

Do Public Expenditure and Subsidies have an Impact on Chile's GDP?

Pedro V. Piffaut, Ph.D.¹, Cristian Colther, Dr.²

¹Columbia University in the City of New York

535 West 116th Street, New York, NY 10027, USA

²Department of Economics, Universidad Austral de Chile, in the City of Valdivia

Calle Viel s/n, Isla Teja, Valdivia-Chile

ABSTRACT: This paper analyzes the effect of public spending on the Chilean economy by analyzing quarterly data for the period 1990-2018. GDP and public expenditure among other macroeconomic variables have been used to estimate a VEC (Vector Error Correction) model. The main objective is to investigate an important component of public spending, such as Government transfers, and their impact on economic growth. Results show a bidirectional causal relationship of the Granger type between GDP and spending on government subsidies. By the same token, there is a unidirectional relationship of the unemployment rate towards subsidy spending. Through a VEC model, short and longterm elasticities are estimated to analyze the adjustment dynamics between the variables being studied, noting the important effect that GDP has on government subsidies spending and the null effect of these subsidies on Chile's economic growth.

KEYWORDS: Fiscal transfers, public spending, subsidies, fiscal policy, economic cycles, public policies, cointegration, co-integrated vector error correction model (VEC).

JEL Classification: C01; C22; C32; C51; C52; H24; H55; E62; E32

1. INTRODUCTION

The analysis of public spending and its effect on the growth of the economy is a topic widely studied since the contributions of John Maynard Keynes on the role of the State in aggregate demand. The main idea is that state actions, through planned and targeted public spending, can help stabilize the economy smoothing fluctuations in the economic cycle (Karagöz and Keskin, 2016, Musgrave and Musgrave, 1989).

According to Shah (2007), government activity affects the economic dimensions of people's lives through a variety of channels such as fiscal policy, which includes public spending, taxes, and transfers. In addition, the regulatory function exercised by the state on economic and productive activity, as well as its foreign policy, intervenes indirectly in the performance of the economy.

There is a wealth of literature that has explored the effect of public spending on the economy, such as the works of Wyplosz (2012) and Garcia, Restrepo, and Tanner (2011) who have analyzed the public spending of developed economies, paying less attention to developing or emerging economies, especially those in the Latin American zone (Kopits, 2004). This may be due to various reasons such as, for example, the fiscal imbalances and public debts experienced by these countries in the 1980s, or due to

political instability, which caused instability in spending and imbalances in the economies on a recurring basis.

However, this situation of instability in developing countries has changed over time. Currently, some of these countries stand out for their stability and macroeconomic balance, low indebtedness, and sustained growth of their economies. In addition, and as a recent element, one can observe a greater fiscal discipline and moderation of its macroeconomic policies, which are expressed in fiscal rules that better conduct the financial management of the governments, which has placed them as economies with great prospects of future development and in particular to Latin America, as a block of economic and commercial interest worldwide. Among some studies that have explored this topic in Latin America, one can quote Calderón and Schmidt-Hebbel (2003), Dutra (2009), and Ffrench-Davis (2010).

Chile is an interesting case for this type of analysis because its economy has a very neoliberal approach, which has been widely open to the international economy, with relative stability during the last thirty years. Following Chile's great macroeconomic and fiscal discipline, it has allowed it to be placed in a prominent position at the Latin American level, as well as being a member of the group of countries of the Organization for Economic Cooperation and Development (OECD). Among the studies that have addressed the behavior of fiscal policies in Chile, stand out the works of Fiess (2005);

Arellano (2006, 2005); Restrepo and Rincón (2006); Medina and Soto (2016); Kumhof and Laxton (2010); Frankel (2011); Engel, Neilson, and Valdés (2011); Medina and Soto (2016).

The present study seeks to contribute to the knowledge of the economy of Chile, analyzing the structure and nature of the behavior of an important component of fiscal spending, such as fiscal transfers, as well as its effect on economic growth. Therefore, this research work is developed in six sections; an introduction; a second section that continues with a brief review of the literature that has addressed this issue at a general level and in a particular way for the Chilean case; the third section follows with a succinct presentation about the evolution of fiscal spending in Chile, while the fourth section presents the methodology followed in this study. The fifth section presents the results and finally, the sixth section presents the main conclusions of this research.

2. LITERATURE REVIEW

It is a fact that modern economies suffer from fluctuations in their path of long-term growth and this effect was evident during the last great economic crisis, which significantly affected the main economies of the world during the years 2008 and 2010.

This situation has placed fiscal policies and their effectiveness in economic growth at the center of the theoretical discussion (Easterly and Rebelo, 1993). Another relevant aspect is to evaluate the capacity of these policies on the fluctuations of the economy, that is, the ability to intervene in economic cycles and thereby try to reduce the vulnerability to external shocks of the economy or at least reduce the severity and duration of recessions.

In this context and in relation to economic cycles, one can mention the instruments created from the public management at the macroeconomic level in an attempt to improve the response of discretionary policies, or the one from the automatic stabilization mechanisms of the economy, reducing the impact that similar shocks may have on the economy.

From a functional point of view, these stabilizing instruments of the economy are related to the approaches of fiscal policies, which seek, through various mechanisms, to intervene in the dynamics of the functioning of the economy in different spheres (Peren-Arin, Koray and Spagnolo, 2015). For instance, public spending can be used as an anti-cyclical instrument to cushion economic fluctuations through changes in the budget and tax structure of a particular country or region (Acemoglu, Laibson, and List 2015 pp.650).

On the other hand, an economy growing above its growth trend, which in colloquial jargon is called an overheated economy, the challenge is to generate measures to contain the accelerated economic growth and capture extraordinary resources in times of abundance, to implement mitigating measures in the periods of decrease or economic recession,

with the ultimate goal of achieving stability of economic growth in the long term.

From the analysis of the behavior of public expenditure, three types of fiscal policies can be defined (Kaminsky, Reinhart and Végh, 2004); 1) the countercyclical, where lower (higher) budget spending and higher (lower) taxes are sought in the boom (recession) periods of the economy; 2) the procyclical, where a high (low) budgetary expenditure and low (high) tax rates are sought in the boom (recession) periods of the economy; and 3) the acyclical, which implies a budgetary expenditure and constant tax rates regardless of the trend and behavior of the economy.

Regarding the tools that are usually used to analyze the degree of influence of macroeconomic indicators, one can mention the Vector Autoregression or VAR approach and their variants (Lütkepohl, 2005), due mainly to the problem of determining the degree of endogeneity or exogeneity of a variable of the economy and its possible influence on other variables of the model (Colombo, 2013). On the other hand, VAR models suppose stationary and stable processes in which there are no tendencies or changes in the average or in the covariances, as well as deterministic seasonal patterns.

Under this line of analysis, public spending can be considered endogenous, since it depends on the collection of taxes, and these, in turn, depend on the growth of the economy (Musgrave and Musgrave, 1989). In addition, a long-term dependence between economic variables and public expenditure can also coexist, that is, a cointegration and stochastic trend relationship can also coexist, an effect that can be adequately studied with a vector error correction model (hereinafter VEC) and that simply consists in adding a corrective function to the original VAR model, as its name says (Carlucci and Montaruli, 2014; Lütkepohl, 2005).

Carlucci and Montaruli (2014), mention that the VEC models can be a tool of empirical analysis as well as public policy evaluation since they facilitate a clear economic interpretation when distinguishing between long- and short-term dynamics while studying the dynamics of deviations around an equilibrium. Among the works carried out in this area are those of Blanchard and Perotti (2002), research in which the authors use a VAR model to determine the impact of fiscal policy on the US economy. Their results show that positive disturbances in public spending have a positive effect on the product.

Following the same approach, Saibu and Oladeji (2008) investigate the effects of monetary and fiscal policies on the growth of real output in Nigeria, using a VEC model to assess the effects of shocks on fiscal and monetary policies in production. Their results show that the anticipated and unforeseen fiscal and monetary shocks do not have significant positive effects on the real product.

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

In turn, Dungey and Fry (2009) identify the effects of fiscal and monetary policy using a cointegrated VAR model analyzing the New Zealand economy, identifying permanent and temporary shocks in a small open economy framework. In their research, the authors analyze fiscal and non-fiscal shocks and determine that the impact of the increase in government spending is reflected in higher production, also concluding that fiscal policy shocks have been greater than monetary policy shocks. Marattin and Salotti (2014), investigate the relationship between public spending and private consumption in the United Kingdom, using a VEC model with quarterly data for the period 1981-2007, finding that some components of disaggregated public expenditure have an effect on consumption.

On the other hand, Burret, Feld, and Köhler (2013) analyze the public finances of Germany in the period 1850-2010, using a VEC model and determining that in the period between the years 1950-2010, fiscal policy is not sustainable in time due to the size of Germany's debt. Boiciuc (2015) analyzes the effects of fiscal policy on the economy through the application of VAR methodology for the case of Romania. Their results show that the impact of fiscal shocks on macroeconomic variables is low and that they present a low or almost zero multiplier effect in the economy.

Igwe, Emmanuel, and Ukpere (2015) investigate the impact of fiscal policy variables, such as capital spending, recurrent spending, and the direct income tax on economic growth in Nigeria for the period 1970-2012, using for this purpose, a VEC model determining that there is indeed an impact of public spending on the growth of the economy. In the same line of research, Zayanderood, Seyedkazemi, and Jalae (2017), use a VEC model to analyze the case of Iran for the period 1966-2013, determining that current expenditures have a positive and significant impact on economic growth.

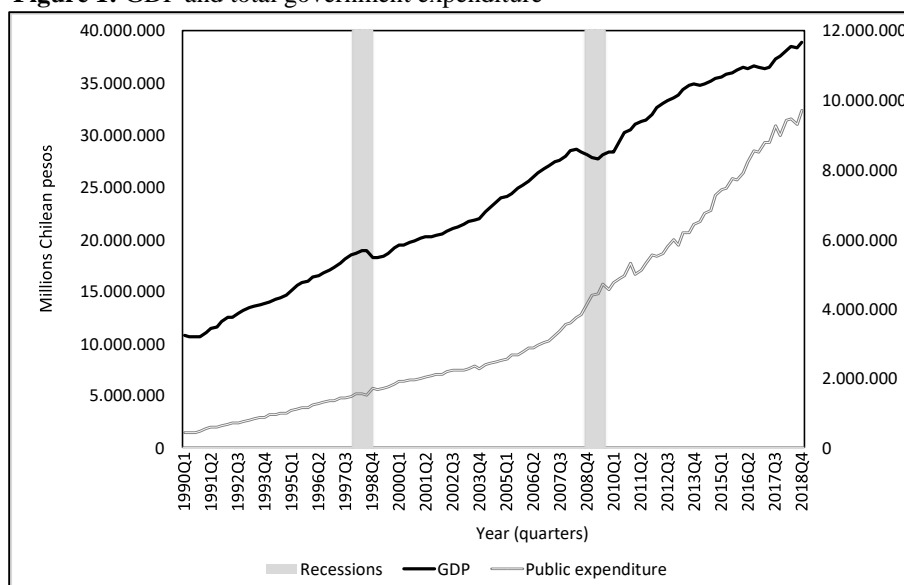
Using a multivariate VEC, Wang (2018) shows the existence of long-term and short-term dynamic interactions between the unconventional monetary policy and fiscal policy for the case of the United States and Japan, but with different effects on the macroeconomic indicators, finding that the combination of monetary and fiscal policy in Japan has less impact on macroeconomic variables than in the case of the US, a country where both policies reinforce each other in their effects on macroeconomics.

From the previous works, it is deduced that there is no standardized analysis approach and in general, it can be observed that these investigations explore the possible relationships between macroeconomic indicators and public spending. Therefore, there are no exclusive studies related to fiscal policies and it is usual to superimpose the effects of one component of spending on other effects, such as monetary policies. Finally, it should be mentioned that there are no definitive results regarding the impact of public spending on the economy. Moreover, there is contradictory evidence, with cases where a positive effect can be observed, while in other cases the impact is only marginal and very dependent on the particular operation of the economy under analysis.

3. EVOLUTION OF PUBLIC SPENDING IN CHILE

Since the last decades, Chile has been characterized by its fiscal discipline, which translates into a budgetary policy that considers the behavior of the economy and the potential income of the State. This characteristic has made possible a balanced fiscal budget that is dependent on the behavior and growth of the economy. However, starting in 2007, public spending has suffered an important change in its trend, with an increase in its growth rate (Figure 1).

Figure 1: GDP and total government expenditure



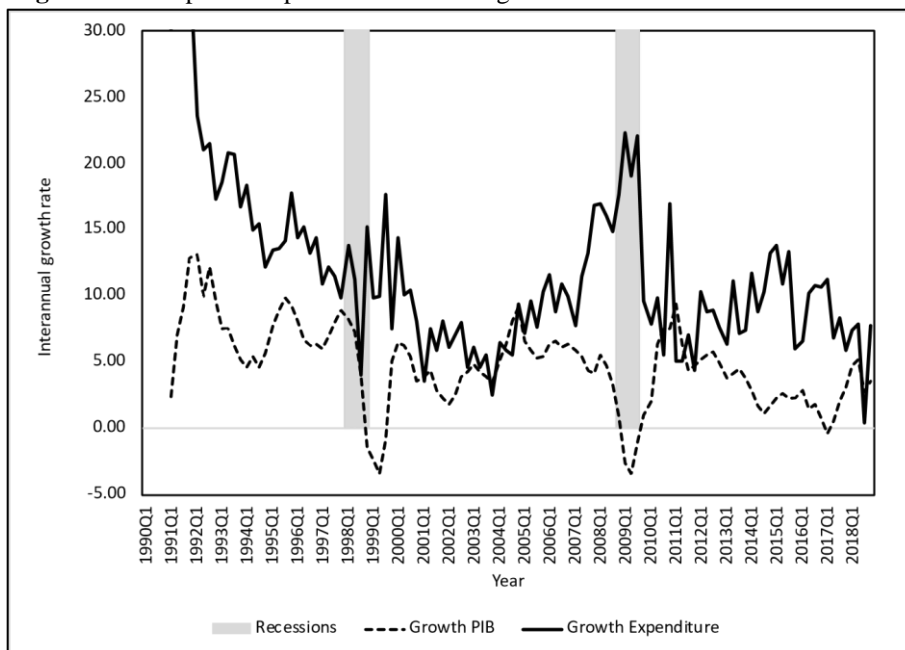
Source: Authors' elaboration using data from the BC of Chile and FR of St. Louis

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

This situation is due to a series of structural reforms that the Government of the period implemented to improve the coverage of social protection in education, health, and pension funds (retirement). Parallel to this increase, the economy experienced a decrease in its growth rate from 6% in the nineties to around 4% in the following decade and 3% from 2010 onwards (see Table 1); this can be corroborated by observing Figure 2, it can be seen, the growth rates of GDP which have been very stable over time, only with two moments in which their rates have been negative, due to international crisis and economic conditions that significantly affected Chile's economy (Figure 2)¹.

from 2010 onwards (see Table 1); this can be corroborated by observing Figure 2, it can be seen, the growth rates of GDP which have been very stable over time, only with two moments in which their rates have been negative, due to international crisis and economic conditions that significantly affected Chile's economy (Figure 2)¹.

Figure 2: Total public expenditure and GDP growth rate



Source: Authors' elaboration using data from the BC of Chile and FR of St. Louis.

In the case of Public Expenditure, despite increasing its level steadily over time, three moments can be identified; the first, from the beginning of the nineties until 2003, where the interannual rate decreases systematically; Then, between 2004 and 2009, the year-to-year growth rate experienced a steady increase, until the end of the economic crisis caused by the subprime crisis at the international level. Since then, its behavior has been more volatile and has tended to decline in recent years, similar to the behavior of the interannual GDP growth rate.

Table 1 summarizes the different periods of growth of the PE, highlighting the period 1990-1999 where average growth reached 16.7%, but with a decreasing trend. On the other hand, during the 2000-2009 period one can see a growing trend with an average growth rate of 10.1%, a period in which and specifically for the year 2009, has the highest growth reaching 22.1 %. Regarding low growth, the period 2010-2018 shows a downward trend in PE growth rates, with an average growth rate of 8.6%.

Table 1: Public expenditure and GDP statistics

Period	GDP growth rate (%)	Public expenditure growth rate (%)
Period (1990-1999)	6.4	16.7
Period (2000-2009)	4.2	10.1
Period (2010-2018)	3.6	8.6
Period (1990-2018)	4.7	11.7
Maximum	13.0	35.6
Minimum	-3.5	0.4
Median	4.9	10.3
Standard deviation	3.2	6.3

Source: Authors' elaboration

¹ During the period, two periods of recession caused by international crises were registered, one occurred in 1998

called "the Asian crisis", and another in 2008 called "the subprime crisis".

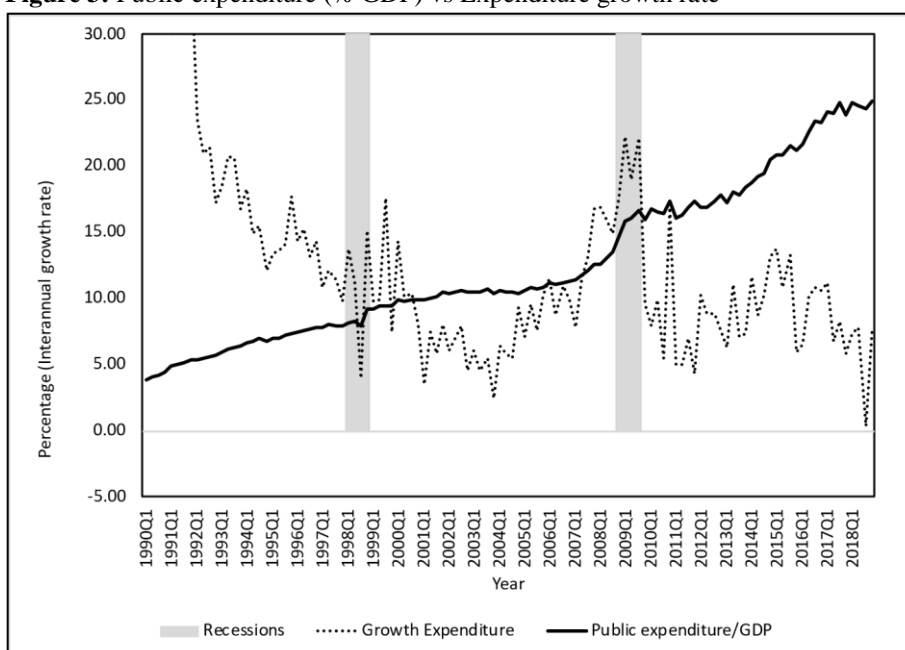
“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

The facts presented above, show the sustained growth of the PE and its fluctuations that is related to different rates of expansion of the PE in coherence with the social challenges faced by the governments of the time. For example, the period 1990-1999 was characterized by the so-called "period of return to democracy" that exhibits a strong social policy essentially focused on overcoming poverty and improving the coverage of social programs, added to the commercial opening and greater growth experienced by the economy in that period. Something different happens during the period 2000-2009, which is characterized by policies of modernization of the State and efficiency in the use of resources, in addition to a strong emphasis on the consolidation of international trade, with an increasing number of free trade agreements signed by Chile with other

economies of the world, period also characterized by excellent income from the high yields of copper mining.

In contrast, the years between 2010 and 2018 are characterized by a period of significant structural reforms in the areas of education and health, which were financed through a tax reform that has had a significant negative impact on the Chilean economy. In addition, the slowdown in international trade due to the last major international economic crisis, the poor performance of the copper mining sector, and the significant decline in private investment, all of which have strongly impacted the growth of the Chilean economy, with lower growth rates. However, the share of public spending as a percentage of GDP has increased over time, with a value of around 24.5% in recent years (Figure 3).

Figure 3: Public expenditure (% GDP) vs Expenditure growth rate



Source: Authors' elaboration using data from the BC of Chile and FR of St. Louis.

Figure 3 also shows the State of Chile has maintained a disciplined fiscal policy, and with steady but moderate growth in the nineties, stable in the 2000s, and an important growth since the last economic crisis experienced by the country, linked to the expansion of the pension system, the increase in health benefits, and implementation of public funds for higher education free of charge for 60% of the most vulnerable population.

In addition, a detailed analysis of public expenditure shows that by decomposing the expenditure it is evident that the transfers component in the form of government subsidies is the expenditure item that has grown the most during the last decades, representing 26% during the 90s, but reaching a percentage of participation on average public spending of 39.5% in 2018, with an average annual growth rate of 3.6%. Table 2 summarizes the main statistical parameters of the transfers for each of the decades.

Table 2: Evolution of government transfers

Periodo	Median	St. Dev.	Min	Max
1990-2000	26.0%	2.7%	20.5%	30.9%
2001-2010	32.6%	2.9%	29.0%	40.3%
2010-2018	39.5%	3.7%	31.3%	46.8%

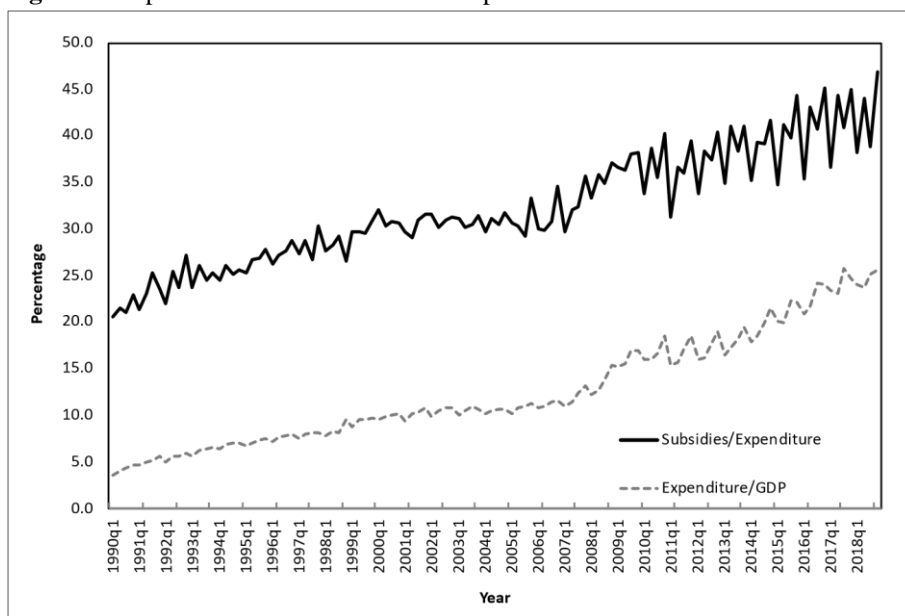
Source: Central Bank of Chile and Federal Reserve of St. Louis.

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

In this case, one can see that public spending has materialized in terms of transfers, stimulating the provision of social services (education, health, and retirement) by private providers, in a logic of subsidies or allocation of transfers

(vouchers) in a subsidiary State approach. As can be seen, both the Expenditure/GDP and the Subsidies/Expenditure ratios show a very similar trend and growth pattern (Figure 4).

Figure 4: Expenditure/GDP vs Subsidies/Expenditure



Source: Authors' elaboration using data from the BC of Chile and FR of St. Louis.

On the basis of the above data and due to the growth of transfers, that is, the spending on subsidies by the Government, the research will focus particularly on this component of expenditure, which in turn is the variable that best adjusts to discretionary changes in fiscal policy in Chile.

4. METHODOLOGY

With the theoretical foundations that motivate this research, the study is developed on the basis of two objectives; First, to determine the different interrelationships that may exist between an important item of public expenditure (PE) such as spending on government subsidies (hereinafter EGS), the gross domestic product (hereinafter GDP) and the unemployment rate (hereinafter UR); second, to determine the possible existence of procyclical and countercyclical relationships between the EGS and the GDP. Although this hypothesis seems intuitively simple and trivial, the empirical evidence and the academic literature are still incipient in demonstrating this interrelation. For the fulfillment of this second objective, a model of autoregressive vectors (VAR)

or, if applicable, a VEC model is implemented in case of cointegration between the variables, as well as the use of the Granger test to determine plausible causal relationships between the different variables. In addition, the existence of cointegration equations is explored, based on maximum likelihood methods (see, for example, Johansen, 1995, 1991, 1988).

The data to be used corresponds to quarterly macroeconomic series data for expenditures on government subsidies (EGS), gross domestic product (GDP), and unemployment rate (UR), with series extending from the first quarter of 1990 to the fourth quarter of 2018. The EGS and GDP variables are in thousands of Chilean pesos, while the unemployment rate (UR) is a rate and therefore must be expressed as a percentage. All the variables are modeled in their logarithmic form. The data correspond to a series obtained from the Central Bank of Chile and the Federal Reserve of St. Louis. Table 3 summarizes the main statistics of the described variables.

Table 3: Macroeconomic series

Macroeconomic Series	N	Mean	St. Dev.	Minimum	Maximum
Government Subsidies	116	1,288,050	1,180,697	82,528	4,892,180
Gross Domestic Product	116	24,200,000	8,500,609	10,100,000	40,800,000
Unemployment Rate (%)	116	7.8	1.5	5.3	11.8

Quarterly data from 1990 Q1 to 2018 Q4. Source: Central Bank of Chile and Federal Reserve of St. Louis.

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

As usual, when analyzing data from macroeconomic time series, the presence of unit roots must be taken into account. For the three series, the presence of unit roots is verified by applying the ADF test of Dickey-Fuller (Dickey and Fuller, 1979), the Elliott-Rothenberg test (Elliott and Rothenberg, 1996), and the KPSS test (Kwiatkowski, Phillips, Schmidt and Shin, 1992), which in contrast to the traditional tests of unit roots, takes stationarity as a null hypothesis.

Table 4 reports the results of the unit root tests for the three series in which the estimated statistics (t statistics) are lower than the critical values with 5% significance (critical value CV 5%), therefore, it is concluded that the series are integrated of order one in levels and of order zero (stationary) in differences. Deterministic components are included as intercept and trend in these tests.

Table 4: Unit root tests

Variable	ADF		KPSS		Elliott-Ro thenberg	
	CV 5%	T stat.	CV 5%	T stat.	CV 5%	T stat.
Government Subsidies	-3.45	-2.69	0.14	0.15	5.64	3.80
Gross Domestic Product	-3.45	-2.47	0.15	0.20	5.64	3.80
Unemployment Rate	-3.45	-2.09	0.14	0.20	5.64	3.05

Source: Authors' elaboration based on the results of the model.

It is important to emphasize that of all the unit root tests, the one proposed by KPSS is the most consistent and perhaps the most rigorous when determining the presence of unit roots in the series. The KPSS test with the auto-covariance function specification weighted by the quadratic spectral core instead of the kernel or Bartlett Kernel, in addition to the automatic bandwidth selection specification, determines the maximum number of lags that the width of the optimal band for the test, thus avoiding biases in the detection of unit roots (Hobijn, Franses, and Ooms, 2004; Newey and West, 1994).

The analysis of unit roots determined the presence of unit roots in the three series using the Dickey-Fuller, Elliott-Rothenberg, and KPSS tests, that is, the series are nonstationary. In addition to the tests, the Saikkonen and Lütkepohl (2002) and Lanne, et al. (2002) tests are used, the latter in order to prove the existence of unit roots with a structural break. The results are summarized in Table 5 and indicate that the unit root null hypothesis for the tiered series cannot be rejected at any conventional level.

Table 5: Saikkonen-Lütkepohl unit root test

Variable	Break Period	CV 5%	T statistic
Government Subsidies	2011 Q3	-2.88	-2.01
Gross Domestic Product	1992 Q4	-2.88	-1.86
Unemployment Rate	1998 Q1	-2.88	-1.98

Source: Authors' elaboration based on the results of the model.

The test estimates the breaks that occurred in the three series and is consistent with economic historical events: for example, the increase in the Subsidies/GDP ratio as of the third quarter of 2011, or the increase in the unemployment rate resulting from the Asian crisis of 1997-1998 and finally the increase in the GDP growth rate from the fourth quarter of 1992, beginning the period of greatest growth of the Chilean economy during the nineties (Table 5).

Once the existence of unit roots in the macroeconomic series has been verified, the VAR or VEC model is applied, as appropriate, to estimate the possible interrelationships between the series already described.

Consider a VAR model with p lags

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + \varepsilon_t \quad (1)$$

Where y_t is a vector of variables $K \times 1$, v is a vector of parameters $K \times 1$, $A_1 - A_p$ are matrices of parameters $K \times K$ and ε_t is a vector of perturbations or errors with mean 0 and covariance matrix $\hat{\sigma}$, being also an independent and identically normally distributed random variable.

A VAR (p) model can be rewritten as a Vector Error Correction (VEC) model of the form

$$\Delta y_t = v + \prod y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (2)$$

where $\prod = \sum_{j=1}^{j=p} A_j - I_K$ and $\Gamma_i = -\sum_{j=i}^{j=p} A_j - I_K$. In the model, the parameters v and ε_t in (1) and (2) are identical.

Engle and Granger (1987) show that if the variables y_t are I (1), the matrix $\hat{\sigma}$ in (2) has rank $0 \leq r < K$, in which r is the number of linearly independent cointegrated vectors. If the variables are cointegrated, then $0 < r < K$ and equation (2)

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

shows that a VAR in the first differences is poorly specified because it omits the lagged term $P_{y_{t-1}}$. Specifically, Engle and Granger pointed out that a linear combination of two or more non-stationary series can be stationary. If there is a linear combination of series that is stationary, $I(0)$, it is said that the non-stationary series, that is, the series with unit roots that give rise to that combination, are cointegrated. The linear stationary combination is called the cointegration equation and can be interpreted as the long-term equilibrium relationship between the different variables that make up the equation and for which it has high importance for the analysis of economic phenomena.

It is important to note that the VEC model in (2) also nests two important special cases; first, if the variables in y_t are $I(1)$, that is, integrated of order 1, but that are not cointegrated, then P is a matrix of zeros and, therefore, has a rank of 0; second, if all the variables are $I(0)$, that is, integrated of order 0, then P has a complete K range.

5. EMPIRICAL RESULTS

Through the use of an Autoregressive Vector (VAR) model, it is interesting to determine the possible interrelations

between the EGS and GDP variables. The unemployment rate (UR) is included in the VAR model as an exogenous variable, as well as a dummy variable for the GDP breakpoint. It should be noted that the monetary policy rate and two more dummy variables, one for the EGS break and another for the UR break, are other variables considered in the model, nevertheless, they do not meet the required statistical significance, so they have been excluded from the final model.

Following the proposed methodology, an initial VAR model is estimated including the three macroeconomic series (EGS, GDP, and UR), in order to determine the optimal number of lags. The VAR model shows that the optimal number of lags is six, based on the usual information criteria (AIC, BIC, and HQIC), which is also an indicator of the high persistence present in the macroeconomic variables included in the model. Due to the non-stationarity of the series, Johansen's test is carried out to verify or rule out the existence of cointegration in the series. The main results based on the trace test suggest the presence of at least one cointegration equation with a level of significance of 5% (Table 6).

Table 6: Johansen cointegration test

Cointegrated vectors	Eigenvalue	Trace statistic	CV at 5%	Probability
$r = 0$	0.0880	18.45	15.49	0.0174
$r < 1$	0.0743	8.41	3.84	0.0037

Source: Authors' elaboration based on the results of the model.

Additionally, the cointegration range of a VEC model is also estimated to determine the number of cointegration equations in a vector model of error correction (VEC), which

complements and reinforces the results obtained with the Johansen test. Table 7 reports the results of the test.

Table 7: Johansen cointegration test

Max Rank	Eigenvalue	Trace Statistic	CV at 5%
0	.	19.82	15.41
1	0.1083	7.21	3.76
2	0.0635	.	.

Source: Authors' elaboration based on the results of the model.

Therefore and due to the presence of cointegration between the series, the implementation of a VAR model is discarded, estimating the corresponding equation of Vector Error Correction (VEC), which is what comes from the result of the cointegration test. Only after this correction is made, the

Granger causality test is applied to establish possible causal relationships between the variables and the subsequent robustness tests of the model to rule out the presence of autocorrelation and heteroskedasticity of the residuals. Table 8 summarizes the main results of the VEC model.

Table 8: VEC model results

Cointegrating Equations	Cointegrating Eq. 1
LNEGS(-1)	1.000
LNPIB(-1)	-2.323 (0.136)
C	25.734

“Do Public Expenditure and Subsidies have an Impact on Chile's GDP?”

Vector Error Correction	D(LNEGS)	D(LNPIB)
Cointegrating Equation 1	-0.168 (0.044)	-0.011 (0.010)
R-squared	0.889	0.930
Adjusted R-squared	0.874	0.919
Akaike AIC	-2.730	-5.637
Schwarz SC	-2.436	-5.268

Source: Authors’ elaboration based on the results of the model.

The results of the VEC model suggest that the GDP has a statistically significant effect on the EGS from the second lag or quarter, which is consistent with the fiscal discipline hypothesis and the management of fiscal expenditure under the formula of the Structural Balance, currently known as the Cyclically Adjusted Balance, adopted in Chile since 2001. However, in the long term, there is a significant effect of GDP on the EGS. In effect and according to the value of the long-term elasticity, an increase of 1% of GDP generates an increase of the EGS of 2.32%. This result suggests that in the long term, increases in GDP impact and increase transfers in subsidies by the Government (EGS) and consequently public expenditures (PE).

Another relevant aspect derived from the VEC model is the adjustment coefficient or speed of adjustment with respect to

long-term imbalances, which for the GDP model is 1.1%, while for the EGS model it is 16.8%. This implies that there is a faster adjustment of the EGS compared to the rate of adjustment of GDP, which is also related to the behavior exhibited by the variable during the analysis period.

Regarding the possible Granger relationships and on the basis of the results of the VEC model, it is concluded that there is a relation of the type of Granger causality between the EGS and the GDP, causal relationship at the 5% significance level with a positive sign from the GDP towards the EGS, that is to say, increases of the GDP produces increases in the EGS. There is also evidence of another inverse causal relationship of a positive sign that is directed from the EGS to the GDP at the 10% level of significance that agrees with the economic theory, according to the results reported in Table 9.

Table 9: Granger causality tests

Variable	Granger Causality	Pr > Chi2
GDP-EGS	Yes	5%
EGS-GDP	Yes	10%
GDP-UR	Yes	5%
UR-EGS	Yes	5%

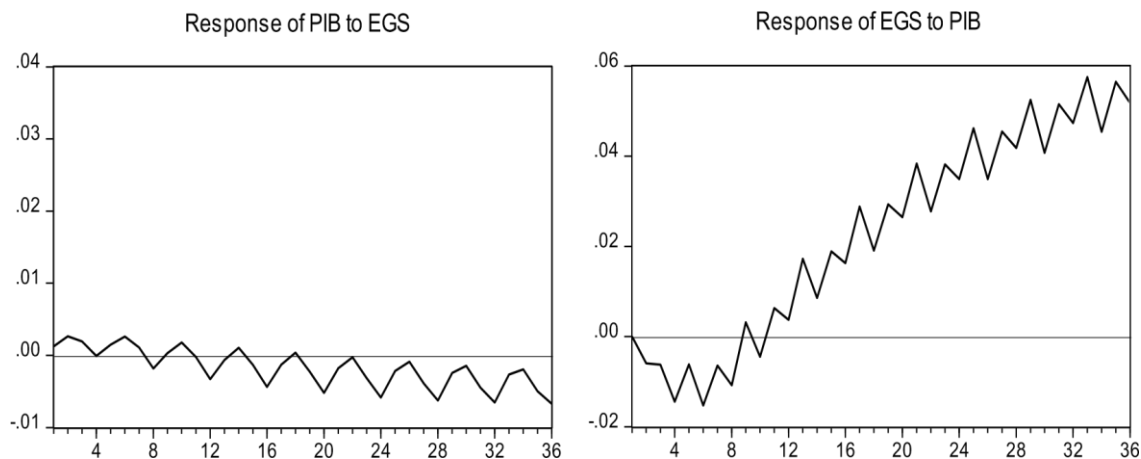
Source: Authors’ elaboration.

With respect to the unemployment rate variable (UR), there is a one-way Granger-type causality relationship from the gross domestic product (GDP) to the unemployment rate (UR), very much in line with the economic theory and with the empirical law of Okun (1962), indicating that increases in GDP decrease the unemployment rate (UR) in a proportion that is characteristic for each economy and country. There is also evidence of a causal relationship of the Granger type from the unemployment rate (UR) to subsidy expenses (EGS), which also agrees with economic theory because, in general, periods of high unemployment are conditioned by decreases in the GDP, which reduces the amounts of transfers from the Government to the people (EGS), which obviously is subject to the conception and vision of the macroeconomic policy followed by the coalition of government that is in power. In the case of Chile and on the basis of the VEC

model, a 1% increase in the unemployment rate (UR) reduces government transfers by 0.06%.

Continuing with the results, Figure 5 shows the response for the next 36 quarters in the face of shocks in GDP and government subsidy spending (EGS). The graph on the left reveals the GDP response to increases in spending on government subsidies (EGS). Specifically, a shock of 1% increase in the EGS translates into a zero increase in GDP, an effect that is gradually becoming negative in the future quarters and that is opposed to the Keynesian theory that increases in Government spending have a multiplier effect on GDP, at least with respect to increases in the EGS, which is also supported by empirical evidence regarding the negative impact of fiscal shocks on economic activity.

Figure 5: Impulse-Response dynamics



Source: Authors' elaboration based on the results of the model.

On the other hand, the panel on the right reveals that a shock of 1% increase in GDP translates into a small initial increase in the EGS of 0.014%, an effect that gradually becomes negative during the first eight quarters, that then transform into a positive and growing effect reaching its highest value of 0.056 and a plateau in quarter 33. The foregoing is an indication of the high persistence of increases in government subsidies and, consequently, increases in fiscal spending in the economy.

In line with the results of this research, several empirical studies show that the effect of an increase in fiscal spending depends on the type of economy under study. For example, the effects in developed economies are positive, although small (Japan and the US), compared to small economies such as Chile where the evidence is null and in some cases even negative. Another factor is the commercial opening and the prevailing exchange rate. In this way, increases in fiscal spending can be harmful in countries that exhibit greater trade openness, as well as Debt/GDP ratios greater than 60% and flexible exchange rate regime (Cerda et al., 2006, Ilzetzki, Mendoza and Végh, 2013; Perotti, 2005).

Regarding the robustness of the model, it is necessary to emphasize that all the rigorous tests were performed to verify the quality and predictive power of the model. Under this perspective, the Durbin-Watson (DW) statistic for serial autocorrelation of a lag is 2.07, which validates the robustness of the VEC model estimated in this section (Durbin & Watson, 1951). Additionally, the model is free of autocorrelation for the specified lags (5) and the presence of heteroskedasticity is rejected for the residuals with a statistical significance level of 0.05.

6. CONCLUSIONS

It is an evident fact that modern economies suffer from fluctuations in their long-term growth path. This situation has placed at the center of the theoretical discussion and design of macroeconomic policies, the way or manner of managing

the volatility present in the markets and in the global economy, as well as the most effective public policies to manage economic cycles. In the present investigation, it has been of interest to analyze the behavior of subsidies as part of a fundamental component of public spending, as well as to inquire about their behavior with respect to economic cycles in the Chilean economy.

In the case of Chile, public spending is on average equivalent to 24.5% of GDP in the last year, with sustained growth over time, as a result of the expansion of the social protection system, which has helped to reduce poverty, increase coverage in health, education, and improve the pension system.

An important part of this increase is due to transfers by the Government, which is the public expenditure item that in the fourth quarter of 2018 reached its maximum value of 46.8% with respect to the total public expenditure. Regarding the type of fiscal policy, the evidence for the Chilean economy indicates that it is rather a procyclical type pattern, with a high budget expenditure and low tax rates in the boom periods of the economy and vice versa, although this point can be debatable depending on the vision of the political coalition in power.

From the empirical results of the VEC model, the greater speed of adjustment of the EGS compared to the speed of adjustment of the GDP allows inferring that discretionary increases in the level of EGS tend to transform into permanent increases in public spending and this is reflected in the increases that fiscal spending has experienced during the last decade as of the third quarter of 2011, a period in which there is a change in trend or breaking point, as a result of the increase in the rate of growth of transfers or subsidies by the Government. The above is precisely what is evident in the Chilean economy as of the end of 2011, which has translated into a significant increase in fiscal spending. In fact, the lowest fiscal expenditure with respect to GDP was reached in

2006 with 17.2%, while in 2018 it ended with 25.21%, a value well above the trajectory followed by spending during the previous decade and totally in contrast to the fiscal discipline exhibited by Chile during the last three decades.

Although economists attached to the New Keynesian approach justify these increases as an important part of fiscal policy and its multiplier effect in the economy, the evidence is not conclusive that increases in the EGS, and by extension of public spending (PE), have a permanent and positive impact on GDP, and consequently, on economic growth. Even more, and based on estimates for Chile with data updated until 2018, the impact on the growth of an increase in government expenditure in subsidies has been close to zero. Although Chile does not exhibit a Debt/GDP pattern close to or much greater than 60%, perhaps its great commercial openness and its flexible exchange rate regime, the Keynesian principles and foundations are not as evident as in others countries.

The evidence presented in this research reaffirms a necessary follow-up of the evolution of this expenditure component, as well as the pattern that total fiscal expenditure as a percentage of GDP. This is of vital relevance, especially in the face of the demographic changes that are taking place in the country, not only in terms of migration but also in relation to the trend towards an older population. All of the above suggests that there is a high probability of higher spending on government subsidies and fiscal spending in the immediate future. Therefore, it is becoming increasingly necessary to conduct research that accounts for this spending trend and its effect, positive or negative, in the short and medium-term for the Chilean economy.

REFERENCES

1. Acemoglu, D., Laibson, D. I., & List, J. A. (2015). *Economics*. Pearson. Retrieved from <https://books.google.cl/books?id=v9m7oAEACAAJ&dq=Acemoglu,+economics&hl=es-419&sa=X&ved=0ahUKEwjLhJ-yr7DhAhVZHbkGHXHXBogQ6AEIMjAB>
2. Arellano, J. (2005). Del déficit al superávit fiscal: razones para una transformación estructural en Chile (Estudios Públicos No. 101).
3. Arellano, J. (2006). Structural change in Chile: From fiscal deficits to surpluses. In *Challenges to Fiscal Adjustment in Latin America: The Case of Argentina, Brazil, Chile and Mexico* (pp. 113–125). Paris: OECD. <https://doi.org/10.1787/9789264022089-6-en>
4. Blanchard, O., & Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, 117(4), 1329–1368. <https://doi.org/10.1162/003355302320935043>
5. Boiciuc, I. (2015). The Effects of Fiscal Policy Shocks in Romania. A SVAR Approach. *Procedia Economics and Finance*, 32, 1131–1139. [https://doi.org/10.1016/S22125671\(15\)01578-6](https://doi.org/10.1016/S22125671(15)01578-6)
6. Burret, H., Feld, L. P., & Köhler, E. A. (2013). Sustainability of Public Debt in Germany – Historical Considerations and Time Series Evidence. *Journal of Economics and Statistics (Jahrbuecher Fuer Nationaloekonomie Und Statistik)*, 233(3), 291–335. Retrieved from <https://ideas.repec.org/a/jns/jbstat/v233y2013i3p291-335.html>
7. Calderón, C., & Schmidt-Hebbel, K. (2003). Macroeconomic policies and performance in Latin America. *Journal of International Money and Finance*, 22(7), 895–923. <https://doi.org/10.1016/J.JIMONFIN.2003.09.005>
8. Carlucci, F., & Montaruli, F. (2014). CO-INTEGRATING VAR MODELS AND ECONOMIC POLICY. *Journal of Economic Surveys*, 28(1), 68–81. <https://doi.org/10.1111/j.1467-6419.2012.00740.x>
9. Cerda, R. A., González, H., & Lagos, L. F. (2006). Is fiscal policy effective? Evidence for an emerging economy: Chile 1833–2000. *Applied Economics Letters*, 13(9), 575–580. <https://doi.org/10.1080/13504850500400686>
10. Colombo, V. (2013). Economic policy uncertainty in the US: Does it matter for the Euro area? *Economics Letters*, 121(1), 39–42. <https://doi.org/10.1016/J.ECONLET.2013.06.024>
11. Dickey, D. A., & Fuller, W. A. (1979). Distribution of the Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association*, 74(366a), 427–431. <https://doi.org/10.1080/01621459.1979.10482531>
12. Dungey, M., & Fry, R. (2009). The identification of fiscal and monetary policy in a structural VAR. *Economic Modelling*, 26(6), 1147–1160. <https://doi.org/10.1016/J.ECONMOD.2009.05.001>
13. Durbin, J., & Watson, G. S. (1951). Testing for Serial Correlation in Least Squares Regression. II. *Biometrika*, 38(1/2), 159. <https://doi.org/10.2307/2332325>
14. Easterly, W., & Rebelo, S. (1993). Fiscal policy and economic growth. *Journal of Monetary Economics*, 32(3), 417–458. [https://doi.org/10.1016/0304-3932\(93\)90025-B](https://doi.org/10.1016/0304-3932(93)90025-B)
15. Engel, E., Neilson, C., & Valdés, R. (2011). Chile's Fiscal Rule as Social Insurance. Working Papers Central Bank of Chile. Retrieved from <https://ideas.repec.org/p/ccb/bcchwp/627.html>

16. Engle, R. F., & Granger, C. W. J. (1987). Co-Integration and Error Correction: Representation, Estimation, and Testing. *Econometrica*, 55(2), 251. <https://doi.org/10.2307/1913236>
17. Ffrench-Davis, R. (2010). Latin America: The Structural Fiscal Balance Policy in Chile: A Move Toward Counter-Cyclical Macroeconomics. *Journal of Globalization and Development*, 1(1). <https://doi.org/10.2202/1948-1837.1051>
18. Fiess, N. (2005). Chile`s Fiscal Rule. In C. Burnside (Ed.), *Fiscal Sustainability in Theory and Practice: A Handbook* (pp. 175–204). Washington, D.C.: The World Bank. <https://doi.org/10.1596/978-0-8213-5874-0>
19. Frankel, J. (2011). A Solution to Fiscal Procyclicality: The Structural Budget Institutions Pioneered by Chile (NBER Working Paper No. 16945). Cambridge, MA. <https://doi.org/10.3386/w16945>
20. Garcia, C. J., Restrepo, J. E., & Tanner, E. (2011). Fiscal rules in a volatile world: A welfare-based approach. *Journal of Policy Modeling*, 33(4), 649–676. <https://doi.org/10.1016/J.JPOLMOD.2010.12.009>
21. Hobijn, B., Franses, P. H., & Ooms, M. (2004). Generalizations of the KPSS-test for stationarity. *Statistica Neerlandica*, 58(4), 483–502. <https://doi.org/10.1111/j.14679574.2004.00272.x>
22. Igwe, A., Emmanuel, E. C., & Ukpere, W. I. (2015). Impact of fiscal policy variables on economic growth in Nigeria (1970-2012): A managerial economics perspective. *Investment Management and Financial Innovations*, 12(2), 169–179. Retrieved from <https://www.scopus.com/inward/record.uri?eid=2-s2.084943621072&partnerID=40&md5=1d2dd4497cca34ff754d6b508ace754e>
23. Ilzetzki, E., Mendoza, E. G., & Végh, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, 60(2), 239–254. <https://doi.org/10.1016/J.JMONECO.2012.10.011>
24. Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12(2–3), 231–254. [https://doi.org/10.1016/0165-1889\(88\)90041-3](https://doi.org/10.1016/0165-1889(88)90041-3)
25. Johansen, S. (1991). Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models. *Econometrica*, 59(6), 1551. <https://doi.org/10.2307/2938278>
26. Johansen, S. (1995). Likelihood-based inference in cointegrated vector autoregressive models. Retrieved from <https://books.google.cl/books?hl=es&lr=&id=BH7nCwAAQBAJ&oi=fnd&pg=PR9&dq=johansen+1995+&ots=Zip457mqVK&sig=JuPaOZOqCZlieK7eOvKLjiBI7k8>
27. Kaminsky, G. L., Reinhart, C. M., & Végh, C. A. (2004). When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies. *NBER Macroeconomics Annual*, 19, 11–53. <https://doi.org/10.1086/ma.19.3585327>
28. Karagöz, K., & Keskin, R. (2016). Impact of Fiscal Policy on the Macroeconomic Aggregates in Turkey: Evidence from BVAR Model. *Procedia Economics and Finance*, 38, 408–420. [https://doi.org/10.1016/S2212-5671\(16\)30212-X](https://doi.org/10.1016/S2212-5671(16)30212-X)
29. Kopits, G. (2004). Overview of Fiscal Policy Rules in Emerging Markets. In *RulesBased Fiscal Policy in Emerging Markets* (pp. 1–11). London: Palgrave Macmillan UK. https://doi.org/10.1057/9781137001573_1
30. Kumhof, M., & Laxton, D. (2010). Documentos de trabajo - Banco Central de Chile. Documentos de Trabajo (Banco Central de Chile), ISSN-e 0717-4411, No. 602, 2010. Banco Central de Chile. Retrieved from <https://dialnet.unirioja.es/servlet/articulo?codigo=3725652>
31. Kwiatkowski, D., Phillips, P. C. B., Schmidt, P., & Shin, Y. (1992). Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? *Journal of Econometrics*, 54(1–3), 159–178. [https://doi.org/10.1016/0304-4076\(92\)90104-Y](https://doi.org/10.1016/0304-4076(92)90104-Y)
32. Lanne, M., Lutkepohl, H., & Saikkonen, P. (2002). Comparison of unit root tests for time series with level shifts. *Journal of Time Series Analysis*, 23(6), 667–685. <https://doi.org/10.1111/1467-9892.00285>
33. Lütkepohl, H. (2005). *Introduction to Multiple Time Series Analysis*. Berlin, Heidelberg: Springer-Verlag. https://doi.org/10.1007/978-3-662-02691-5_1
34. Marattin, L., & Salotti, S. (2014). Consumption multipliers of different types of public spending: a structural vector error correction analysis for the UK. *Empirical Economics*, 46(4), 1197–1220. <https://doi.org/10.1007/s00181-013-0719-0>
35. Medina, J. P., & Soto, C. (2016). Commodity prices and fiscal policy in a commodity exporting economy. *Economic Modelling*, 59, 335–351. <https://doi.org/10.1016/J.ECONMOD.2016.08.002>
36. Musgrave, R. A. (Richard A., & Musgrave, P. B. (1989). *Public finance in theory and practice*. McGraw-Hill Book Co.
37. Newey, W. K., & West, K. D. (1994). Automatic Lag Selection in Covariance Matrix Estimation. *The Review of Economic Studies*, 61(4), 631–653. <https://doi.org/10.2307/2297912>

38. Peren Arin, K., Koray, F., & Spagnolo, N. (2015). Fiscal multipliers in good times and bad times. *Journal of Macroeconomics*, 44, 303–311. <https://doi.org/10.1016/J.JMACRO.2015.01.002>
39. Perotti, R. (2005, January 1). Estimating the Effects of Fiscal Policy in OECD Countries. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=717561
40. Phillips, P. C. B., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335–346. <https://doi.org/10.1093/biomet/75.2.335>
41. Restrepo, J. E., & Rincón, H. (2006). Identifying Fiscal Policy shocks in Chile and Colombia (Documentos de Trabajo No. 370). Santiago de Chile. Retrieved from <https://www.bcentral.cl/web/guest/documentos-de-trabajo>
42. Saibu, M. O., & Oladeji, S. I. (2008). Openness and the Effects of Fiscal and Monetary Policy Shocks on Real Output in Nigeria (1960-2003)*. *African Development Review*, 20(3), 529–548. <https://doi.org/10.1111/j.1467-8268.2008.00197.x>
43. Saikkonen, P., & Lütkepohl, H. (2002). Testing for a Unit Root in a Time Series with a Level Shift at Unknown Time. *Econometric Theory*, 18(2), 313–348. <https://doi.org/10.1017/S0266466602182053>
44. Shah, A. (2007). Budgeting and budgetary institutions. World Bank.
45. Wang, L. (2018). Monetary-fiscal policy interactions under asset purchase programs:
46. Some comparative evidence. *Economic Modelling*, 73, 208–221. <https://doi.org/10.1016/J.ECONMOD.2018.03.019>
47. Wyplosz, C. (2012). *Fiscal Rules: Theoretical Issues and Historical Experiences*. Cambridge, MA. <https://doi.org/10.3386/w17884>
48. Zayanderoodi, M., Seyedkazemi, M., & Jalaei, A. (2017). Study of optimal fiscal policy in Iran. *International Journal of Economic Perspectives*, 11(3), 1037–1048. Retrieved from <https://www.scopus.com/inward/record.uri?eid=2-s2.0.085057638237&partnerID=40&md5=ff75a8a0ce6003de9703b12d4c550f27>