Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.7, No.4, 2016

Empirical Relationships Between Investment Decisions and Potential Output: The Case of Mozambique

Ibraimo Hassane Mussagy
Catholic University of Mozambique, Faculty of Economic and Managemnet-Beira
Av. Eduardo Mondlane, 149 Ponta-Gêa, PO box 149, Beira

Abstract
This paper focuses on the relationship of investments decisions, in consistence with the endogenous potential output growth hypothesis, in Mozambique. The VAR method was used to make the empirical analysis of potential output and investment decisions between the periods of 1996:1 to 2012:4. The potential output was not an observed variable and it was estimated using the Hodrick-Prescott Filter. The results from the impulse responses from VAR (3) model through the 10 quarters, have shown that the potential output responds positively through the period of analysis to changes in investment. And in the same way investments respond passively to shocks on potential output. This results highlighted important implications for conduction of economic policy as a whole.
Keywords: Aggregate Demand, Potential output and Investment.

1. Introduction

Mozambique has made a very significant development effort seeking to establish its sustained growth process with economic policy, particularly monetary and fiscal aimed at monitoring the performance of the economy by way of short-term fluctuations.

During the 80's Mozambique introduced Structural Adjustment Programmes, promoted by the World Bank and International Monetary Fund, to restructure the economy and reducing government intervention. These policies aim to achieve long-term or accelerated economic growth and low inflation. (http://www.imf.org/external/np/pfp/1999/mozam/).

According to Blinder (1997) monetary policy neo-Keynesian used by central banks provides that increases in inflation arise from differences between actual gross domestic product and potential. To this end, the potential output can be defined as the ability to produce goods and services the economy at levels that do not generate inflationary pressures. They are used for such purpose as the concepts of NAIRU (Non-Accelerating Inflation Rate of Unemployment) and NAICU (Non-Accelerating Inflation Rate of Capacity Utilization). These concepts have been extensively discussed in the economic literature: Sawyer (2002), Lanzafame (2010), León-Ledesma and Thirlwall (2002).

Therefore, those responsible for economic policy must monitor the performance of the economy and meet its growth potential by controlling the effect of fluctuations generated on the demand side in the short term (Moreira, 2011). On this side, one of the components that have highlighted and which has been responsible for the economic performance in Mozambique's investment.

Since the 90s the country has experienced remarkable levels of investment. The legal framework pertaining to the realization of national and foreign investment establishes a set of guarantees and incentives to promote investment in Mozambique, which can be referenced in three large groups: protection of property rights, transfer of funds abroad and fiscal incentives and customs. During 1996-98, the economy grew at an annual average rate of 10 percent. Growth was fostered by political and economic stability; structural reforms, including the privatization of state enterprises and banks; substantial foreign aid inflows; and favorable weather (http://www.imf.org/external/np/pfp/1999/mozam/).

This paper focuses on an empirical relationship between potential gross domestic product and investment decisions and the implications for monetary policy. It also highlights the gross domestic product growth changes caused by demand shocks. It is not the subject of this work to analyze the fluctuations arising on the supply side and the technical discussion of potential gross domestic product estimation methods.

2. Related Literature

2.1. The Structural Model

The structural model applied in this study is the endogenous potential output growth caused by the demand side. It is extensively discussed in this part to clarify the fundamental theory used in the study. Let the gross investment rate be:

$$i_t = \frac{I_t}{Y_t} - \left(\frac{I_t}{Y_t}\right)^* = \upsilon(Y_{t-1} - Y^P{}_{t-1}) \text{, given } \upsilon > 0 \quad (1)$$

The expression (1) shows that the gross investment rate deviations (i_t) are a positive function of the lagged output growth gap $(Y_{t-1} - Y^P{}_{t-1})$.

There is an accelerator effect in the determination of the potential output growth. And the same gross investment are determining, one period ahead, the capital or potential output formation, such as:

$$Y^P{}_t = Y^P{}_{t-1} + i_{t-1} + \delta_t \quad (2)$$

This equation communicate the role of investment in the potential output growth. Potential output growth in period t ($Y^P{}_t$) is a function of its value in previous period ($Y^P{}_{t-1}$), lagged grow investment rate deviation in previous period (i_{t-1}) and a potential output growth shock (δ_t), that represents productivity changes and investments innovations.

Consider the following:

$$i_{t-1} = 0 \text{ and } \delta_t = 0 \quad (3)$$

Then combining expressions (1) and (2) and endogenous potential output growth function can be represented as follows:

$$Y^P{}_t = Y^P{}_{t-1} + \upsilon(Y_{t-2} - Y^P{}_{t-2}) \quad (4)$$

$\upsilon > 0$ (Condition for the endogenous potential output growth model form the demand side)

The final equation (4) shows that the output growth gap affects potential output growth two periods ahead. It assumes that the output gap is caused by demand fluctuations, inducing higher gross investment rates above that level considered desirable in past periods.

In conclusion, the endogenous potential output growth shows that an impact of investments on the potential output growth can be understood as necessarily a kind of endogeneity from the demand side, as investments are an intrinsic part of aggregate demand. This structural model is pointed by Moreira (2011) in his empirical study conducted in Brazil.

2.2. Empirical Evidence

Libânio (2009) explores the Keynesian idea that aggregate demand matters for economic activity, both in the short and long run. To that extent, it discusses the endogeneity of the natural rate of growth, and presents two empirical exercises: the first one tests for unit roots in output for 12 Latin American countries using panel data. The results suggest that gross domestic product series are non-stationary and therefore shocks (both from supply and demand) have persistent effects in the economy. The second exercise tests the hypothesis of an endogenous natural rate of growth, and suggests that potential output has been influenced by the actual level of economic activity in Latin American countries. This result corroborates the hypothesis that aggregate demand has long-run effects in the economy.

In the same line, Moreira (2011) conducted a research in the Brazilian economy during the period 1971-2010. The study aimed at identifying the long term effects of investments decisions, in consistence with the endogenous potential output growth hypothesis. The theory adopted in the study states that potential output dynamics is endogenous to the demand side. The empirical analysis was based on the adoption of the Vector Autoregressive (VAR) method. The results were consistent with the hypothesis under analysis and have important implications for the monetary policy in particular and for the economic policy as a whole.

In general the studies conducted by Libânio (2009) and Moreira (2011) presents evidences on endogeneity of the natural growth rates. And they have important effects for economic policies.

3. Methodology

This study was conducted in Mozambique and used quarterly time series data for the period 1996-2012. Then the empirical model was run to assess the relationship between investment decisions and the potential output for Mozambique. The model was the same used by Moreira (2012) in his study in Basil. The methodology employed in this study is a quantitative one that involves first performing unit root tests before running the main model of VAR.

3.1. The VAR Methodology

The VAR is commonly used for forecasting systems of interrelated time series and for analyzing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system.

$$X_t = \alpha + A\sum_{i=1}^{k} X_{t-1} + \nu_t \quad (5)$$

Where: X are the endogenous variables vector, α is the equation constants vector, A is the coefficients vector, v_t is the white-noise shocks vector and k VAR model's lag order.

- **ADF Statistical Test**

The variables used in the study are nonstationary. The Augmented Dickey-Fuller (ADF) unit root tests was applied in order to check and make sure that the dependent variable are stationary.

- **Lag Length Criteria**

The optimal lag length for the VAR model is reached based on information criteria, such as Akaike Information Criterion (AIC), Schwarz Criterion (SC) and Hannan-Quinn Criterion (HQ), which are generally adopted as measures of good fitness to the data.

3.2. Variables of the Study

The data we used were taken from the Mozambique National Institute of Statistics (INE) online at (www.ine.gov.mz).

1. **Gross Domestic product (Y)** is the total amount of final goods and services produced by a country in certain period of time, normally one year.
2. **Gross Capital Formation (I)** Gross Fixed Capital Formation, is a macroeconomic concept used as measure of the net investment in an economy.
3. **Potential Gross Domestic product (Yp)** is defined as the maximum level of output that an economy can achieve without generating inflationary pressures. There are several statistical procedures to calculate the potential output but in this study the Hodrick-Prescot (1997) method is used.

3.3. Hodrick–Prescott Filter

Hodrick and Prescott (1997) have developed a statistical technique to estimate a trend of a time series data. Particular, the Hodrick-Prescott Filter is a smoothing method that is widely used among macroeconomists to obtain a smooth estimate of the long-term trend component of a series. The HP filter decomposes a time series data into growth and cyclical components such as: $Y_t = Y_t^g + Y_t^c$, where Y, is the natural log of the gross domestic product, Y_t^g and Y_t^c , are the growth cyclical respectively.

Technically, the Hodrick-Prescott filter is a two-sided linear filter that computes the smoothed series *s* of *y* by minimizing the variance of *y* around *s*, subject to a penalty that constrains the second difference of *s*. That is, the HP filter chooses *s* to minimize:

$$\sum_{t=1}^{T}(y_t - s_t)^2 + \lambda\sum_{t=2}^{T-1}((s_{t+1} - s_t) - (s_t - s_{t-1}))^2 \qquad (6)$$

The penalty parameter λ controls the smoothness of the series σ. The larger the λ, the smoother the σ. As $\lambda = \infty$, *s* approaches a linear trend.

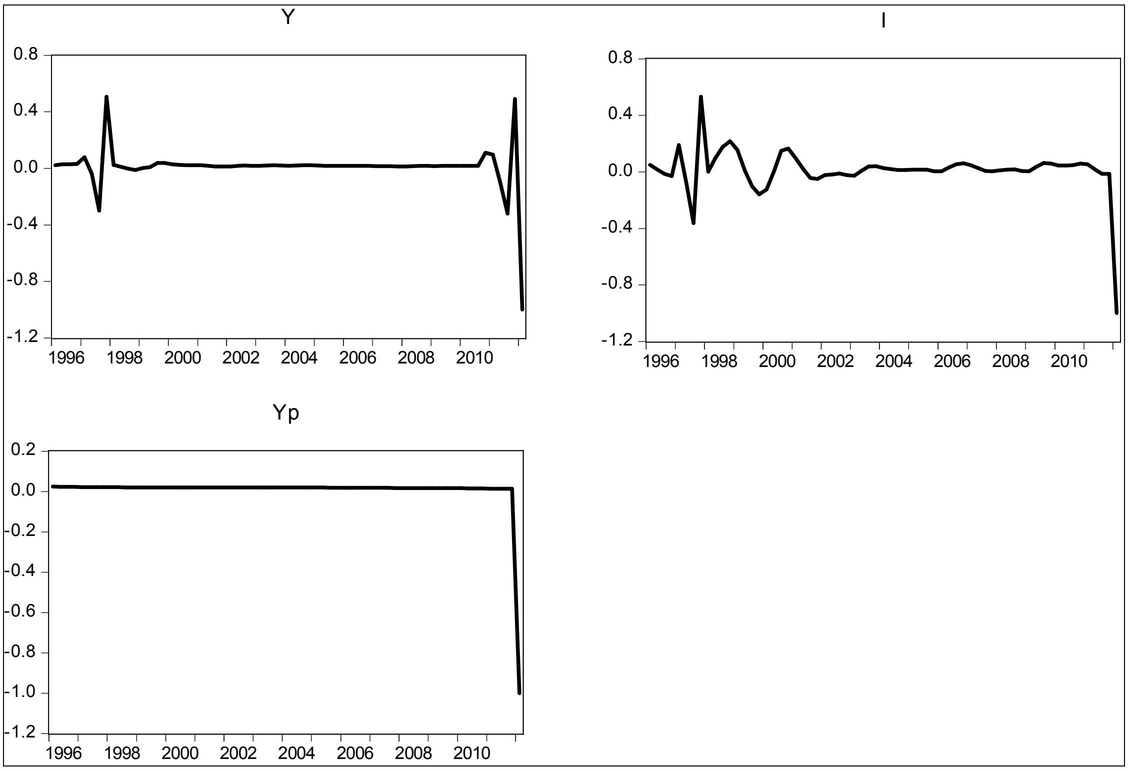
Several studies have used this statistical procedure to estimate the potential output. Some of them are Razzak and Dennis (1999) have used the same method to estimate output gap for New Zealand and Moreia (2011) have used to estimate the potential output.

4. Empirical Analysis

4.1. Time Series Behavior

Figure 1 displays the series over the period of analysis. In the long run, the effective Gross Domestic Product cannot grow at higher average rates than Potential Output (Y_p). This means that the economic growth can be higher or lower than the growth potential in the short term, but on average over longer periods these indicators should coincide. The potential output is a variable not observed and thus have to be constructed from a conceptual theory to be used. Since this Y_p almost stabilizes, according to theory. Note that the Y_p growth rate did not exceed 3% in the period under review. In its turn, annual rate of real change of gross fixed capital formation (I_t) is clearly more volatile than Y_t, and so than Y_{pt}, what is showed by the standard deviation for these variables; this remark is consistent with the styled fact according to which investment cycle presents higher volatility than output cycle.

Figure 2: Growth Rate of the Series



4.2. Stationarity of the Time Series and the Identification of the Optimal Lag

The variables to be used in this study are time series variables which are usually non-stationary. They should be tested for stationarity before running the model. Unit root tests are performed on the following variables: Potential Output (Y_p) and Investment (I_t). The test for the presence of unit roots and identify the order of integration for each variable are presented in Table 1. The stationarity of the data set was performed using Augmented Dickey-Fuller (ADF) and the variables were specified including intercept.

Table 1: ADF Unit Root Test

Variables/Order of Integration	ADF Test Statistics	Critical Value
Yp (II)**	-2.875802	-2.61263
I (II)*	-4.012558	-3.5504

*, **, denote significance at the 1% and 5%

The variables used in the study were stationary through ADF test. The null hypothesis of unit root is rejected with significance at 5%. The ADF statistics in this case suggest that all variables are integrated of order two I(2). These results are fundamental to run the VAR model.

Then the identification of the Optimal Lag was done using the Akaike Information Criterion (AIC), Schwarz Criterion (SC) and Hannan-Quinn Criterion (HQ). Table 3 presents the AIC, SC and HQ statistics for each of the VAR models tested–from VAR (0) to VAR(3), that is, from VAR with lag order equal to zero to VAR with lag order equal to three. The lower the statistics, the better the fitness or adherence to the data. Hence, as it is showed, the VAR (3) with generated better results.

Table 2: VAR Lag Order Selection Criteria

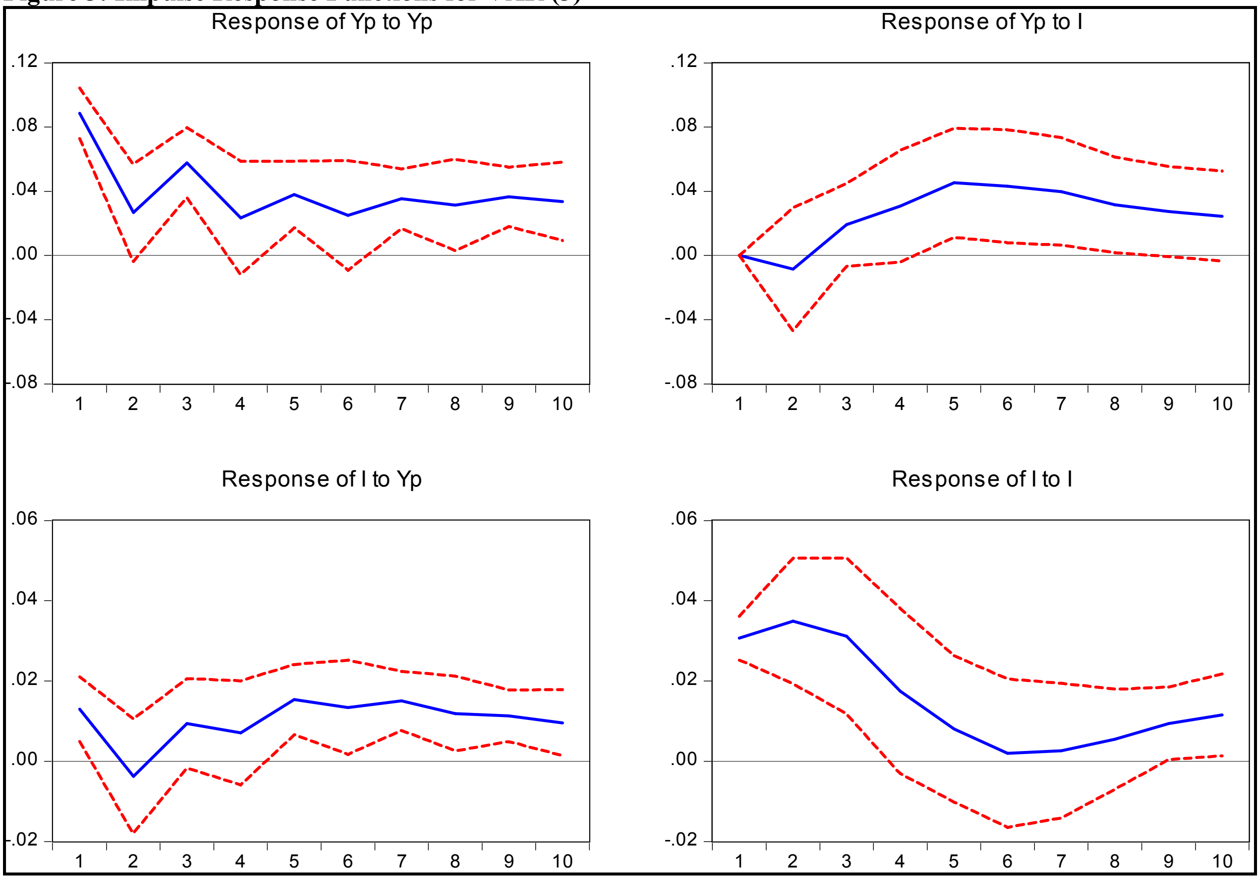
Lags	AIC	SC	HQ
0	-2.853213	-2.784004*	-2.826089
1	-2.846501	-2.638874	-2.765130
2	-2.785775	-2.439730	-2.650157
3	-3.045661	-2.561198	-2.855796*
4	-3.071928*	-2.449047	-2.827815

4.3. Impulse Response Functions and Variance Decomposition

Impulse-response functions (IRFs) measure the dynamic marginal effects of each shock on all of the variables over time. The Cholesky order was firstly establish between the exogenous and endogens variables into the model. The Figure 2 shows the impulse responses from VAR (3) model through 10 quarters.

The IRFs (response of Yp to I_t) reveal that the Potential Output (Y_p) respond positively to Investment (I_t). Although there are some negative fluctuations in the response over the first 2 quarter, it then was positive through the estimation period. Conversely, the response of I positive shock of Y_p are followed by a slightly reduction in the 2 quarter then it stabilizes throughout the period. The empirical results are in line with the expected results shown in the theory.

Figure 3: Impulse Response Functions for VAR (3)



The variance decomposition indicates the amount of information each variable contributes to the other variables in the VAR model. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables.

Table 4 presents the Variance decomposition of Y_p and I_t. In the top of the table the Variance decomposition of Y_p is presented. It is possible to see that the specific results tells that 20% and 30% of future changes in Y_p is due to changes in the I_t in the 5^{th}, 7^{th} period. After 10 quarters from the occurrence of shocks, 67% of the Y_p variance is determined by variations in itself while approximately 33% depends on the I_t changes (Table 3).

Variance decomposition of I_t reveals the less volatile pattern of I_t in comparison of Y_p. The shocks on the 5^{th} and 10^{th} period explained approximately 86% and 74% though fixed capital investment changes, while only approximately 14% and 26%, respectively, are determined by Y_p. In general investment I_t tends to improve the potential output.

Table 4: Variance Decomposition through 10 Quarters

Variance Decomposition of Yp:

Period	S.E.	Yp	I
1	0.088726	100.0000	0.000000
2	0.093056	99.14874	0.851261
3	0.111169	96.45793	3.542069
4	0.117679	90.04706	9.952936
5	0.131682	80.23875	19.76125
6	0.140791	73.34348	26.65652
7	0.150533	69.65972	30.34028
8	0.156964	68.06465	31.93535
9	0.163454	67.76511	32.23489
10	0.168671	67.62355	32.37645

Variance Decomposition of I:

Period	S.E.	Yp	I
1	0.033284	15.15988	84.84012
2	0.048370	7.797575	92.20242
3	0.058305	7.963751	92.03625
4	0.061259	8.530423	91.46958
5	0.063657	13.71036	86.28964
6	0.065082	17.35808	82.64192
7	0.066838	21.49239	78.50761
8	0.068097	23.72579	76.27421
9	0.069660	25.29315	74.70685
10	0.071258	25.97750	74.02250

5. Conclusion

In this paper, the relationship between potential output and of investment has been explored. The endogenous growth model was explored to analyze this relationship. The empirical findings have presented a positive relationship between these two variables. For this purpose, Impulse-response functions for the period of 10 quarters were presented. The results of Impulse-response functions from potential output to investment reveal a positive response to investment shocks and the same positive relationship was found on the shocks from potential output to investment. Therefore, the growth rate of the Mozambican output is important information for the conduct of a public economic policy since it enables the authorities to know how much the country can grow in a sustainable manner consistent with the stable macroeconomic indicators such as inflation unemployment and the output.

6. References

Blinder, A. (1997). Is there a Core of Practical Macroeconomics that we Should all Believe? American Review.

Hodrick, R., & E. C. Prescott, (1997). Post war Business Cycles: An Empirical Investigation. Journal of Money Credit and Banking, 1-16.

IMF site: http://www.imf.org/external/np/pfp/1999/mozam/: accessed in September 2015

Lanzafame, M. (2010). The Endogeneity of the Natural Rate of Growth in the Regions of ITALY. International Review of Applied Economics

Libanio, G. A. (2009). Aggregate Demand and the Endogeneity of the Natural Rate of Growth: Evidence from Latin American Economies. Cambridge Journal of Economics, v. 33, p. 967-984, 2009.

Moreira, R. R. (2011a). Endogenous Potential Output Growth by the Demand Side Through a VAR Model: the Brazilian economy (1971-2010).

Moreira, R. R. (2011b). Flexibility in an Inflation Targeting Regime under Demand Shocks: a Model with Endogenous Potential Output from the Demand Side. Journal of European Economy, v. 10, p. 306-326, 2011.

Mozambique National Institute of Statistics: www.ine.gov.mz: accessed in September 2015.

Razzak W. & Dennis R. (1997). The Output Gap Using the Hodrick-Prescott Filter with a non-constant Smoothing Parameter: an Application to New Zealand. http://razzakw.net/paper5.pdf

Sawyer, M.C. (2002). The NAIRU, Aggregate Demand and Investment. Metroeconomica, 53(1).