Role of government spending on economic growth: an endogenous potential model for Bolivia*

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Abstract

The purpose of this paper is to contribute with an endogenous potential growth model (EPGM) for Bolivia from 1993 to 2012. The empirical evidence suggests that government consumption is the main exogenous determinant on potential growth (EPGM) with differentiated time effects: it accelerates contemporaneously economic growth but it affects negative and dynamically on long-term growth rate. Public and private investments have significant and dynamical degree of substitution (crowding out effect). As complementary analysis, effects of public spending on real effective growth are evaluated.

Keywords: Role of public spending; crowding-out effect; potential output growth; real effective growth.

Resumen

El propósito de este trabajo es contribuir con un modelo de crecimiento endógeno potencial (MCEP) para Bolivia con información desde 1993 al 2012. La evidencia empírica sugiere que el consumo del gobierno es el principal determinante exógeno sobre el crecimiento potencial (EPGM) con efectos difernciados en el tiempo: acelera contemporáneamente el crecimiento económico y afecta de forma negativa y dinámica en la tasa de crecimiento a largo plazo. La inversión pública y privada tienen un grado significativo de sustitución dinámica (efecto crowding-out). Como análisis complementario, se evalúan los efectos del gasto público sobre el crecimiento real efectivo.

Palabras claves: rol del gasto público; efecto desplazamiento; crecimiento del producto potencial; crecimiento del producto efectivo real.

Clasifiación JEL: H50; H54; L38; O11; O23.

1. Introduction

In this paper the role of public spending on trend output growth is evaluated from the perspective of an endogenous growth model for Bolivia focused on potential output as a contribution to the mainstream literature.

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The endogenous growth model (EGM) hypothesizes that productive public spending is one factor that may contribute to real effective growth (Barro, 1990; Romer, 1990). Similarly, public investment is designated as *proxy* of productive public expenditure (Butkiewicz & Yanikkaya, 2011). The support of the EGM hypothesis is based on public investment to promote economic growth by increasing levels in human capital, infrastructure, research and development.

The traditional literature evaluates the effect of public spending on real effective growth by theoretical and empirical level (Li, 2009). From the Keynesian perspective, government spending stimulates aggregate demand; the neoclassical approach assumes that government spending does not affect economic growth (Kaminsky, 2009).

Similarly, there is some theoretical and empirical disgruntled between the sense of causality between government spending and economic growth. For example, while Endogenous Growth Model (EGM) and Keynesian perspective point to public spending as an exogenous factor on real growth; Wagner's law (LW) establishes a reverse terms of causality: economic growth influences on public spending by tax collection and by automatic stabilizers (Ramirez, 2008). Moreover, empirical studies have shown a double causality between economic growth and public spending (Jonas, Lindh & Ohlsson, 1997; Tanzi & Zee, 1997).

The empirical relationship between public expenditure and economic growth is inconclusive (positive or negative effects) (Gaber, Gruevski, & Gaber, 2013); negatively, by the side of government consumption in panels for developed and developing countries (Butkiewicz & Yanikkaya, 2011), it is concluded that there is no causal link between public spending and economic growth for several countries (Dakurah, Davies, & Sampath, 2001); or differentiated effects in time as principal short-term effects (Zagler & Dürnecker, 2003) or negative effects in the short-term and without implications for the long-term (Carter, Craigwell, & Lowe, 2013; Engen & Skinner, 1992).

In addition to empirical confrontations, there is a lack of studies addressing the role of fiscal policy on potential output by two instruments: government consumption and public investment. As consequence, this paper seeks to answer the following questions: What are the effects of fiscal policy on potential growth? What are the temporal implications of public spending in contemporary and dynamic effects on economic growth?

As an additional objective, the role of public spending on private investment is evaluated, whose influence can be of three types: a) positive by accelerating economic activity *(crowding - in*); b) negative which implies a shift on private investment *(crowding - out)* (Mountford & Uhlig, 2009); c) neutral.

Fiscal policy is efficient when public investment achieves a significant positive impact on private investment (Dhumale, 2000). An adittional design of efficient fiscal policy is added when public spending has positive and significant implications on potential output effect.

Consequently, the document is divided into four sections: the first deals with the theoretical argumentations included in the endogenous growth model (EGM); the second comprises the data and methodology used; the third section provides the results and findings of the investigation; the fourth section covers the discussion, limitations and challenges for future research. Finally, the main conclusions of the paper are issued.

2. Theoretical foundations: an endogenous potential growth model

Keynes proposed the separation of public expenditure on current and capital spending for purposes of economic analysis (Ramirez, 2008). First, government consumption, comprising part of current expenditure, can hinder and negatively affect economic growth (Zagler & Dürnecker, 2003; Barro, 1991). Second, public investment can positively influence on economic growth (Barro, 1990).

There is some consensus that exist differentiated impacts of fiscal instruments on economic growth: current expenditure has no return in time; however, capital spending has a long-term effect by infrastructure investment (Auschauer, 1989; Becerril, Alvarez, Moral, & Vergara, 2009).

Consequently, the endogenous growth model − in terms of Barro (1990) − assumes that the real growth is a function of private capital stock and the flow of public goods provided by the government:

$$Y_t = A * K_t^{\beta} * G_t^{\gamma} \quad (1)$$

Where is a constant interpreted as the productivity of the economy; β and γ symbolize the respective contribution of each factor, which sum represents the total return of the factors of production.[1]

If it is assumed the existence of one vector of control variables that can influence on economic growth related to exchange rate, trade liberalization and natural resources rents, similarly, it is considered the existence of multiplicative cyclical *and stochastic* factors, following the next equation:

$$Y_t = A * K_t^{\beta} * G_t^{\gamma} * Z_{it}^{\delta_i} * \varsigma_t * \varepsilon_t \quad (2)$$

Then, assuming that real output (*Yt*) is compounded by three multiplicative factors: trend or long-term (τ_t), cyclical (ς_t) and stochastic element (ε_t):

$$Y_t = \tau_t * \varsigma_t * \varepsilon_t \quad (3)$$

1 In the strict sense of Barro (1990), it is assumed that the actual output of the economy shows yields at constant scale : an increase of 1% in factor levels produces an positive effect variation of 1% in real output. Eventhough this restriction is questionable: the economy may have decreasing scale returns.

Equating (2) and (3), the exogenous variables of endogenous potential output are determined as a measure of trend growth:

$$\tau_t = A * K_t^{\beta} * G_t^{\gamma} * Z_{it}^{\delta_i} \quad (4)$$

In advance, a positive effect of private investment on potential output is expected (β > o). Similarly, it is expected a positive and significant impact of public expenditure on potential output (γ>0). The sign and statistical significance of represents the technological change that affects the average potential growth.

The importance of addressing the major determinants of potential output focuses on comparison between the long-term rate and the production possibility frontier (PPF): the final target of fiscal policy is based on accelerating the trend growth and the factors that impact toward positive potential output or to maximize rate economic growth in balance.

To complement this, the topic relevance focuses on capacity growth for the long run in the order of endogenizing fundamental decisions that explain economic growth (Gallego & Johnson, 2001), and the role exerted by controversial public spending impact on economic growth.

3. Data & methodology

Data were obtained from official sources in Bolivia (INE, Central Bank of Bolivia, UDAPE). Quarterly information was used from 1990 (Q1) to 2014 (Q1) for initial phase; on intermediate stage, there was lost the first and the last eight observations by using band filters; Finally, by considering lags to the adjusted sample the period covered from 1993 (Q3) to 2012 (Q1) [75 observations after adjustment].

According to the expression offered in equation 4, it is considered:

$$\tau_t = f(K_t, G_t, Z_{it}) \quad (5)$$

For potential output (τ_t) there was considered two alternative specifications as proxies on economic growth: a) the Baxter-King filter (1999) and b) Christiano-Fitzgerald filter (2003), whose criterias are employed in applied macroeconomic topics. The purpose of applying two filters is to evaluate the consistency of results (Kydland & Prescott, 1990).

As a first explanatory variable (K_t), gross private capital formation was used $\left(\frac{Priv.Inv.}{Y}\right)_t$-in percentage of GDP as ratio of functional productivity of capital stock of private sector.

As second explanatory element (G_t), government consumption $\left(\frac{Gc}{Y}\right)_t$ and public investment $\left(\frac{Pub.Inv.}{Y}\right)_t$-both variables were used in percentage of GDP – in order to measure functional productivity of each fiscal policy instrument.

As control variables (*Zit*) or alternative explanations on potential output, three variables were included: 1) trade openness ($openn_t$), (exports and imports in terms of GDP) (Butkiewicz & Yanikkaya, 2011; Li, 2009 .; Bojanic, 2013); 2) the real effective exchange rate that captured effects of monetary and exchange rate policy (Znanstveni, 2008) and as a measuring of assessing aggregate demand shocks (An & Kim, 2010); 3) oil prices reflected the impact of the global economy as well as a *proxy* of export prices of Bolivian natural gas (indexed to oil prices).

The omission of the control variables can mislead to different conclusions about the phenomenon of explanation (Wooldridge, 2010). All variables considered were seasonally adjusted by ARIMA Census X-12 method multiplicative.

The next step was to analyze the order of integration in variables, which have varying degrees: a) government consumption was the only variable that showed a stationary behavior in levels [I(0)]; all other variables were stationary after making one difference [I(1)] *(see Annex 1).*

From a dynamic perspective, different degrees of integration can not allow estimating dynamic models of long-term (cointegration, vector error correcting models); therefore, it was preceded to model contemporary short-term effects (VARs).

A] Contemporary effects: an endogenous growth potential model (EGPM)

Carrying equation 4 to a linear equation with appropiated order of integration [I(d)], it arised:

$$g_t^p = \alpha + \beta\, g_t^K + \gamma_1 log\left(\frac{Gc}{Y}\right)_t + \gamma_2\, g_t^{Pub.Inv.} + \delta_i \ln Z_{it} \qquad (5)$$

In (5) it is pointed: the potential output growth (g_t^p) interpreted as the trend growth or long term rate; the growth of private investment (g_t^K) as a share of GDP; the logarithm of government consumption $\left(\frac{Gc}{Y}\right)_t$ as a share of GDP; growth in public investment as a share of GDP($g_t^{Pub.Inv.}$); a vector of control variables formed by the growth in trade openness (g_t^{openn}), the change in the real effective exchange rate (g_t^{reer}) and growth in oil prices($g_t^{Oil\ Prices}$).

In order to evaluate the consistency of results, the model (5) was estimated using four econometric methods: a) Ordinary Least Squares (OLS); b) Generalized Linear Model (GLM) c) Robust Least Squares (RLS); d) Stepwise Least Squares (SLS)[2] .

B] Dynamic effects by an unrestricted Vector autoregressive model (VAR)

2 Backward explanatory variables were selected according to the level of statistical significance (probability less than or equal to 10%).

The endogenous growth model has two limitations: 1) it measures contemporary effects (in the same period) omitting dynamic effects; 2) it assumes a strong exogeneity for exogenous variables.

However, there may be multi-causality relationship between variables, so it is possible to evaluate the Wagner's Law or endogenous growth: government spending affects economic growth or viceversa? Besides it posible to consider dynamic impacts of government spending on private investment (some time later). An unrestricted VAR model with generalized impulse was considered for a vector of five endogenous variables :

$$y_t = \left\{ \left(\frac{Gc}{Y}\right)_t,\ g_t^{Pub.Inv.},\ g_t^K,\ \boldsymbol{g_t^p},\ g_t^{reer} \right\} \quad (6)$$

Within the vector of endogenous variables the real exchange rate was included and it was evaluated as one element of monetary-exchange policy that absorbe or generate fluctuations over the rest variables of the system (Farrant & Peersman, 2006; An & Kim, 2010). In the unrestricted VAR model, trade openness and oil prices were exogenous variables in the model.

To choose the size of lag VAR model, the criterion of *Akaike* was selected which recommended an optimum size in six lags [VAR (6)] *(see Annex 2)*. The relevance of this approach was to capture the fourth quarter, essential for quarterly models in meeting the specification assumptions *(see Annex 3).*[3]

It also was evaluated *an alternative specification* in (6), including the growth of real effective output (g_t^{effect}) instead of potential growth (g_t^p). The purpose of the alternative specification was not only to analyze the interrelationship between the role of public spending and real effective growth but also other significant determinants on economic growth (causality short-term):

$$y_t = \left\{ \left(\frac{Gc}{Y}\right)_t,\ g_t^{Pub.Inv.},\ g_t^K,\ \boldsymbol{g_t^{effect}},\ g_t^{reer} \right\} \quad (7)$$

4. Findings and results

4.1. Results of contemporaneous effects on potential output growth

According to results presented in Tables 1 and 2, it was shown that government consumption positively influenced, at 1% of significance level, as the main contemporary determinant on potential growth. An increase of +1% of government consumption to GDP-positively increased the rate of potential output growth between 0.08 and 0.10% -.

Moreover, public investment and private investment exerted a similar, positive and significant contribution to potential growth (at 1% of signifi-

3 For the third VAR specification that considered real effective growth instead of potential growth, Akaike recommended one lag VAR(1); for criterion Likelihood Ratio (LR for its english acronym) VAR model (4) was suggested. In order to avoid problems in the multivariate autocorrelation for secound lag a VAR model with six lags was chosen [VAR(6)].

cance level, respectively); therefore the importance of the variables was the same. Trade liberalization, real exchange rate and oil prices did not influence on growth meaningful by contemporary mechanisim.

Consistency of results was observed by the two alternative measures in potential output growth, Baxter-King and Christiano-Fitzgerald filters, and the same way by four estimation methods: Ordinary Least Squares (OLS) Robust Least Squares (RLS), Generalized Linear Model (GLM) and Stepwise forward regression with Least Squares (SLS).

In three of the four estimation methods, there was observed was a negative and significant constant (at 1% of significance level) which was interpreted as: a) a negative change in the long-term productivity for the Bolivian economy; b) when there is stagnation on public and private investment, lack of government consumption and a closed economy, there is a quarterly contraction of potential output between 0.19 and 0.24%.

For Stepwise Least Square method estimation (SLS): a) the change in productivity of the Bolivian economy is zero; b) an economic stagnation produces zero rate of potential economic growth.

Table 1.
Contemporaneous Effects on potential growth
Measuring 1, Baxter-King filter

Dependent variable: Growth of potential output, Baxter– King Filter.
Adjusted sample: 1993 (Q3) - 2012 (Q1)
Nº observations: 75 after adjutsment

		[A] Ordinary Least Squares (OLS)			[B] Robust Least Squares (RLS)			[C] Generalized Linear Model (GLM)			[D] Setwise forward Regression Least Square (SLS)		
Variable	Parameter	Coefficient	Standard error	t statistic	Coefficient	Standard error	Z statistic	Coefficient	Standard error	Z statistic	Coefficient	Standard error	t statistic
Constant	α	-0.19***	0.06	-3.08	-0.22***	0.06	-3.46	-0.19***	0.06	-3.08	-0.06	0.09	-0.63
Log (Gov. Cons./ GDP)	γ1	0.08***	0.03	3.25	0.09***	0.03	3.65	0.08***	0.03	3.25	0.08***	0.02	3.25
Growth of Public Invest./GDP	γ2	0.03***	0.01	3.31	0.03***	0.01	2.77	0.03***	0.01	3.31	0.03***	0.01	2.82
Growth of Private Invest / GDP	β	0.03***	0.01	3.22	0.03***	0.01	3.05	0.03***	0.01	3.22	0.02***	0.01	2.97
Growth of Trade Openness/ GDP	δ1	-0.02	0.02	-1.53	-0.02	0.02	-1.25	-0.02	0.02	-1.53	-0.02	0.01	-1.32
Δ Real effective exchange rate	δ2	0.03	0.03	1.23	0.03	0.03	1.14	0.03	0.03	1.23	0.02	0.03	0.80
Growth of Oil Prices	δ3	0.00	0.01	0.10	0.00	0.01	-0.18	0.00	0.01	0.10	0.00	0.01	0.56
Number of autoregressive terms		5			5			5			5		
Number of impulse variables		1			1			1			1		
Number of lagged variables		0			0			0			1		
R^2 ajusted		0.58			0.41						0.59		
Prob. Jarque - Bera		0.80			0.44			0.80			0.84		
Prob. B–G (LM, 1 lag, F Statist.)		0.10									0.08		
Prob. B–G (LM, 2 lags, F Statist.)		0.27									0.18		
Prob. No Heterosk.(ARCH, 1 lag)		0.25									0.53		
Prob. No Heterosk.(ARCH, 2 lags)		0.31									0.81		

Significance level: *** al 1%; ** at 5%; † at 10%..

In [D] there was introduced from 1 to 4 lags for every explainable variable.
The normality test *Jarque-Bera* evaluates the null hypothesis (Ho) of normal distribution in residuals. *Breusch Godfrey* (B-G) test evaluates the null hypothesis of no serial correlation (no autocorrelation) for one and two lags in residuals. The ARCH test evaluates the null hypothesis of homoscedasticity (no heteroskedasticity) for one and two lags of respective form by using the F statistic. In every case, the null hypothesis (Ho) is rejected if the probability is less than 5%. Each model meets the econometric specifications when no Ho is rejected.

Table 2
Contemporaneous Effects on potential growth
Measuring 2, Christiano-Fitzgerald filter

Dependent variable: Growth of potential output, Christiano– Fitzgerald Filter.
Adjusted sample: 1993 (Q3) - 2012 (Q1)
N° observations: 75 after adjutsment

		[A] Ordinary Least Squares (OLS)			[B] Robust Least Squares (RLS)			[C] Generalized Linear Model (GLM)			[D] Setwise forward Regression Least Square (SLS)		
Variable	Parameter	Coefficient	Standard error	t statistic	Coefficient	Standard error	Z statistic	Coefficient	Standard error	Z statistic	Coefficient	Standard error	t statistic
Constant	α	-0.22***	0.06	-3.86	-0.24***	0.06	-4.13	-0.23***	0.06	-4.05	-0.10	0.08	-1.21
Log (Gov. Cons./ GDP)	γ1	0.09***	0.02	4.07	0.10***	0.02	4.35	0.10***	0.02	4.24	0.10***	0.02	4.35
Growth of Public Invest./GDP	γ2	0.03***	0.01	3.18	0.02***	0.01	2.65	0.03***	0.01	3.06	0.02***	0.01	2.80
Growth of Private Invest / GDP	β	0.02***	0.01	3.45	0.03***	0.01	3.51	0.02***	0.01	3.30	0.03***	0.01	3.53
Growth of Trade Openness/ GDP	δ1	-0.01	0.01	-0.76	0.00	0.01	-0.30	-0.01	0.01	-0.70	-0.01	0.01	-0.39
Δ Real effective exchange rate	δ2	0.02	0.02	0.80	0.03	0.02	1.15	0.02	0.02	1.00	0.01	0.02	0.37
Growth of Oil Prices	δ3	0.00	0.01	-0.08	0.00	0.01	-0.14	0.00	0.01	-0.15	0.01	0.01	0.86
Number of autoregressive terms		5			5			5			5		
Number of impulse variables		3			3			3			3		
Number of lagged variables		0			0			0			1		
R^2 ajusted		0.65			0.44						0.68		
Prob. Jarque - Bera		0.96			0.27			0.89			0.71		
Prob. B–G (LM, 1 lag, F Statist.)		0.30									0.28		
Prob. B–G (LM, 2 lags, F Statist.)		0.55									0.55		
Prob. No Heterosk.(ARCH, 1 lag)		0.48									0.47		
Prob. No Heterosk.(ARCH, 2 lags)		0.85									0.68		

Significance level: *** al 1%; ** at 5%; † at 10%..

In [D] there was introduced from 1 to 4 lags for every explainable variable.

The normality test Jarque-Bera evaluates the null hypothesis (Ho) of normal distribution in residuals Breusch Godfrey (B-G) test evaluates the null hypothesis of no serial correlation (no autocorrelation) for one and two lags in residuals . The ARCH test evaluates the null hypothesis of homoscedasticity (no heteroskedasticity) for one and two lags of respective form by using the F statistic. In every case, the null hypothesis (Ho) is rejected if the probability is less than 5%. Each model meets the econometric specifications when no Ho is rejected.

4.2. Causality and results of dynamic effects

The next step was to explain the direction of causality relationship between government spending and economic growth (potential and effective real rate) by controlling other alternative explanatory factors: private investment, trade openness, real exchange rate and oil prices.

On the Granger causilty sense, the lack of correlation between past values of *X* and no effect on *Y*, it implies the absence of causal influence of *X* on *Y*. Therefore, the Wagner´s Law (WL) states that economic growth proceeds to public spending with greater statistical significance.

According to Table 3, real effective economic growth caused Government consumption at 1% of statistical significance; b) government consumption caused real effective economic growth at 5% of statistical significance; therefore, the hypothesis of bidirectional causality in both variables was not rejected.

Moreover, the endogenous growth model (EGM) indicates that government spending is one explanatory factor on economic growth. The hypothesis of EGM was appreciated for Bolivia from potential prospect: government consumption caused *potential growth* with greater significance statistics (1%) compared to the contrary sense (10% of significance). Finally, public investment caused unidirectionally the real effective economic growth.

In sum, the evidence for Bolivia revealed a causal bidirectionality relationship between government consumption and real effective economic growth; an unidirectional causality from government consumption to potential growth (Endogenous Potential Growth Model, EPGM). On the side of public investment, a one-way causality mechanism was evident: the real effective economic growth was caused by public investment.

From a dynamic perspective and in order to generalize the results in impulse-response functions, Table 4 summarizes the dynamic role of public spending by considering three specifications on economic growth: two specifications for potential growt [*measuring 1*: Baxter-King filter (BK), *measuring 2*: Christiano-Fitzgerald filter (CF)]; an alternative measure of economic growth was related to real effective growth.

The results indicated that government consumption had a positive and significant impact on real effective growth (quarter 1) and negative effect on potential growth (quarters 4 and 5 by generalized impulses).

Moreover, the impact of public investment were evaluated: a) it did not consistently influence on potential growth (in both answers); b) it had no effects on real effective growth; c) Public investment generated a significant negative impact on private investment in Bolivia; thus *crowding-out* effect was observed over a quarter after a positive shock have occurred in public investment (for every model specification).

Table 3
Granger Causality test
Ho: Explainable variables do not cause Granger dependent variables

	Model a) Growth of real potential output (BK)	**Modelo b)** Growth of real potential output (CF)	**Modelo c)** Growth of real effective output
Number of lags in VAR model	6	6	6
Criterion of lag size	Akaike	Akaike	No autocorrelación
Dependient variable: Log (Gov. Consumption / GDP)		χ^2	
Growth of Public Investment/ GDP	4.40	4.75	5.70
Growth of Private Investment/ GDP	4.68	4.05	16.94***
Growth of real output	11.27†	10.76†	29.40***
Δ Real effective exchange rate (reer)	2.79	2.67	7.69
All variables	24.37	23.73	49.20***
Dependent variable: Growth of Public Investment/ GDP		χ^2	
Log (Gov. Consumption / GDP)	12.32†	11.57†	13.61**
Growth of Private Investment/ GDP	5.47	5.76	8.74
Growth of real output	5.22	4.57	4.25
Δ Real effective exchange rate (reer)	7.92	7.43	8.46
All variables	25.70	24.75	27.66
Dependent variable: Growth of Private Investment/ GDP		χ^2	
Log (Gov. Consumption / GDP)	3.45	3.29	3.78
Growth of Public Investment/ GDP	0.21	0.50	1.71
Growth of real output	10.09	8.76	7.20
Δ Real effective exchange rate (reer)	7.07	6.70	7.46
All variables	25.43	20.47	20.12
Dependent variable: Growth of real output		χ^2	
Log (Gov. Consumption / GDP)	17.10***	17.82***	16.29**
Growth of Public Investment/ GDP	9.60	10.57	14.46**
Growth of Private Investment/ GDP	4.25	4.79	4.33
Δ Real effective exchange rate (reer)	6.40	6.46	3.65
All variables	35.21†	36.32†	38.91**
Dependent variable: Δ Real effective exchange rate (reer)		χ^2	
Log (Gov. Consumption / GDP)	3.99	3.98	7.76
Growth of Public Investment/ GDP	2.06	1.70	2.58
Growth of Private Investment/ GDP	3.62	3.19	2.57
Growth of real output	4.29	3.97	8.96
All variables	16.70	16.28	23.60

It is rejected null hypothesis with different significance level: *** at 1%; ** at 5%; † alt 10%.

Additionally, a positive perturbation of private investment influenced negatively on public investment growth, which indicates the degree of substitution, negative and significant, between both types of investments.

Dynamically, private investment did not generate any impact on potential growth and private investment significantly appreciated the real exchange rate. However, the positive effect of private investment on real effective growth was observed.

By assessing the role of exchange-monetary policy, the real exchange rate did not influence on economic growth (neither potential nor effective growth), it did not absorb fluctuations on effective and potential growth; b) the real exchange rate generated negative shocks on private investment growth.

By generalized perspective, government consumption moved in the same direction as real effective growth, showing procyclicality of government consumption to effective growth and acyclic orientation with potential growth (neutral response). Public investment was neutral to economic growth in both effective and potential rates (acyclic orientation of public investment).

In sum, dynamic effects for Bolivia indicate that greater participation in government consumption positively influenced on effective growth and negatively on potential growth; public investment generated no impact on economic growth (neither effective nor potential rates) as well as displacement effect on private investment growth.

There were different effects on cyclical orientation for each type of public spending. From the perspective of real effective economic growth, government consumption responded procyclically and public investment was neutral to business cycle. From the perspective of potential growth, the fiscal policy in Bolivia was neutral to business cycle (acyclical) in both fiscal instruments: government consumption and public investment.

Table 4
Summary of dynamic effects, degree of significance per quarter

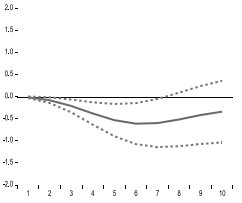
			Impulses:				
			Shock of Gov. Consumption/ GDP.	**Shock of Public Invest./ GDP**	**Shock of Private Invest. /GDP**	**Shock in accelerating Economic Growth**	**Shock in monetary – exchange policy**
Responses:	Gov. Consump./ GDP			(+)*** (1) (+)*** (1) (+)*** (1)	N.S. N.S. N.S.	N.S. N.S. (+)*** (1)	N.S. N.S. N.S.
	Growth of Publ. Inv./ GDP		(+)*** (1) (+)*** (1) (+)*** (1)		(-)*** (1) (-)*** (1) (-)*** (1, 4 & 6)	(-)*** (2) (+)*** (1) N.S.	N.S. N.S. N.S.
	Growth of Private Inv./ GDP		(-)*** (1) (-)*** (1) N.S.	(-)*** (1) (-)*** (1) (-)*** (1, 2)		N.S. N.S. (+)*** (3 to 7)	(-)*** (1 to 2) (-)*** (1 to 2) (-)*** (1 to 2)
	Economic Growth	Potencial (BK) Potencial (CF) Efectivo real	(-)*** (4 to 7) (-)*** (4 to 5) (+)*** (1)	N.S. (-)*** (3 to 5) (-)*** (2)	N.S. N.S. (+)*** (1 to 2)		N.S. N.S. N.S.
	Δ Real effective exchange rate		(+)*** (5 to 7) (+)*** (5 to 7) N.S.	N.S. N.S. N.S.	(-)*** (1 to 4) (-)*** (1 to 4) (-)*** (1 to 4)	(-)*** (1 to 5) (-)*** (1 to 3) N.S.	

Impacts: (+) positive; (-) Negative; *** Statistically significant in two bands of trust; NS = not significant.
Number of quarters in brackets with statistical significance.
Three models specifications are presented: a) the first row corresponds to the specification that includes growth in potential output (baxter-King, BK); b) the second row corresponds to the specification in potential output (Christiano-Fitzgerald, CF); c) the third row corresponds to the specification in real effective economic growth (real GDP changes).

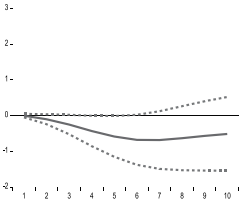
Figure 1
Panel impulse-response (accumulated and generalized)
Public spending on economic growth (potential and effective)

Panel A. Dynamic effects of Gov. consumption on economic growth.

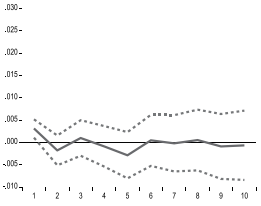
a.1) Resp.of potential economic growth *Measuring 1, Baxter–King*



a.2) Resp. of potential economic growth *Measuring 2, Christiano-Fitzg.*

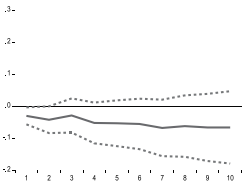


a.3) Resp.of real effective growth

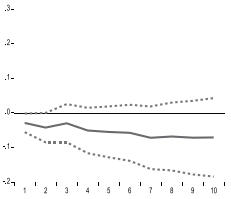


Panel B. Dynamic effects of government consumption on private investment.

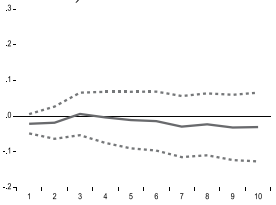
b.1) Model 1



b.2) Model 2



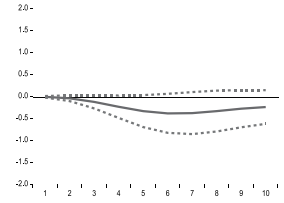
b.3) Model 3



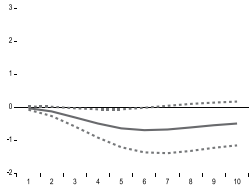
Model 1 includes potential growth (measuring 1,Baxter-King); Model 2 includes potential growth (measuring 2, Christiano-Fitzgerald); Model 3 includes real effective economic growth.

Panel C. Dynamic effects of public investment on economic growth.

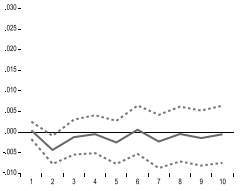
a.1) Resp. of potential economic growth *Measuring 1, Baxter–King*



a.2) Resp. of potential economic growth *Measuring 2, Christiano-Fitzg.*

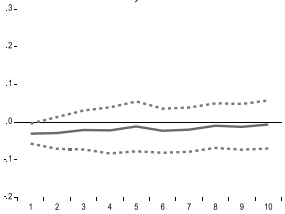


a.3) Resp. of real effective growth

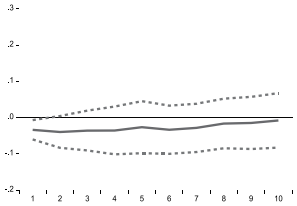


Panel D. Dynamic effects of public investment on private investment.

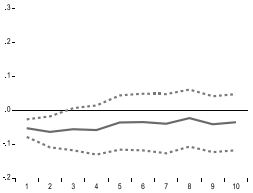
d.1) Model 1



d.2) Model 2



d.3) Model 3



Model 1 includes potential growth (measuring 1,Baxter-King); Model 2 includes potential growth (measuring 2, Christiano-Fitzgerald); Model 3 includes real effective economic growth.

4.3. Importance of disturbances on economic growth

In order to assess the relevance of shocks that influence on trend output or so called potential growth, an analysis of Cholesky decomposition of variance was performed. The results in Table 5 indicated that for medium term-within 12 to 20 quarters-changes in the share of government consumption (as a percentage of GDP) generated from 34 to 36% of the variability in the rate of potential growth and 31% of variation on the real effective growth rate; these results indicate that economic growth (in potential and effective rates) were affected by one-third (1/3) from changes caused by government consumption.

Table 5
Decomposition of Variance of the economic growth rate

Descomposition of variance of potential growth rate
(Measuring 1, Baxter– King filter)

Quarter	Share of gov. consump. to GDP	Growth of publ. inv./ GDP	Growth of private inv./ GDP	Economic growth	Δ Real effective exchange
4	39	8	2	49	2
8	38	17	8	35	2
12	36	15	8	36	4
16	36	15	8	36	4
20	36	15	9	36	4

Descomposition of variance of potential growth rate
(Measuring 2, Christiano– Fitzgerald filter)

Quarter	Share of gov. consump. to GDP	Growth of publ. inv./ GDP	Growth of private inv./ GDP	Economic growth	Δ Real effective exchange
4	37	7	3	51	2
8	37	16	9	37	2
12	35	14	9	38	4
16	35	14	9	38	4
20	34	14	9	38	4

Descomposition of variance of real effective economic growth rate
(Alternative measuring, Growth of GDP)

Quarter	Share of gov. consump.	Growth of publ. inv./ GDP	Growth of private inv./ GDP	Economic growth	Δ Real effective exchange
4	29	12	7	52	0
8	32	18	7	43	0
12	31	18	8	42	0
16	31	17	8	43	0
20	31	17	9	42	0

According to Table 5, from a dynamic perspective, public investment growth to GDP had greater contribution than private investment growth. Changes in exchange-monetary policy measured by the change in the real effective exchange rate (reer) exerted a change of 2 to 4% on potential growth and 0% of variation on the real effective economic growth. In summary, the monetary-exchange policy in Bolivia did not influence on variations on economic growth.

5. Discussion of results

The related literature revealed that for developing countries-during the 60s to the 80s-government consumption adversely affected on economic growth and government capital spending did not accelerate the rate of economic growth (Landau, 1986).

For the Bolivian economy, government consumption has been the main source of variability in growth for the last two decades (about one third of its rate). However, government consumption affects in different magnitudes to growth: i) it increases the potential growth contemporaneously by increasing trend in actual GDP growth; ii) government consumption has negative impact on potential growth in dynamically mechanimism, how different impacts are explained in time?

A positive shock in government consumption affects positively with greater participation in public investment to GDP, which crowds out private investment over time (inverse relationship), private investment has a positive relationship with the effective growth; therefore, the final expansionary impact of government consumption on trend growth is negative in time (public and private investments are indirect transmission channels).

The results found in this document are consistent with the evidence of displacement effect of public investment on private investment that have been shown in other countries in Latin America (Ramirez & Nazmi, 2003). The findings in this research were contrary to what was stated by Coronado & Aguayo (2002), who found that public investment and private investment in Bolivia were complementary with traction effect or positive effect for period from 1990 to 2000 *(crowding in)*[4] .

From 70s to 90s, private investment most contributed to effective economic growth compared to public investment (Khan & Kumar, 1997) for developing countries; in Bolivia, evidence shows that from the 90s and 2000s, private and public investment have different weights on potential output and effective growth: i) equal contribution by contemporaneous mechanism; ii) dynamically, public investment has generated greater variability on trend rate.

4 The findings of Coronado & Aguayo (2002) are unreliable because of the limited size of their annual sample.

The results for Bolivia are consistent with empirical evidence for developing countries, where an increase on government consumption to GDP (current expenditure) exerts more positive and statistically significant impact on the effective growth compared to a positive change in public investment to GDP (Ghosh & Gregoriou, 2008; Devarajan, Swaroop, & Zou, 1996). The contribution of this paper is to extend the existing theoretical discussion between public spending and economic growth. However, the effects are different in time.

Contemporaneously − in the same quarter- there was evidence an endogenous potential growth model for Bolivia (EPGM) by not rejecting the hypothesis that government consumption and public investment are two determining factors on potential growth.

Dynamically, two theoretical stance indicate an opposite direction between causality of public spending and economic growth: while for endogenous growth model (EGM) government spending -by the consumption side- is an exogenous determiner on economic growth; for the Wagner's law (WL) economic growth causes and influences on government consumption.

In the case of Bolivia, an eclectic result was evident: there is a bidirectional, procyclically relationship, between real effective growth and government consumption; moreover, government consumption causes unidirectionally to potential growth potential (EPGM).

In Bolivia, the fiscal policy plays a mix role: it accelerates the trend growth of the economy as favorable aspect of contemporary form; however, dynamically, government consumption influences with negative growth potential innovations. Finally, a defficient fiscal role comes in Bolivia as a displacement effect of public investment on private investment (crowding-*out*) (Dhumale, 2000).

5.1 Implications for public policy, limitations and future research

The policy implications have similarities to medical science: symptoms and diagnoses are used to identify respective treatments (Weick, 1995). In this regard, the main criticism of the role of public spending is focused on the negative impact of public investment on private investment and no dynamic effect of public investment on economic growth.

The main task for the Bolivian economy consists in defining strategic areas for public investment that complement with private investment: empirical evidence for Bolivia points that both public and private investments have a significant degree of substitution in time.

Within limitations of this paper, results indicate differential impacts of public spending on potential growth and effective economic growth in time (contemporaneous and dynamic effects), suggesting the possible presence of nonlinear effects, eventhough this modeling was not performed. Conse-

quently, the practical question is related to what should be the share of government consumption and public investment in the economy in order to equalize the potential growth and effective rate (zero output gap): how fiscal policy should react to get effective-potential growth?

6. Conclusions

In this paper the role of public spending on trend output was considered by a potential endogenous growth model (EPGM) as additive contribution to the existing literature. Two types of influences were evaluated: a) contemporaneous effects (in the same quarter) and b) Dynamic effects (some time later). Alternatively, the role of public spending on real effective growth was evaluated.

Contemporaneous effects revealed that government consumption was the main determinant on potential growth. This finding was consistent across four methods of econometric estimation [Ordinary Least Squares (OLS), robust least squares (RLS), generalized linear model (GLM) and Stepwise Least Squares (SLS)].

By dynamic modeling (unrestricted VAR), the results showed a mixed efficiency of fiscal role: I) government consumption accelerated the real effective growth (changes on GDP rates); II) it slowed the potential growth of the economy; III) private investment was crowed-out by public investment.

The contemporaneous and dynamical results indicated that the share of government consumption -to GDP- has differentiated effects in time on potential growth: it accelerates growth by contemporary mechanism but it decelerates the economy by dynamic component.

Similarly, the sense of temporal and causal implications between public spending and economic growth were discussed. The evidence for Bolivia, 1993 – 2012, demonstrated an Endogenous Potential Growth Model (EPMG): government consumption caused to potential growth; moreover, there was a procyclical bi-causality relationship between government consumption and real effective growth.

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Annex 1
Order of integration of the variables

Operationalization	Specification	Levels			First difference			Order of integration
		ADF	Ph- P	KPSS	ADF	Ph- P	KPSS	
Log Real output trend, BK	Deterministic trend with drift	-2.33399	-1.077999	0.2012**	-1.061401	-16.59***	0.152684	I(1)
Log Real output trend, CF	Deterministic trend with drift	-2.16048	-1.039051	0.2058**	-1.104222	-16.67***	0.144471	I(1)
Log Real effective output trend	Deterministic trend with drift	-0.28913	-0.923356	0.20764**	-13.88723***	-13.87373***	0.11248	I(1)
Log Gov. Cons./ GDP	With drift	-4.922***	-9.3385***	0.67657				I(0)
Log Publ. Invest./GDP	With drift	-2.804572	-2.593217	0.408975	-12.22306***	-14.10382***	0.158677	I(1)
Log Priv. Invest./ GDP	With drift	-2.14379	-2.37698	0.123004	-8.5636***	-8.6007***	0.089226	I(1)
Log Opennes Trade	With drift	-1.84948	-1.354598	1.023***	-9.191646***	-13.7874***	0.067368	I(1)
Log Reer	With drift	-1.98697	-2.357801	0.296037	-7.953434***	-8.011919***	0.04893	I(1)
Log Oil Prices	With drift	-0.25553	-0.568764	1.171078**	-6.249217***	-7.608775***	0.104693	I(1)

BK = Baxter–King filter; CF = Christiano & Fitzgerald Filter; Log = Natural Logarithm; Reer = Real effective exchange rate ; Opennes trade correspond to sum of exportations and importations in terms of GDP [(X+M)/GDP].
Significance level: *** at 1%; ** at 5%.
Augmented Dickey–Fuller test (ADF) and Phillips– Perron (Ph-P) evaluate the null hypothesis of unit root (every serie is not stationary) ; Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test evaluates the null hypothesis of stationary serie.

Annex 2
Selecting the optimal lag size for the unrestricted VAR model

MODEL 1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	689.65	NA	0.00	(18.21)	-17.42517*	-17.89697*
1	724.14	59.52466*	6.61e-15*	(18.47)	(16.90)	-17.84428
2	746.91	36.19	0.00	(18.41)	(16.06)	(17.47)
3	767.91	30.49	0.00	(18.30)	(15.16)	(17.05)
4	793.91	34.19	0.00	(18.33)	(14.40)	(16.76)
5	820.31	31.10	0.00	(18.36)	(13.66)	(16.49)
6	850.69	31.63	0.00	-18.51213*	(13.02)	(16.32)
7	867.59	15.27	0.00	(18.29)	(12.01)	(15.79)

MODEL 2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	689.68	NA	0.00	(18.21)	-17.42590*	-17.89771*
1	723.60	58.55	6.71e-15*	(18.45)	(16.89)	-17.82956
2	747.85	38.53910*	0.00	(18.43)	(16.08)	(17.50)
3	769.38	31.26	0.00	(18.34)	(15.20)	(17.09)
4	794.59	33.16	0.00	(18.34)	(14.42)	(16.78)
5	821.01	31.12	0.00	(18.38)	(13.68)	(16.51)
6	850.60	30.81	0.00	-18.50959*	(13.02)	(16.32)
7	865.20	13.20	0.00	(18.22)	(11.95)	(15.72)

MODEL 3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	748.84	NA	0.00	(18.10)	-17.35173*	-17.79767*
1	780.59	55.56	8.09e-15*	-18.26479*	(16.78)	-17.6679
2	803.36	36.99	0.00	(18.21)	(15.98)	(17.31)
3	823.28	29.88	0.00	(18.08)	(15.10)	(16.89)
4	853.79	41.95675*	0.00	(18.22)	(14.50)	(16.73)
5	868.58	18.48	0.00	(17.96)	(13.50)	(16.17)
6	898.09	33.20	0.00	(18.08)	(12.87)	(15.99)
7	921.43	23.35	0.00	(18.04)	(12.08)	(15.65)

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Annex 3
Compliance of econometric assumptions: Three unrestricted VARs

	Model 1		Model 2		Model 3	
	Statist.	Prob.	Statist.	Prob.	Statitst.	Prob.
1) Normality, Jarque- Bera Statistic.	10.45	0.40	12.41	0.26	11.86	0.29
2) Heteroskedasticity, Residual VAR test	966.72	0.70	956.20	0.77	950.17	0.81
3) LM Autocorrelation for number of lags						
1	21.24	0.68	17.54	0.86	16.89	0.89
2	23.82	0.53	23.10	0.57	25.27	0.45
3	15.79	0.92	16.47	0.90	17.21	0.87
4	24.59	0.49	28.80	0.27	24.51	0.49
5	25.03	0.46	22.48	0.61	25.41	0.44
6	23.63	0.54	24.27	0.50	26.13	0.40
7	16.12	0.91	17.61	0.86	16.00	0.91
4) Stability of VAR Model	No root lies outside of the unit circle, VAR satisfies the stability condition.		No root lies outside of the unit circle, VAR satisfies the stability condition.		No root lies outside of the unit circle, VAR satisfies the stability condition.	

The Jarque-Bera test evaluates the null hypothesis (Ho) of multivariate normal distribution in residuals. Heteroskedasticity test evaluates the null hypothesis of multivariate homoscedasticities (no Heteroskedasticity) in VAR residuals. The autocorrelation LM test the null hypothesis of no serial correlation in multivariate way (no autocorrelation) by number of lags (from 1-7). In all cases, the null hypothesis (Ho) is rejected if the probability is less 5%. Each model gets the econometric specifications when not rejecting Ho (Prob. Greater than 5 or 10%).
In order to achieve a stable VAR model, there should be no polynomial roots outside the unit circle, otherwise the model becomes unstable, explosive and variables do not converge over time.