Public expenditure and economic growth: an analysis for Colombia during the second half of the XX century

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Abstract

This study attempts to shine some light on the relationship between public expenditure and economic growth. In order to do this, the so-called Keynes hypothesis and Wagner's law are used as theoretical framework alongside with Granger's causality. Using several VAR models and disaggregated public expenditure data, we found that Keynes hypothesis holds for the aggregated series and for the social expenditure series, and Wagner's law holds for the infrastructure and government operating expenses series.

Keywords: Granger's causality, Keynes hypothesis, Wagners law, VAR models.

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1 Introduction

Economic growth is a topic that has formed part of public policy agenda and debate in Colombia since, at least, a good portion of the last century (Kalmanovitz, 2010), and the current times are not an exception. Two of the biggest legislative projects of the current government, the Funding Law, and the National Development Plan were sold to the public as an attempt to reactivate the rate of growth of the country: according to the minister of finance and public credit, Alberto Carrasquilla, "The funding law is an attempt to generate sustainable and inclusive growth through three pillars: entrepreneurship, equity and lawfulness"León (2019); likewise, the former director of the National Planning Department (DNP in spanish), Gloria Alonso, said that "The National Development Plan biggest stake is to elevate potential economic growth of the country" Monterrosa (2015). It's a fact that the figures doesn't look too good: for 2014, the growth rate was superior to 4%, but for 2016 and 2017, it didn't reach 2% (Gómez and Higuera, 2018). Even more worrying is the cause for these fluctuations. According to Gómez and Higuera (2018), elevated rates of growth during these decade were the result of expansive fiscal policy impulsed by soaring oil prices, which once stalled, left the country with economic growth sustained on a less than competitive internal market, serious productivity issues, stalled population growth and investment focused on traditional sectors.

Using a growth accounting exercise, Gómez and Higuera (2018) identify serious restrictions to Colombia's economic growth from the three different perspectives that this exercise has to offer: total factor productivity (TFP), labour and capital. In the first place, the TFP has been in average negative since the the country entered the new century which is explained by inadequate public goods provision, rigidity on markets and suboptimal regulation. In second place, labour faces falling growth rates along with inefficient use, due to high informality which is around 50% of the total work force, and is

around 50% less productive than it's formal counter part. Finally, in regards to investment, even though is one of the largest of Latin America in relation to GDP, is strongly biased towards energy and mining industries, with around 50% of direct foreign investment.

It is known that economic growth is not a sufficient condition for economic development because of distributional reasons. But even then, concern about growth rates that share both politicians and researchers is motivated by the clear relationship between growth and the standards of living of citizens on high income countries. Evidence shows that countries with sustained growth rates are also able to reach the highest rates of poverty reduction (Todaro and Smith, 2015).

Some of the elements behind the three barriers to the TPF mentioned before are related to public policy. During the second half of the XX century, Colombia experienced the highest growth rates on recorded history, which overlaps with important growth in public expenditure in relation to the GDP (Colmenares and Ocampo, 2007). Nevertheless, is no evident the existence of a casual relationship, and even if it does exists, what is it's direction. This signals the necessity of clearing the relationship between this two economic phenomena as one of the angles from which to study the problem of economic growth in Colombia.

In this work, this relationship is studied using the statistical concept of Granger's causality, also known as predictive causality, for the second half of the XX century in Colombia. Granger's causality provides a basic if limited framework to study causality in time series where the presence of a counterfactual is not possible and although useful, it's conclusions about true causality should be taken with skepticism. In this study we found that Keynes hypothesis (expenditures causes growth) holds for aggregate series of public expenditure, and for social expenditure; and Wagner´s law (growth causes public expenditure) holds for infrastructure and government operating expenses.

2 Theoretical framework

When studying the relationship between public expenditure and economic growth, the literature uses two theoretical referents which sustain each direction of the relationship: Keynes hypothesis and Wagner's law. In "General theory of interest, employment and money" Keynes proposed fiscal stimulus as an adjustment mechanism to reach full employment and therefore maximize output, with a greater efficacy than that of monetary policy, which suffered from some limitations like agents conventions that affected interest rates (Deleplace and Lavialle, 2008). Wagner's first law holds that as a society reaches industrialization, and middle class expands, citizens demand higher public expenditure in the form of public goods and services, education, regulation, externalities correction, etc. (Albi and Zubiri, 2009). Therefore, Wagner's approach, in contrast to that of Keynes, makes economic growth the exogenous variable in the relationship and public expenditure it's consequence.

Campo and Mendoza (2018) attempt to determine the presence of Keynes hypothesis in Colombia using panel data from a sample of 24 departments from 1984 to 2012. To do this, they estimate a cointegrated panel data model that shows a statistically significant long term relationship between GDP and primary public expenditure (i.e. public expenditure without considering debt payments). On an international level, Loizides and Vamvoukas (2005) study the relationship between GDP growth and public expenditure using Granger's causality for Greece, UK and Ireland from 1948 to 1995. Using a vector error correction model, they find that expenditure causes economic growth in Granger's sense in the short run for the three countries, in the long run for Ireland and the UK and that the relationship is reversed on Greece and UK.

Aggregated time series data for a single country study are also used to investigate this relationship. Avella (2008) study this relationship using a

historical revision of national accounts from 1925 to 2003, and with the help of a VAR model proves that per capita GDP growth causes in Granger's sense public expenditure, therefore proving that Wagner's law hold.

According to Rao (2010) the estimation of growth models using time series for country specific studies has two branches conditional on the type of production function that is to be estimated. The first one concerns exogenous growth models based on seminal Solow's neoclassical growth model, that estimate a Cobb-Douglas production function as a stable equilibrium relationship, and not the rate of growth of GDP because it's determinant doesn't have explanatory variables (it's exogenous). The second one concerns the estimation of endogenous growth models and has four different approaches: the first one uses calibration techniques to analyze the prediction of the models; the second one uses VAR models to analyze predictions; the third one uses estimation of structural parameters for VAR models; and the fourth one concerns models that make ad hoc expansions to the production functions using variables such as human capital, infrastructure, trade openness, etc. Rao (2010) makes a methodological proposal: the use of error-correction models specified using the GETS approach of Hendry for an estimation of both endogenous and exogenous growth models.

Now, to estimate a single equation error-correction model, exogeneity of the independent variables (public expenditure) must be assumed (Johnston and Dinardo, 1997). A more flexible approach is that of vector autoregression (VAR) models, where all the variables are treated symmetrically and therefore no distinction between exogenous and endogenous variables is needed (Enders, 2008). According to Enders (2008) VAR models can be estimated using OLS in each equation while all the variables are stationary. If the variables are not stationary, a VAR in differences should be estimated. Nonetheless, it's possible that a linear combination of random variables is stationary, a property also known as cointegration. If cointegration is present, then a VAR in differences is not correctly specified, and a model that includes the coin-

tegrating relationship (or long-term relationship) should be estimated; this is also known as a vector-error correction (VEC) model, the multi-equation counterpart of Rao's model.

3 Econometric models and estimation

Wagner's law and Keynes hypothesis provide theoretical referents that allow us to suspect simultaneity between the variables, therefore a multiple equation model must be employed. When there is simultaneity in the variables and there is not a clear distinction between endogenous and exogenous variables, a natural modelling framework is vector autoregressions (VAR) or vector error-correction (VEC) models. These models have a non-theoretical construction because it's internal structure is defined using statistical information criteria (Gujarati, 2009). VAR models can be estimated using OLS for each equation (Enders, 2008).

The basic model has the following specification:

$$
\begin{aligned}
y_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{1t} \\
k_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{2t} \\
g^1_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{3t} \\
g^2_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{4t} \\
g^3_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{5t} \\
g^4_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{6t} \\
g^5_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{j=1}^{5} \sum_{i=1}^{p} g^j_{t-i} + e_{7t}
\end{aligned}
$$

Where public expenditure (g) superindex denotes the type of public expenditure (social expenditure, infrastructure, etc). Capital (k) and labour variable (which makes all the variables per capita) are included to make sure a correct specification of the model is achieved.

Following Avella (2008), we attempt to prove the presence of Keynes hypothesis or Wagner's law using Granger's causality. To do this, we must

estimate several models to correctly apply Granger's causality test: a first model containing all expenditure variables disaggregated, to prove the presence of Wagner's law by type of public expenditure, that is similar to the basic model presented above; a second model containing aggregate public expenditure to prove both Keynes hypothesis and Wagner's law; and five more models that contain only one type of public expenditure to prove the presence of Keynes hypothesis by type of public expenditure. The models, other than first, have the following specification, where g_t^j can be any of the five types of public expenditure ($j = 1, ..., 5$) or an aggregate expenditure variable:

$$
\begin{aligned}
y_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{i=1}^{p} g_{t-i}^j + e_{1t} \\
k_t &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{i=1}^{p} g_{t-i}^j + e_{2t} \\
g_t^j &= \alpha_1 t + \textstyle\sum_{i=1}^{p} y_{t-i} + \sum_{i=1}^{p} k_{t-i} + \sum_{i=1}^{p} g_{t-i}^j + e_{3t}
\end{aligned}
$$

If the series are non-stationary, inference on a VAR model with the variables on levels is spurious because the distribution of the parameters doesn't follow the standard distributions (Stock and Watson, 2015). Moreover, if cointegration is present, the estimation of VAR on first difference produces specification bias and a VEC model must be estimated. Nevertheless, Toda and Yamamoto (1995) define a procedure to make inference on a VAR model with non-stationary variables on levels. This procedure consist on the application of a Wald test on a VAR model with correct diagnostic test. A number of lags equal to the biggest order of integration of variables is then added. Yamamoto and Toda show that the number of additional lags allows Wald's statistic to have a chi-squared distribution.

4 Data

The data consist of 9 time series of 47 observations for the period 1950-1996. These variables are: real GDP from Colombia on millions of US dollars from

2011; capital stock of Colombia on millions of US dollars; economically active population on millions; public expenditure on social sector (health, education, agriculture, housing, labour) as GDP percentage; public expenditure on justice and security as GDP percentage; public expenditure on infrastructure as GDP percentage; public expenditure on government operating expenses as GDP percentage; and public expenditure on payment of public debt interest as percentage of GDP.

The first three series were obtained from the ninth version of Penn World Tables. The rest were obtained as nominal amount from chapter 5 of the "Estadísticas Históricas de Colombia" published by the DNP, and with a nominal GDP series from the same database, those were transformed as GDP percentage.

5 Results

Dickey-Fuller augmented tests for unit roots are conducted on the series and the result is that all series are integrated of first order. Next, the Johansen cointegration test was applied and 4 cointegration relationships were found. Therefore, Toda-Yamamoto's procedure to test Granger causality is adequate.

The models were estimated and after the correct specification was obtained after checking diagnostic test (normality and serial correlation tests), Granger causality test was applied. The results were the following:

Model	Causality direction	Hypothesis present
Aggregate expenditure	G$\rightarrow Y$	Keynes hypothesis
Social expenditure	G$\rightarrow Y$	Keynes hypothesis
Infrastructure expenditure	G$\leftarrow Y$	Wagner's law
Defense expenditure	Doesn't exists	
Operating expenditure	G$\leftarrow Y$	Wagner's law
Debt interest expenditure	Doesn't exists	

This implies that public expenditure causes GDP per capita in Granger's sense for the aggregate series but doesn't exists for the opposite direction,

therefore Keynes hypothesis is proved. When disaggregating public expenditure, it can be concluded that: Keynes hypothesis is again proved for social expenditure; and Wagner's law is proved for public expenditure on infrastructure and government operating expenses.

6 Conclusions

This study's objective was to identify the relationship between public expenditure and economic growth for the sample period. Keynes hypothesis and Wagner's law, and the statistical concept of Granger's causality were our tools. the estimated econometric models allow us to conclude that the type of relationship between growth and public expenditure is conditional on the how the latter is measured.

Even though the previous results satisfy our study´s objective, it's necessary to disclaim that the conclusions obtained are limited in nature and can't be used to guide policy. First of all, Granger's causality doesn't say anything about the direction (sign) of the relationship, therefore it's possible that public expenditure causes GDP growth in Granger's sense because it has a negative impact on it. Secondly, Granger's causality is not strictly speaking true causality: it doesn't allow us to conclude that the occurrence of one phenomena always leads to the occurrence of another. Instead it's predictive causality: a variable causes another in Granger's sense because the changes on the former occurred first and it's an useful predictor of the latter. This can lead to a post hoc fallacy.

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