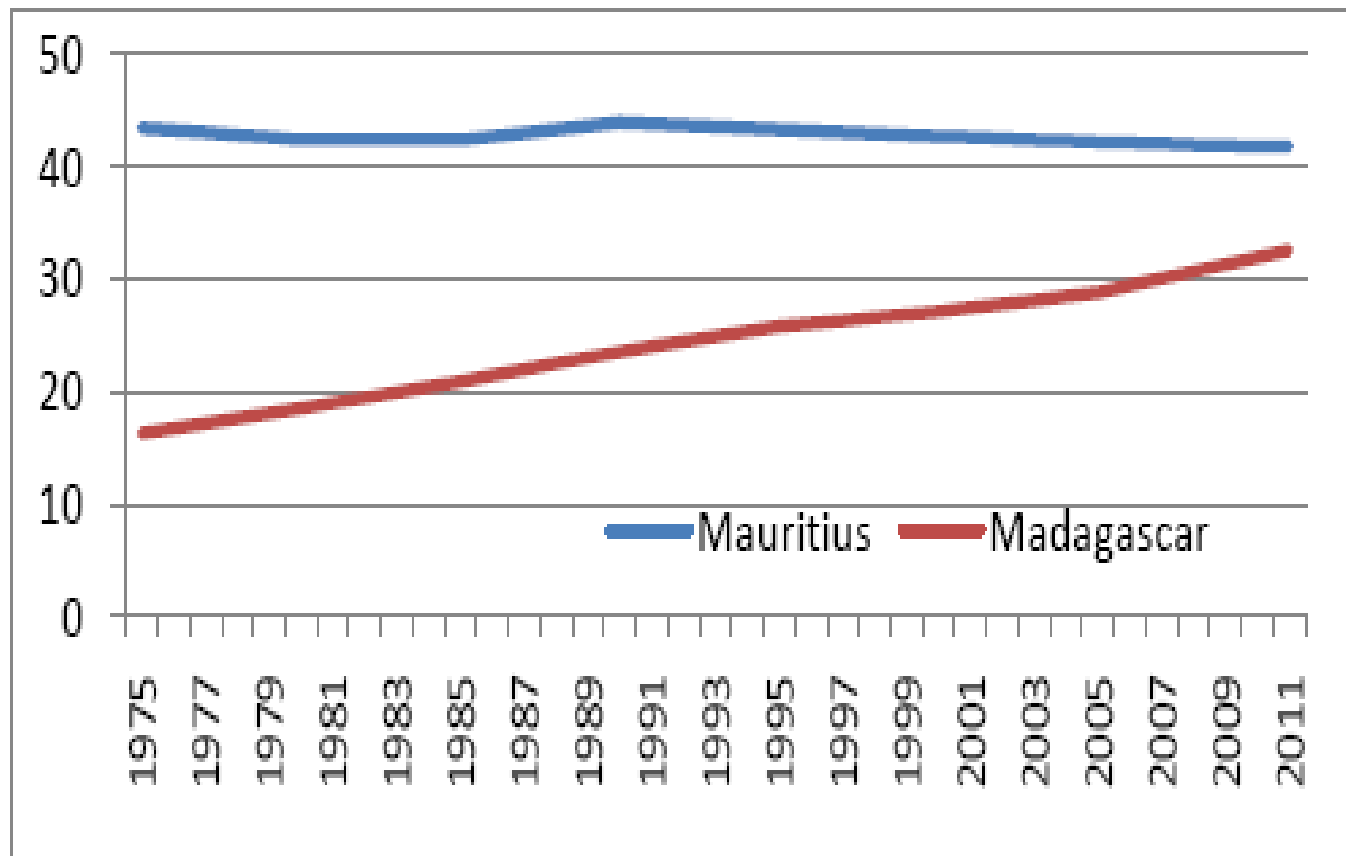# Export diversification: Infrastructure, agglomeration, and human capital

- *Variables used and motivation*
- *6 indicators of industrial development*
  1. Share of manufactures in total merchandise exports (manufexp)
  2. Share of manufacturing in output (manufva)
  3. Share of industry in output (industryva).
  4. Share of high-technology products in total manufactures exports (hightechexp),
  5. Normalized Hirschman index of export product concentration (concentration)
  6. Number of products exported (num_products).
- *RHS variables*
  1. Urbanization (proxy for agglomeration)
  2. Electric power consumption per capita (infrastructure)
  3. Secondary and tertiary school enrolment rates (human capital)
  4. Natural resource rent
  5. FDI
  6. Trade with developed countries

Source: http://www1.wider.unu.edu/L2Cconf/

[1] The country with the lowest urbanization rate in Africa is Burundi. However, Burundi is not included in this study due to lack of data on electric power consumption

AFRICA
Urban Population
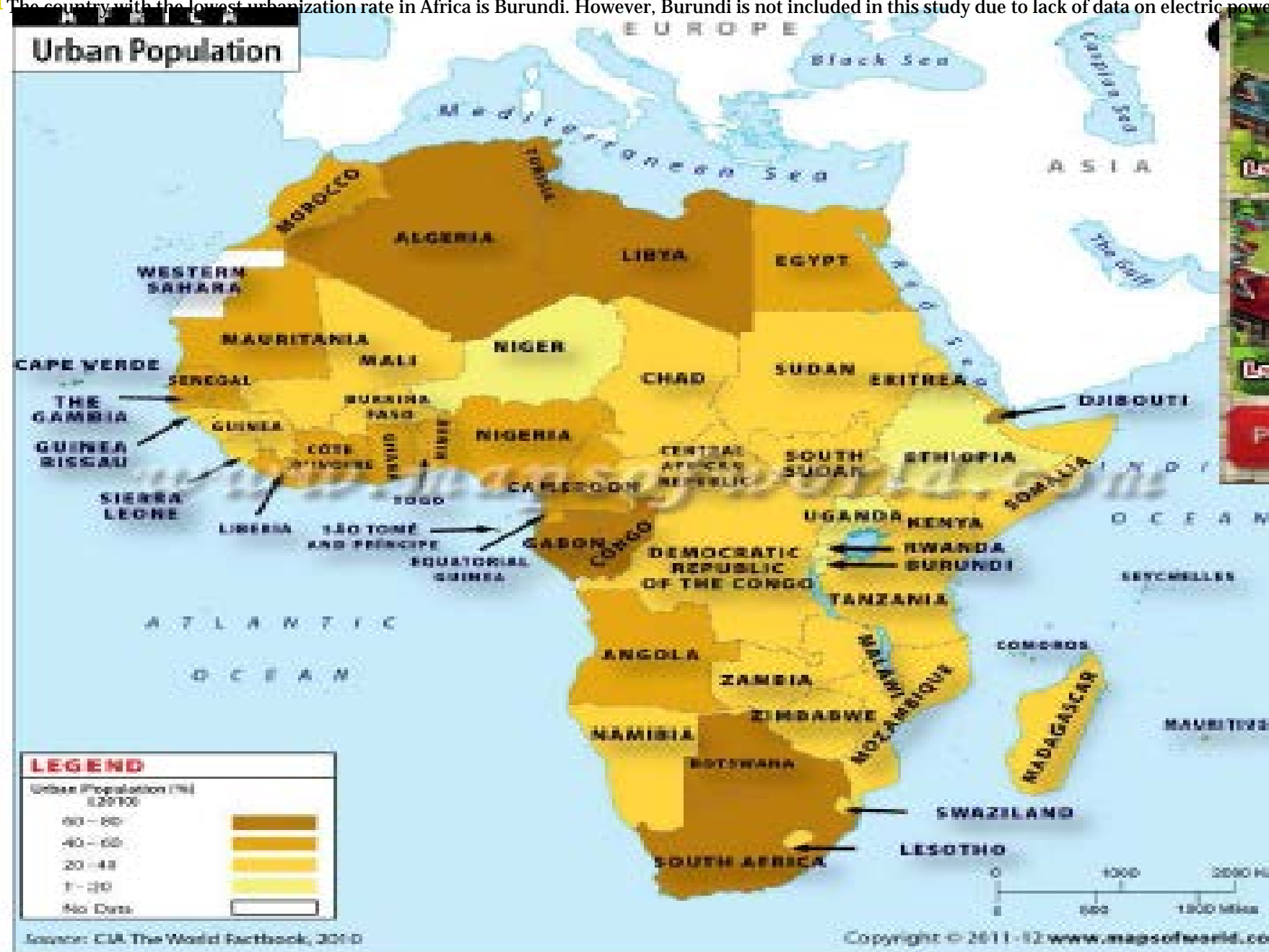
LEGEND

Urban Population (%)
(2010)

60 – 80	
40 – 60	
20 – 40	
1 – 20	
No Data	

Source: CIA The World Factbook, 2010

Copyright © 2011-12 www.mapsofworld.com

Source: www.mapsoftheworld.com

Table 3. GMM estimates
Industrialization indicator: Manufacture exports (manufexp)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	**(8)**	(9)
lagged manufexp	0.420*** (0.06)	0.403*** (0.06)	0.408*** (0.06)	0.358*** (0.07)	0.490*** (0.05)	0.494*** (0.05)	0.349*** (0.06)	0.465*** (0.05)	0.428*** (0.05)
Urban	0.35 (0.34)	-2.078 (1.39)	3.984** (2.02)	7.318*** (2.22)	3.15*** (0.85)	2.38*** (0.69)	3.59* (1.87)	2.47*** (0.81)	2.535*** (0.71)
FDI	-0.066 (0.21)	-0.146 (0.221)	-0.100 (0.219)	-0.340 (0.258)					
Secondaryenrol	0.132 (0.22)	0.485* (0.29)	0.303 (0.28)	0.093 (0.29)			0.188 (0.29)		
secondaryenr_sq	-0.001 (0.001)	-0.005** (0.002)	-0.003 (0.002)	-0.002 (0.002)			-0.002 (0.002)		
Naturalresrent	-2.03*** (0.77)	-2.38*** (0.79)	-2.57*** (0.82)	-1.83** (0.92)	-0.441 (0.66)	-0.576 (0.66)	-1.78** (0.88)	-1.59*** (0.54)	0.753 (1.86)
Electric	7.79** (3.90)	-3.63 (7.22)	-2.34 (6.26)	-1.358 (6.31)	7.85** (3.24)	6.51** (3.24)	13.61 (9.26)	5.02* (2.96)	3.88* (2.18)
urban x electric		0.337* (0.18)					0.708*** (0.24)		
urban_squared			-0.089** (0.04)	-0.120*** (0.04)	-0.023*** (0.007)	-0.016*** (0.005)	-0.073*** 90.02)	-0.018*** (0.006)	-0.165*** (0.006)
urban_squared x electric			0.008** (0.13)	0.008** (0.03)					
Expdevecon				-0.086 (0.057)	-0.093** (0.04)	-0.093** (0.04)	-0.056 (0.05)	-0.082* (0.04)	-0.071* (0.04)
Impdevecon				0.276*** (0.08)	0.199*** (0.06)	0.193*** (0.04)	0.187** (0.08)	0.243*** (0.06)	0.224*** (0.06)
naturalresrent_sq					-0.611** (0.26)	-0.592** (0.27)			-0.588*** (0.28)
Income					-34.22* (20.16)	-3.664 (3.30)			
income_sq					1.88 (1.23)				
Time							-0.321 (0.34)	-0.027 (0.18)	
naturalresrent x urban									-0.037 (0.05)
Obs	180	180	180	170	282	282	174	294	294

Industrialization indicator: Industry, share of output (industva)

	(1)	(2)	(3)	(4)	(5)	**(6)**	(7)
lagged industva	0.668*** (0.03)	0.127** (0.05)	0.126** (0.06)	0.559*** (0.04)	0.619*** (0.04)	0.544*** (0.03)	0.50*** (0.03)
urban	0.907*** (0.24)	2.272*** (0.62)	2.191*** (0.66)	1.754*** (0.32)	1.301*** (0.31)	1.685*** (0.29)	1.525*** (0.27)
FDI	0.024 (0.02)	-0.285*** (0.07)	-0.284*** (0.07)	-0.063 (0.05)	-0.097* (0.02)	0.014 (0.02)	-0.049** (0.019)
naturalresrent	1.889*** (0.51)	1.935*** (0.48)	1.943*** (0.49)	1.380*** (0.49)	-1.114 (0.469)	-8.130*** (1.28)	-6.100*** (1.23)
electric	2.984* (1.25)	-20.76** (9.72)	-19.57* (10.38)	-12.84*** (4.81)	-9.307*** (4.39)	-20.03*** (4.33)	-17.13*** (4.06)
urban x electric ξ	-0.117*** (0.04)	-0.593*** (0.17)	-0.582*** (0.18)	-0.554*** (0.06)	-0.186*** (0.04)	-0.334*** (0.04)	-0.318*** (0.04)
expdevecon	-0.005 (0.02)	0.043 (0.03)	0.042 (0.03)	-0.022 (0.06)	-0.020 (0.02)	0.003 (0.02)	-0.001 (0.02)
impdevecon	0.037 (0.03)	-0.012 (0.03)	-0.009 (0.03)	0.008 (0.03)	0.04 (0.03)	0.032 (0.02)	0.017 (0.02)
secondaryenrol		-0.146 (0.15)	-0.168 (0.16)				
secondaryenr_sq		0.001 (0.001)	0.001 (0.001)				
urban_sq		0.009 (0.01)	0.009 (0.01)	0.018*** (0.002)			
FDI_sq		0.002*** (0.0004)	0.002*** (0.0004)	0.0007* (0.0004)	0.004 (0.004)		
electric_sq		4.159*** (1.39)	3.985*** (1.49)	3.018*** (0.58)	1.402*** (0.53)	2.929*** (0.51)	2.650*** (0.48)
time			0.055 (0.16)	-0.033 (0.07)			
naturalresrent_sq					1.023*** (0.186)		
naturalresrent x urban						0.219*** (0.02)	0.122*** (0.02)
naturalresrent_sq x urban							0.021*** (0.002)
Obs	333	175	175	333	333	334	333

Table 5　GMM estimates
Industrialization indicator: Manufacturing, share of output (manufva)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lagged manufva	0.592*** (0.05)	0.647*** (0.034)	0.648*** (0.035)	0.636*** (0.036)	0.628*** (0.035)	0.619*** (0.035)	0.61*** (0.03)
Urban	-0.023 (0.05)	0.366*** (0.09)	0.370*** (0.09)	0.279*** (0.09)	0.354*** (0.09)	0.327*** (0.09)	0.279*** (0.10)
FDI	-0.0002 (0.008)	0.023* (0.01)	0.023* (0.01)	0.022* (0.01)	0.021* (0.01)	0.026** (0.01)	0.029** (0.01)
secondaryenrol	0.008 (0.04)						
secondaryenr_squared	0.0003 (0.0003)						
naturalresrent	-0.012 (0.12)	-0.156** (0.07)	-0.151** (0.07)	-0.226*** (0.08)	-0.068 (0.08)	0.103 (0.09)	0.657** (0.31)
Electric	1.038** (0.50)	0.898*** (0.21)	0.868*** (0.21)	1.037*** (0.21)	1.103*** (0.22)	1.064*** (0.12)	1.517** (0.47)
urban x electric ξ							0.009 (0.12)
Time	-0.090** (0.03)	-0.109*** (0.03)	-0.109*** (0.026)	-0.107*** (0.029)	-0.142*** (0.024)	-0.141*** (0.025)	-0.156*** (0.02)
urban_sq		-0.0024*** (0.0007)	-0.0025*** (0.0007)	-0.0018*** (0.0007)	-0.002*** (0.0007)	-0.002*** (0.0007)	-0.001 (0.001)
FDI_sq		-0.0002* (0.0001)	-0.0002* (0.0001)	-0.00015 (0.0001)	-0.00018* (0.00009)	-0.00015* (0.00009)	-0.001 (0.001)
num_product		-0.004 (0.028)	0.0004 (0.067)	0.004 (0.03)			
num_product_sq			-0.0017 (0.002)				
expdevecon				-0.009** (0.004)			
impdevecon				0.004 (0.008)			
concentration					-2.079*** (0.65)	-6.355** (2.47)	-7.759*** (2.71)
concentration_sq						4.382* (2.33)	5.493** (2.56)
naturalresrent_squared						-0.094*** (0.03)	-0.095** (0.04)
naturalresrent x urban							-0.014* (0.03)
Obs	289	344	344	311	344	344	344

Table 6. GMM estimates
Industrialization indicator: High-tech exports (hightechexp)

	(1)	(2)	(3)	(4)	(5)
lagged hightech exp	0.053 (0.07)	0.051 (0.07)	0.059 (0.08)	0.053 (0.08)	-0.052 (0.08)
urban	0.143 (0.35)	0.21 (0.38)	2.597** (1.04)	2.577** (1.04)	2.409** (1.05)
FDI	0.188 (0.11)	0.189 (0.11)	0.283** (0.14)	0.292** (0.14)	0.275** (0.14)
tertiaryenrol	0.064 (0.09)	-0.103 (0.40)	0.245** (0.11)	0.248** (0.11)	0.229* (0.11)
naturalresrent	-1.128** (0.12)	-1.174** (0.52)	-0.979 (0.63)	-0.645 (0.87)	-3.866 (2.84)
electric	2.03 (2.88)	2.43 (2.98)	16.11*** (5.40)	15.89*** (5.45)	16.85*** (5.45)
tertiaryenrol_Sq		0.0033 (0.007)			
urban x electric ξ			-0.356*** (0.12)	-0.353*** (0.13)	-0.355** (0.128)
expdevecon			0.123*** (0.04)	0.125*** (0.04)	0.118*** (0.04)
impdevecon			0.019 (0.06)	0.014 (0.06)	0.022 (0.06)
naturalresrent_sq				-0.183 (0.327)	
naturalresrent x urban					0.056 (0.05)
Obs	99	99	91	91	91
Sargan test [a]	90.54 [0.55]	89.81 [0.54]	73.78 [0.72]	72.64 [0.74]	72.77 [0.73]

Standard errors in parentheses. ** indicates significance at 0.05, and *** indicates significance at 0.01.

[a] Ho: difference in coefficients not systematic.

Table 7. GMM estimates

Industrialization indicator: Number of products exported (num_products)

	(1)	(2)	(3)	(4)	(5)	(6)
lagged num_product	0.388*** (0.07)	0.308*** (0.07)	0.319*** (0.07)	0.183** (0.08)	0.183** (0.08)	0.160** (0.08)
urban	2.762*** (0.86)	9.306*** (2.36)	-4.94 (3.70)	-10.12** (5.14)	-9.34* (5.08)	-11.62** (5.17)
FDI	0.224*** (0.07)	0.234** (0.47)	0.283*** (0.47)	0.239*** (0.07)	0.236*** (0.07)	0.234*** (0.07)
secondaryenrol	1.714*** (0.42)	0.989 (0.42)	0.973* (0.54)	1.373*** (0.54)	0.785*** (0.28)	0.568* (0.29)
secondaryenrol_sq	-0.011*** (0.003)	-0.003 (0.004)	-0.006 (0.004)	-0.006 (0.004)		
naturalresrent	-1.982 (1.62)	-0.208 (1.68)	-0.616 (2.00)	-0.385* (2.12)	-0.397* (2.10)	-25.32*** (8.48)
electric	4.12 (5.05)	38.77*** (12.07)	20.71** (12.07)	26.58*** (8.95)	31.46*** (8.13)	32.87*** (8.17)
urban x electric		-0.952*** (0.322)				
urban_sq			0.155** (0.06)	0.213*** (0.07)	0.223*** (0.07)	0.249*** (0.07)
urban_sq x electric			-0.013** (0.05)	-0.019*** (0.005)	-0.022*** (0.005)	-0.025*** (0.005)
naturalresrent_sq			-0.809 (0.72)			
expdevecon				-0.018 (0.08)	-0.035 (0.07)	-0.007 (0.007)
impdevecon				-0.382** (0.15)	-0.331** (0.14)	-0.208 (0.16)
Year					2.166** (0.89)	2.918*** (0.93)
naturalresrent xurban						0.459*** (0.166)
Obs	176	176	176	154	154	154

Table 8. GMM estimates
Industrialization indicator: Concentration of exports

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lagged concentration	0.588*** (0.06)	0.539*** (0.06)	0.404*** (0.05)	0.405*** (0.05)	0.405*** (0.05)	0.404*** (0.05)	0.343*** (0.05)
Urban	-0.004 (0.004)	0.018** (0.008)	0.041*** (0.009)	0.042*** (0.01)	0.042*** (0.01)	0.046*** (0.009)	0.045*** (0.008)
FDI	-0.003 (0.004)	-0.0007* (0.0004)	-0.001*** (0.0003)	-0.001*** (0.0003)	-0.001*** (0.0003)	-0.001*** (0.0003)	-0.001*** (0.00)
Secondaryenrol	-0.0004 (0.001)	-0.0014 (0.0009)	-0.0026** (0.001)	-0.0031** (0.001)	-0.0026 (0.002)	-0.0018 (0.001)	-0.002** (0.001)
Naturalresrent	0.007 (0.008)	-0.008 (0.009)	0.003 (0.012)	0.003 (0.013)	0.003 (0.012)	0.005 (0.013)	0.141*** (0.04)
Electric	0.042* (0.02)	0.141*** (0.04)	0.168*** (0.04)	0.157 (0.12)	0.168*** (0.05)	0.181*** (0.04)	0.158*** (0.03)
urban x electric [§]		-0.0027** (0.001)	-0.004*** (0.001)	-0.0041** (0.002)	-0.004*** (0.001)	-0.004*** (0.001)	-0.04*** (0.00)
Naturalresrent_sq		0.0113*** (0.003)	0.015*** (0.003)	0.015*** (0.003)	0.015*** (0.003)	0.016*** (0.003)	0.011*** (0.003)
Expdevecon			0.0011*** (0.0003)	0.0011*** (0.0003)	0.0011*** (0.0003)	0.0012*** (0.0003)	0.0015*** (0.00)
Impdevecon			0.0019*** (0.0006)	0.0019*** (0.0006)	0.002*** (0.0007)	0.002*** (0.0007)	0.001 (0.0006)
electric_sq				0.0016*** (0.018)			
secondaryenrol _sq					0.0002 (0.001)		
Time						-0.0036 (0.0038)	
naturalresrent x urban							-0.003*** (0.0007)
Obs	176	176	154	154	154	154	154
Sargan test [a]	176.74 [0.34]	180.01 [0.25]	159.59 [0.18]	158.60 [0.18]	158.47 [0.18]	157.75 [0.19]	156.32 [0.19]

Standard errors in parentheses. ** indicates significance at 0.05 and *** indicates significance at 0.01.
[a] Ho: difference in coefficients not systematic.

Policy implications

- Human capital does not appear to make a significant direct contribution to the shares of industry and manufacturing in output and to manufactures exports should not imply that human capital is not an important factor. On the contrary, these results may simply reflect the low quality of skills that are supplied in the labor market and that education is not generating the appropriate type of input for the manufacturing and industrial sectors.

- This could be **one reason Africa, on average, appears to be taking 'one step forward and two steps back'** on the path of industrial development.

- Effect of infrastructure (electric power consumption) is positive in all cases except in the case of export diversity—we find a positive effect on 'concentration.'

- In addition, the effect of electric power consumption on industry there operates with a threshold.

  This should raise concerns since the interplay of electricity and urbanization is negative: as electric power consumption increases there is a positive effect from the independent increase and a negative influence from the interaction between electric power and urbanization, and <u>the negative effect may actually dominate in cases where the pace of infrastructure development is not consistent with the pace of urbanization.</u>

- **This is the second reason African countries may be taking 'one step forward and two steps back.'**

- Consider the case of Ethiopia—a country with one of the lowest urbanization rates—which in 2010 had an urbanization rate of 16.8%, the threshold level would be approximately 80 kilowatt hour (kWh) per capita. Ethiopia had 54.3 kWh per capita in 2010; still below the threshold level.

- On the other hand, Gabon which has the highest urbanization rate in Africa, at 85.8% (in 2010), would need to have a threshold level of electric power at approximately 4070 kWh per capita. In 2010 Gabon had only about 1004 kWh per capita.

Final remarks

1. It seems that the constraints that are hampering Africa's industrial development are all of the infrastructural type: hard or physical type, and soft infrastructure—human capital and institutions. Perhaps viewing these constraints as infrastructural problems could lead to policies that would take into account the different interactions among the two types of infrastructure.

2. Role of regional integration in alleviating the infrastructural constraints.