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Productivity and Competitiveness as determinants of Growth: Empirical Evidence from a Small Island Economy Mauritius

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Abstract

Sustaining stable growth can be a challenging task for small island economies in periods of fluctuating economic cycles and during external shocks. This paper explores the case of a non-natural resources small island economy, namely Mauritius and investigates whether or not productivity and competitiveness are the determinants of growth for the period 2002-2012. Using ordinary least squares, principal components analysis and robustness tests, mixed evidence supporting productivity and competitiveness as determinants of growth is found. Multifactor productivity, labour productivity and capital productivity consistently report positive relationship with real output. There is limited evidence supporting the relationship between the measures of competitiveness and growth in Mauritius.

1. Introduction

The growth theory witnessed a revival of interest in the 1980s (Lucas 1988, 1993; Romer 1986, 1990). New avenues of growth research opened and researchers were able to formulate innovative models. There are diverse schools of thought on growth theory. A review of the literature on growth indicates three main areas of interest for researchers. Firstly, researchers use regression analysis to show differences in growth between countries. Secondly, there is a focus on the role of public policy and the interaction between public policy and growth. Thirdly, another strand of the literature explores the determinants of growth. Debate on growth theory is ongoing and there is no consensus on the factors influencing growth.

The question addressed in this paper is whether or not productivity[1] and competitiveness[2] influence growth. This paper also fills the gap and contributes to the growth literature by examining the determinants of growth for a small island economy, which is almost inexistent. As such, this paper presents an overview of Mauritian economy and subsequently focuses on exploring the determinants of growth.

Mauritius has evolved from a low-income, agriculture-based economy to a middle-income diversified economy. The Mauritian economy is dependent on four pillars, namely financial services, textile, tourism and sugar. However, in an attempt to diversify the economy emerging sectors such as information and communication technology, seafood, hospitality and property development, healthcare, renewable energy and education are being encouraged to grow. Since independence in 1968, Mauritius gradually adapted to changing world conditions and as such, structured its economy to remain competitive. Research by World Economic Forum (WEF) classifies Mauritius at an efficiency-driven stage (WEF report 2013). Since 2005, the competitive analysis of the WEF is based on the Global Competitiveness Index (GCI), which is a broad measure of microeconomic and macroeconomic foundations of national competitiveness. The 2013-2014 WEF report shows that Mauritius is ranked 45th in the world, becoming the highest ranked country in sub-Saharan Africa. An overview of the GCI shows that between 2001 and

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[1] Productivity can be defined as the relationship between the diverse inputs of production namely capital and labour and the output of goods and services. Capital productivity and labour productivity are two key productivity indicators that are broadly used. Nevertheless, the limitation with these indicators is that they provide an indication of the influence of only one factor of production at a particular time on productivity. One way to improve these partial indicators is through the multifactor productivity which takes into consideration the concurrent influences of numerous factors on production, as well as qualitative factors namely enhanced quality of inputs, improved quality of goods and better management.

[2] Competitiveness can be defined as the set of factors, policies and institutions establishing a country's level of productivity. The level of prosperity that can be achieved by an economy is then set by the level of productivity. The rates of return attained by investments in an economy are also determined by the productivity level. The rates of returns obtained by investments in an economy are, on the other hand, the primary drivers of an economy's growth rates. Hence, it can be said that the more competitive an economy is, the higher its likelihood to sustain growth.

2013, ranking of Mauritius has fluctuated widely, ranging from 32 to 60. This is an indication that of the struggle that Mauritius has faced in order to remain competitive.

Using quantitative techniques such as ordinary least squares, principal components analysis and robustness tests, this study investigates the determinants of growth using measures of productivity and competitiveness as explanatory variables. The findings show mixed evidence supporting productivity and competitiveness as determinants of growth.

The rest of this paper is organized as follows. Section 2 introduces the theoretical considerations. This is followed by the research design, which details description of the hypothesis, data and methodology in Section 3. Section 4 presents empirical analyses of the determinants of growth using different regression specifications and robustness checks. Section 5 concludes.

2. Theoretical Considerations

History bears witness to the fact that small island economies inevitably face stagnant or declining growth rate across economic cycles[3]. The debate on how to improve growth has been ongoing among academics, central bankers, finance regulators and industry practitioners. Different schools of thought propose different theories on this field. However, there is no consensus on the determinants of growth. As such, this study investigates the determinants of growth by focusing on proxies of productivity and competitiveness. Hence,

$$Growth = f(productivity, competitiveness) \tag{1}$$

Where growth is defined by real output; productivity is defined by labour, capital and multifactor; competitiveness is defined by unit labour cost, USD/MUR, labour cost manufacturing, wage rate index and inflation.

3. Research Design

This section reports on the research design and details the hypotheses, data and methodology.

3.1 Hypotheses

It is anticipated that the three measures of productivity, namely labour, capital and multifactor are positively related to real output. A mixed relationship between real output and the measures of competiveness, namely unit labour cost, USD/MUR, labour cost manufacturing, wage rate index and inflation is postulated. Table 1 showcases the hypotheses used in examining the determinants of growth.

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[3] Rand and Tarp (2001) examined the duration of business cycles in three different regions of the world, namely Sub-Saharan Africa, Latin America and Asia. Their study revealed that the average length of business cycle for all developing countries is between 7 and 18 quarters, which is equivalent to less than 4.5 years.

Table 1: Hypotheses - Determinants of growth

Variable name	Hypothesis
Real output	N/A
Labour productivity	+
Capital productivity	+
Multifactor productivity	+
Unit labour cost	+/-
USD/MUR	+/-
Labour cost manufacturing	+/-
Wage rate index	+/-
Inflation	+/-

This study aims at providing empirical evidence on whether or not productivity and competitiveness have implications on growth. Accordingly, measures of productivity and competitiveness are included the formulation of hypotheses. Statistically significant association among productivity, competitiveness and growth would confirm the hypotheses that productivity and competitiveness are vital determinants of growth

3.2 Data

For the purposes of this study, the case of a small island economy, namely Mauritius has been used. To empirically examine the determinants of growth, data has been collected for the period 2002-2012. The proposed time period for the analysis is solely based on the availability of the required data from Government authorities[4]. Table 2 reports the definitions of all the variables.

Table 2: Variable, acronym, definition and source

Variable	Acronym	Definition	Source
Real output	RO	(Value added in year n / Value added in base year)*100	Statistics Mauritius
Labour productivity	LP	(Output/Labour input)*100	Statistics Mauritius
Capital productivity	CP	(Output/Capital input)*100	Statistics Mauritius
Multifactor productivity	MP	(Output/Multifactor input)*100	Statistics Mauritius
Unit labour cost	ULC	(Labour cost/output)*100	Statistics Mauritius
USD/MUR	USDMUR	Volatility of exchange rate between US and MUR	Bank of Mauritius
Labour cost manufacturing	LCM	Cost incurred per labour in the manufacturing sector	Statistics Mauritius
Wage rate index	WRI	Measure of change in price of labour	Statistics Mauritius
Inflation	INFL	Year-on -Year inflation rate	Bank of Mauritius

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[4] This study recognizes the limited availability of data in small island nations such as Mauritius and is aware of econometric issues that arise from data constraints.

3.3 Methodology

To test the determinants of growth, this study employs the ordinary least squares methodology and explores the underlying models

$$RO_t = \beta_0 + \beta_1\, MP_t + \beta_2\, ULC_t + \beta_3\, USDMUR_t + \beta_4\, LCM_t + \beta_5\, WRI_t + \beta_6\, INFL_t + \varepsilon_t$$

(2)

Where RO is further defined as real output; MP is further defined as multifactor productivity; ULC is further defined as unit labour cost; USDMUR is further defined as the exchange rate between United States and Mauritius; LCM is further defined as labour cost manufacturing; WRI is further defined as wage rate index; INFL is further defined as inflation; ε is the error term

Furthermore, this study conducts robustness tests[5] to provide empirical validity for the determinants of growth. Following on equation (2), this study tests for the determinants of growth by employing additional measures of productivity such as labour productivity and capital productivity.

$$RO_t = \gamma_0 + \gamma_1\, LP_t + \gamma_2\, ULC_t + \gamma_3\, USDMUR_t + \gamma_4\, LCM_t + \gamma_5\, WRI_t + \gamma_6\, INFL_t + \varepsilon_t$$

(3)

LP is further defined as labour productivity

$$RO_t = \alpha_0 + \alpha_1\, CP_t + \alpha_2\, ULC_t + \alpha_3\, USDMUR_t + \alpha_4\, LCM_t + \alpha_5\, WRI_t + \alpha_6\, INFL_t + \varepsilon_t$$

(4)

CP is further defined as capital productivity

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[5] As an additional robustness check, this study also employs gross domestic product (GDP) growth rate as a proxy for growth and tests the determinants of GDP growth using the same explanatory variables, namely productivity and competitiveness. The results of this robustness test are discussed in Appendix 1.

4. Empirical Results

4.1 Descriptive Statistics

Table 3 exhibits the summary statistics of real output and the explanatory variables. A range of descriptive statistics is reported. It is noteworthy to point out that over the three measures of productivity; capital productivity exhibits a negative value of -0.86 over the period under study despite the increasing investments in machinery and equipment by local firms. Between 2002 and 2012, the range of wage rate index varies considerably and peaks in the 2008 and 2009 period at 13.7% and 10.8% respectively at the height of the Global Financial Crisis.

Table 3: Descriptive statistics of data for period 2002-2012

	RO	LP	CP	MP	ULC	USDMUR	LCM	WRI	INFL
Mean	4.16	2.80	-0.86	0.61	4.01	0.46	2.80	6.78	5.74
Median	4.20	2.57	-0.86	0.34	5.28	0.71	2.57	5.00	4.90
Mode	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*	4.70	3.90
Standard Deviation	1.48	1.19	1.16	1.10	8.28	6.62	1.19	3.56	2.51
Kurtosis	-0.95	-0.61	-0.43	-0.17	0.32	-0.49	-0.61	-0.24	-1.25
Skewness	-0.13	0.62	-0.53	0.43	0.11	0.22	0.62	1.08	0.41
Min	1.60	1.37	-3.02	-1.06	-10.60	-9.60	1.37	3.10	2.50
Max	6.30	5.06	0.64	2.71	19.62	12.62	5.06	13.70	9.70
Count	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00

*N/A: not applicable

Macroeconomics studies [Moosa (1986) and Klein and Ozmucur (2002)] have been criticized for being faced with multicollinearity problem. This study may be exposed to the same problem. As such, additional tests are conducted in order to control for the multicollinearity problem. This study begins by testing for the correlation between the different variables and Table 4 presents the Pearson correlation matrix.

Table 4: Pearson correlation coefficients

	RO	LP	CP	MP	ULC	USDMUR	LCM	WRI	INFL
RO	1.00								
LP	0.61	1.00							
CP	0.95	0.52	1.00						
MP	0.90	0.82	0.90	1.00					
ULC	0.47	0.00	0.59	0.36	1.00				
USDMUR	-0.40	-0.01	-0.53	-0.35	-0.49	1.00			
LCM	0.10	-0.11	0.22	0.15	0.61	-0.54	1.00		
WRI	0.29	-0.13	0.16	0.08	0.24	-0.19	0.46	1.00	
INFL	0.50	0.10	0.61	0.38	0.47	-0.28	-0.25	-0.12	1.00

The correlation coefficients in Table 4 indicate that some variables are correlated[6]. To deal with this issue, Principal Components Analysis (PCA) is conducted and this is applied to equations (2), (3) and (4)[7]. The results of PCA are reported and discussed in the next section.

4.2 Regression Results

4.2.1 Determinants of growth

This section presents the determinants of growth as they are examined through OLS regression settings. Table 5 reports the results of estimating equations (2), (3) and (4).

Table 5: Determinants of growth
The table reports regression results with real output as dependent variable. Ordinary least squares estimation is reported. Independent variables are defined in Table 2. T-statistics are shown in italics. *Significance at 10 per cent level, **significance at 5 per cent level and ***significance at 1 per cent level are reported.

Independent variable	Equation (2)	Equation (3)	Equation (4)
MP	0.954125***		
	5.18973		
LP		0.582953*	
		2.455274	
CP			1.062067**
			4.148498
ULC	-0.431706	-0.776145	-0.268239
	-1.766342	*-2.035282*	*-0.822454*
USDMUR	-0.63346	-1.102112*	-0.3748
	-1.953787	*-2.186909*	*-0.852747*
LCM	-0.167538*	-0.229231	-0.102626
	-2.397634	*-1.951092*	*-1.110251*
WRI	0.269166**	0.407212**	0.181443
	2.876485	*2.780766*	*1.419839*
INFL	0.229351	0.49292	0.1204
	1.44274	*2.06034*	*0.564238*

The results show that the three measures of productivity namely, multifactor productivity, labour productivity and capital productivity exhibit statistically significant positive coefficient. This confirms the hypotheses that multifactor productivity, labour productivity and capital productivity are positively related to real output, implying that an increase in productivity results

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[6] Breaking down general equations to specific equations is another approach to deal with correlated variables.
[7] In the presence of correlated variables, principal components analysis is used where researchers typically include components comprising 95% of the total variance (Jackson, 1993).

in an increase in real output. In addition, labour cost manufacturing has a negative coefficient with a 10% level of significance, indicating that an increase in labour cost manufacturing leads to a reduction in real output. Moreover, the findings indicate that wage rate index has a positive coefficient, which is significant at 5%.

From the above discussion, it is concluded that while empirical evidence is established for the relationship between the three measures of productivity and real output, there is limited support establishing the link between competitiveness and real output. Furthermore, there is no evidence in support of unit labour cost and inflation affecting real output.

4.2.2 Tests

Equations (2), (3) and (4) can be criticized for being sensitive to multicollinearity. As such, PCA is conducted. The results are reported in Table 6.

Table 6: Determinants of growth using Principal Components Analysis
The table reports regression results with real output as dependent variable. Principal Components Analysis estimation is reported. Independent variables are defined in Table 2. T-statistics are shown in italics. *Significance at 10 per cent level, **significance at 5 per cent level and ***significance at 1 per cent level are reported.

Independent variable	Equation (2)	Equation (3)	Equation (4)
MP	**1.209246*****		
	6.617378		
LP		**0.871888****	
		3.200022	
CP			**1.245474*****
			7.659506
ULC	**0.098539**	**0.144472**	**0.032201**
	1.105469	*0.938452*	*0.408982*
USDMUR	**0.102317**	**0.099041**	**0.052407**
	0.911586	*0.512788*	*0.534101*
Cumulative Proportion	**87%**	**86%**	**89%**

By using PCA methodology, 3 principal components were chosen for each equations based on their variance contribution. The findings on Table 6 indicate that productivity is a determinant of growth.

5. Conclusion

This paper explores the determinants of growth using measures of productivity and competitiveness as explanatory variables. Through empirical findings and robustness tests, this study reports mixed findings on the determinants of growth. The three measures of productivity, namely multifactor productivity, labour productivity and capital productivity consistently report statistically significant positive relationship with real output. As a result, an improvement in productivity in Mauritius can lead to better growth. Another finding in this paper is the limited and inconsistent empirical evidence supporting the relationship between competitiveness and growth in Mauritius.

Appendix 1

This study also explores whether the use of another proxy for growth, namely GDP growth can be used to obtain robust estimates of the determinants of growth. As a result, the following models are tested,

$$GDPG_t = \alpha_0 + \alpha_1\ MP_t + \alpha_2\ ULC_t\ + \alpha_3\ USDMUR_t + \alpha_4\ LCM_t + \alpha_5\ WRI_t + \alpha_6\ INFL_t + \varepsilon_t$$

$$(A)$$

$$GDPG_t = \theta_0 + \theta_1\ LP_t + \theta_2\ ULC_t\ + \theta_3\ USDMUR_t + \theta_4\ LCM_t + \theta_5\ WRI_t + \theta_6\ INFL_t + \varepsilon_t$$

$$(B)$$

$$GDPG_t = \sigma_0 + \sigma_1\ CP_t + \sigma_2\ ULC_t\ + \sigma_3\ USDMUR_t + \sigma_4\ LCM_t + \sigma_5\ WRI_t + \sigma_6\ INFL_t + \varepsilon_t$$

$$(C)$$

GDPG is further defined as gross domestic product growth rate

Table 7 exhibits the results and when the results of equations (2), (3) and (4) are compared to the results of equations (A), (B) and (C), no major changes in the findings are found. Minor changes in the coefficients are observed but the general conclusion discussed in the empirical results section is not altered.

Table 7: Determinants of growth
The table reports regression results with GDP growth as dependent variable. Ordinary least squares estimation are reported. Independent variables are defined in Table 2. T-statistics are shown in italics. *Significance at 10 per cent level, **significance at 5 per cent level and ***significance at 1 per cent level are reported.

Independent variable	Equation (A)	Equation (B)	Equation (C)
MP	0.933069***		
	4.795567		
LP		0.615647**	
		2.955274	
CP			0.990749**
			3.225829
ULC	-0.450085	-0.751414*	-0.333607
	-1.740076	*-2.245744*	*-0.852636*
USDMUR	-0.659533	-1.072291*	-0.465647
	-1.922124	*-2.42503*	*-0.883113*
LCM	-0.161791*	-0.2156	-0.107782
	-2.187814	*-2.091474*	*-0.971958*
WRI	0.255937*	0.380166**	0.186542
	2.584413	*2.958808*	*1.216782*
INFL	0.247894	0.484057*	0.170596
	1.473468	*2.305998*	*0.666411*

6. References

Jackson, D.A, 1993, Stopping Rules in Principal Components Analysis: A comparison of Heuristical and Statistical Approaches, Ecology, 74(8), 2204-2214.

Klein, R.L. and Ozmucur, S., 2002, The Estimation of China's Economic Growth Rate, Journal of Economic and Social Measurement 28, 187-202.

Lucas, R., 1988, On the Mechanics of Economic Development, Journal of Monetary Economics 22: 3-42.

Lucas, R., 1993, Making a Miracle, Econometrica, 61(2, March):251-72.

Moosa, I., 1986, A Principal Component Approach to the Estimation of Oil GDP in Kuwait, Journal of Social Science 1, 215-224.

Rand, J. and Tarp, F. (2001), Business Cycles in Developing Countries: Are They Different?, Centre for Research in Economic Development and International Trade, University of Nottingham.

Romer, P., 1990, Endogenous Technological Change, Journal of Political Economy 98 (5):S71-S102.

Romer, P., 1986. Increasing Returns and Long-Run Growth, Journal of Political Economy 94(5): 1002-37, 35

The Global Competitiveness Report 2013-2014, World Economic Forum, Geneva.