

# Dynamic economic and coordination of fiscal – monetary policies in Latin America: Evaluation through a DSGE model

*Daney Valdivia<sup>φ</sup>*

*TAX AUTHORITY CHALLENGE*

*Danyira Pérez<sup>ν</sup>*

*CENTRAL BANK OF VENEZUELA*

## Abstract

The recent sovereign debt and subprime crises affected the world economy and highlighted the role and importance of policy coordination against adverse scenarios (price, demand, supply and external shocks, etc.).

This paper assesses the effectiveness of fiscal and monetary policy coordination, for a set of Latin American countries (Bolivia, Brazil, Chile, Colombia, Peru, Uruguay, Venezuela) during the periods 2007 – 2008 and 2009 – 2010, through the application of dynamic stochastic general equilibrium model specified in parameters for each economy and comparable in structure to each other. The results show that a combined shock of fiscal and monetary policy have important effects when faced with an adverse situation, especially in preserving price stability and economic growth in the short and long run, as opposed to individual shocks, which in some cases be offset by not pursuing a common goal. In the first case, an active monetary policy, helped by fiscal intervention was more effective in maintaining macroeconomic stability, and in the second case the determinant was fiscal policy. Additionally, the framework proposed would contribute to an adoption and evaluation of fiscal and monetary policies through various instruments.

**JEL Classification:** E32, E61, E63, O40

**Key words:** policy coordination, dynamic stochastic general equilibrium, macroeconomic stability.

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<sup>φ</sup> Contact: [daneyvaldivia@yahoo.com](mailto:daneyvaldivia@yahoo.com). [dvaldivia@ait.gob.bo](mailto:dvaldivia@ait.gob.bo)

<sup>ν</sup> Contact: [daperez@bcv.org.ve](mailto:daperez@bcv.org.ve)

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## I. INTRODUCTION

Policy coordination is crucial when making decisions by Policy Makers. In this context, this paper evaluates the coordination of fiscal and monetary policies in order to reduce the negative shocks in the region between 2007 and 2010. This assessment is performed through a semi structural model, in line with the Keynesian new vintage.

The countries' data used come from CEPALSTATS, KLIM and the International Monetary Fund. The simulation of the coordination of fiscal and monetary policies is done through Dynare program. On the one hand, the stylized facts show that the effectiveness of branches of monetary policies were effective during the commodity price crisis. That is, during the financial crisis, in the context of inflation targeting schemes or monetary aggregates controlling liquidity in the economy to not have higher prices. What was most effective? Manage monetary aggregate or the one that has inflation targeting regimes? In return for the sovereign debt crisis, 2009-2010, were more effective fiscal policies?

One of the results is that during the decline in economic growth in 2009 Latin American countries implemented aggregate demand policy shocks, which produced the "decoupling hypothesis" of growth between advanced and developing economies. The simulation results for the countries are mixed. In the case of Chile, with inflation targeting framework, the results were not as expected in controlling prices and boost growth. A combined fiscal-monetary shock failed to meet the expectations of control prices and economic growth. Instead, the Peruvian economy was atypical because it achieved remarkable growth in their history, however with inflationary cost. In this case the combined policy resulted in effective control on prices according to its inflation targeting framework and intervention in the money market.

Brazil and Uruguay reached mixed results because in these cases fiscal and monetary policies did not show the same degree of correlation. In the first case, during the period 2007-2008, growth is sacrificed; and during 2009-2010 marginal growth is achieved. For the Uruguayan case, the product remains positive above its structural level; however with inflationary cost.

Bolivia, for its scheme of monetary and fiscal policy presents the expected results achieved in the first period to control inflation and secondly properly contribute to output growth.

The document is divided as follows: Section 2 and 3 shows stylized facts for the selected economies and literature or research papers relevant for monetary fiscal coordination. Section 4 develops a transverse theoretical dynamic stochastic general equilibrium model for all countries. The fifth section shows what kind of data used, as

were calibrated and the results of the simulation are presented. Finally, Section 6 presents the main conclusions and recommendations of policy coordination.

## **II. POLICY COORDINATION IN LATIN AMERICA**

Macroeconomic coordination has multiple benefits for countries, such as minimizing external vulnerability, respond to common shocks and reduce transmission of macroeconomic instability.

Latin American economies are by nature heterogeneous and structurally different. However, the countries of the region have shown in recent decades a considerable interest in achieving macroeconomic stability by implementing monetary policy, fiscal and exchange aimed at price stability. These efforts materialized in favorable outcomes, such as reducing inflation and improving fiscal balances.

Since the early nineties, several countries in the region launched structural reforms (economic, institutional), which provided an enabling environment for the successful adoption of inflation targeting regime (as in the case of Brazil, Chile, Colombia and Peru), which significantly reduced inflation rates.

Similarly, the reforms (tax, financial and price liberalization), and the establishment of treaties, trade agreements and economic integration areas (CAN, MERCOSUR), have contributed to greater trade integration and interdependence of economies region. This is part of the minimum set of initial conditions required in the process of macroeconomic coordination. While in Latin America cannot be said that there is a full macroeconomic coordination from the theoretical point of view, the efforts made in this regard indicate that the region is aimed at this end.

Moreover, international economic crises have prompted efforts to reduce uncertainty in the domestic economy, by generating positive externalities for the rest of the countries. In this regard, the international financial crisis that hit Latin American economies in 2008 and 2009 generated as main reaction that many countries in the region implement a range of countercyclical measures that allowed mitigate the impact of this crisis on the domestic economy. Applying these countercyclical policies during the crisis was different for each country, depending on economic conditions prior to the period of crisis.

Regarding fiscal policy, the measures taken were aimed at public expense. On the revenue side, the measures were aimed at promoting investment and consumption, by introducing changes in taxes on income (deductions, exemptions), as well as taxes on goods and services.

On the expenditure side, the measures focused on investment in infrastructure, implementation of programs to support business and industry (mainly in the case of SMEs and agricultural production) and the momentum of housing schemes, various social and labor programs. Governments increased current expenditure rather than capital expenditure, by increasing transfers to low-income households as part of the social protection strategy to minimize the effects of the crisis in this sector of the population. Additionally, social measures included subsidies to consumption (electricity, fuel, food and transportation).

Regarding monetary policy, several central banks in the region have taken steps to provide liquidity to domestic financial systems (increased credit lines, liquidity through repurchase agreements, etc.). Also, legal reserve requirements were lowered in order to increase the secondary expansion potential of the money supply and measures were implemented to improve regulation and supervision of the financial system. Interest rates remained low, which helped reduce borrowing costs thanks to lower international prices, favored the reduction of inflation rates.

Macroeconomic policy actions undertaken in Latin America over the past decade indicate advances in the management of the business cycle. The measures of fiscal and monetary policy, implemented by most countries before and during the economic crisis, helped reduce the impact of this on the economies of the region and a revival of economic activity faster than in other regions affected. Below is a breakdown of the macroeconomic measures adopted by countries in the region during the financial crisis



**Table1: Latin America, Macroeconomic measures applied by country, 2008-2011**

Country	Type of measure applied	
	Monetary and financial Policy	Fiscal Policy
<b>Bolivia</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments</li> <li>2. Decrease in rate of liquidity absorption through open market operations (second half of 2008).</li> <li>3. Provision of liquidity in national currency through the redemption of securities issued in open-market operations.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases</li> <li>2. Increase or early disbursement of public spending allocations: US\$ 691 million was invested in infrastructure in 2009 while US\$ 725 million was invested in 2010.</li> </ol>
<b>Brazil</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments: effective legal reserve reduced. (Measure discontinued in february of 2010).</li> <li>2. Liquidity injections in national currency: <ul style="list-style-type: none"> <li>- Rediscount operations streamlined. Authorization to acquire portfolios of small and medium-sized banks (September 2008).</li> <li>- Central bank authorized to grant loans to banks secured by loan portfolios. (Measure discontinued in 2009)</li> </ul> </li> <li>3. Changes to the monetary policy rate</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases: the tax on financial operations was cut from 3% to 1.5% for direct consumer credit operations and the overdraft credit line. (Measure discontinued during 2010). From August 2011, capital goods, construction materials, trucks and light commercial vehicles were exempt from industrial products tax (IPI), under the new industrial policy. (Measure discontinued in 2012).</li> <li>2. Increase or early disbursement of public spending allocations.</li> </ol>
<b>Chile</b>	<ol style="list-style-type: none"> <li>1. Temporary relaxation of legal reserve requirement.</li> <li>2. Liquidity injections in national currency (One stop 28-day and 60-90 day repo operations).</li> <li>3. The central bank announced in July 2009 that it would establish a Term Liquidity Facility (FLAP) for banks, to provide 90- and 180-day liquidity with the current monetary interest rate.</li> <li>4. Changes to the monetary policy rate.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases (Temporary increase in housing subsidy and new subsidy for middle-income housing).</li> <li>2. Increase or early disbursement of public spending allocations (mainly spending on infrastructure and social spending).</li> </ol>
<b>Colombia</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments Reduction in bank reserve for current and savings accounts.</li> <li>2. Liquidity injections in national currency (Provision of temporary liquidity through 14- and 30-day repos).</li> <li>3. Changes to the monetary policy rate (measure discontinued in april on 2010).</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases</li> <li>2. Increase or early disbursement of public spending allocations.</li> <li>3. Priority given to infrastructure programmes and sectors (concessions, major highways, departmental roads, tertiary roads, housing, drinking water and basic sanitation) and to social and productive stimulus programmes.</li> </ol>
<b>Perú</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments: Legal reserve requirement reduced five times for local-currency deposits and three times for foreign-currency deposits. (Measure discontinued in 2011).</li> <li>2. Liquidity injections in national currency (The central bank of Peru lengthened the maturities of loans to some financial institutions).</li> <li>3. Changes to the monetary policy rate</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases</li> <li>2. Increase or early disbursement of public spending allocations</li> <li>3. Other measures: were also announced, mainly aimed at expediting investment. They include a fund of resources from the public sector and pension fund administrators to finance infrastructure works through concessions or publicprivate partnerships.</li> </ol>
<b>Uruguay</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments (measure was discontinued in June 2011).</li> <li>2. Liquidity injections in national currency: Early redemption, in two stages, of securities issued by the central bank, which offers the possibility of obtaining liquidity in local currency or dollars (November 2008).</li> <li>3. Changes to the monetary policy rate</li> </ol>	<ol style="list-style-type: none"> <li>1. Tax cuts or benefits and subsidy increases: exemption from the economic activities income tax (the manufacture of energy equipment was 100% exempted from IRAE).</li> <li>2. Other measures: Cut of at least 5% in spending and investment by the Government and public enterprises. Increase in specific domestic tax (Imesi)</li> </ol>
<b>Venezuela</b>	<ol style="list-style-type: none"> <li>1. Legal reserve adjustments</li> <li>2. To stimulate lending, Venezuela's central bank kept interest rates unchanged major commercial and universal banks.</li> </ol>	<ol style="list-style-type: none"> <li>1. Increase in the VAT rate from 9% to 12%.</li> <li>2. Other measures: spending cuts decreed for budget items the authorities considered to be superfluous, such as changes of vehicles and representation expenditures</li> </ol>

Source: ECLAC

### III. Stylized Macroeconomic Facts

During the period 2000 - 2013, the economic performance of Latin America was significantly influenced by external and internal events that marked macroeconomic trends in the region. At the beginning of the period, the economies of the region showed a recovery after the Asian crisis of 1997, due to improved economic conditions in the international context. The commodity prices and trade flows began to increase simultaneously reviving Asian and European economies. The situation in external markets for goods turned positive, while the world economy maintained a growth trend.

However, this economic recovery was brief. For 2001 and 2002, unfavorable external economic conditions were present; the economies of the region were affected negatively. The 2001 recession resulted in a contraction of international trade, which was compounded by falling prices of commodities, causing deterioration in the terms of trade, mainly in non-oil economies in the region.

The negative effect of the international situation was not limited to the export sector and spread to all other areas of activity, with the most severe consequences in the domestic economy. Thus, the economic activity of the countries in the sample showed an average growth of 1.2% for the first period.

**Table 2: Latin America, GDP growth, 2000 – 2012**  
(Dollars at constant 2005 prices)

	2000 - 2003	2004 - 2008	2009 - 2012
<b>Bolivia</b>	2.3	4.8	4.5
<b>Brazil</b>	2.4	4.8	2.7
<b>Chile</b>	3.7	5.5	4.0
<b>Colombia</b>	2.8	5.4	4.1
<b>Perú</b>	3.0	7.7	5.7
<b>Uruguay</b>	-3.2	6.1	5.4
<b>Venezuela</b>	-2.4	10.5	1.3
<b>Total</b>	<b>1.2</b>	<b>6.4</b>	<b>4.0</b>

Source: ECLAC

In terms of prices, inflation continued to show a downward trend in most countries, reaching 7.9% for the period 2000-2003.

**Table 3: Latin America, Annual average inflation, 2000 – 2012**  
(Percentages)

	2000 - 2003	2004 - 2008	2009 - 2012
<b>Bolivia</b>	3.0	8.1	5.1
<b>Brazil</b>	8.7	5.1	5.5
<b>Chile</b>	2.8	4.9	2.3
<b>Colombia</b>	7.3	5.5	3.3
<b>Perú</b>	2.4	2.8	2.9
<b>Uruguay</b>	10.3	6.8	7.5
<b>Venezuela</b>	20.8	19.9	25.6
<b>Total</b>	<b>7.9</b>	<b>7.6</b>	<b>7.5</b>

Source: ECLAC

The slowdown in economic activity caused adverse effects in the labor market. In this regard, the unemployment rate in the region was 8.4%, while the employment rate fell by more than half a percentage point. Meanwhile, the labor supply fell sharply, reaching the lowest level in ten years.

With regard to the financial situation, falling stock indexes and the uncertainty following the events of September 2001 in the United States, those had a negative effect on the world economy. Additionally, some facts from the region were added to the previous events such as the financial crisis in Argentina (which generated some impact on neighboring economies, such as Uruguay, Brazil and Chile), political conflict emerged in Venezuela in late 2002 and the energy crisis in Brazil.

In the period between 2004 and 2008 visualizes a new situation in the region, linked to favorable external conditions, again. This contributed to improve terms of trade in the region. Thus, exports increased significantly becoming the main engine of the recovery for economies in the Latin Americas region. Commodity prices reached unprecedented levels favoring exporting economies. According to ECLAC measurements and own computations, economic activity during this period for the selected countries grew at an average rate of 6%. In this context, average inflation was relatively stable, reaching about 7%.

This growth process was interrupted by the deterioration of the international financial context, generated by the financial crisis in the United States in mid-2007 and later spread worldwide.

However, the effects of the crisis begin to impact the economies of the region in late 2008. Although these effects occurred differently in each of the countries of Latin

America, it is noteworthy that unlike previous crises, the recession of 2007 upset all economies in the region. In addition to the contraction in economic activity, during 2008 - 2009 was shown a decline in inflation, as a result of the fall in international prices of some commodities, the contraction of domestic demand and the appreciation of the exchange rate.

The recovery in Latin America was manifested in a faster way than in the rest of the regions affected by the global economic downturn. Thus, from the second half of 2009 encouraging signs are emerging in most countries of the region, with the exception of Venezuela, whose recovery begins from the first quarter of 2011.

In short, the macroeconomic performance in Latin America and the Caribbean over the past decade shows a significant influence of the conditions of the international context: economic crisis episodes, negative changes in export markets and periods of difficult access to external financing.

#### IV. MODEL

Policy coordination is essential to assess the impact of mixed set of economic policies that can be incorporated or combined in any economy. In our case, this paper covers different countries, so it's necessary to have a common model for a uniform assessment of this coordination in different countries.

Following Clarida et. al. (2000), Lubik and Schorfheide (2004), Woodford (2003) and Leeper (2005), the proposed model tracks the new macroeconomic vintage. The elaborated model is transversal or common to all countries studied. In this line, the role of fiscal and monetary policy is active according to their instruments to deal with adverse shocks in the economy. In this case, depending of Policy Makers' target policies can be in the same direction or in opposite directions. In the latter case, there isn't coordination and policies would have small or null effect on the economy.

#### HOUSEHOLDS

The representative household has a non-separable function between consumption and labor and separable in Money. This kind of utility function shows the policy effects on the individual utility function of fiscal and monetary.

$$U\left(C, L, \frac{M}{P}\right): \sum_1^{\infty} \beta^t \left( \frac{\left(C_t L_t^{\varphi}\right)^{1-\sigma}}{1-\sigma} + \xi \left(\frac{M}{P}\right)_t^{\mu} \right) \quad 1$$

st.

$$P_t C_t + P_t I_t + inom_t B_{t+1}^T + M_t = W_t N_t + Z_t K_t + M_{t-1} + B_t^T \quad 2$$

$C_t$  total consumption,  $L_t$  leisure,  $\left(\frac{M}{P}\right)_t$  demand for real balances,  $\sigma$  the parameter of risk aversion,  $\varphi$  elasticity of labor dis-utility,  $\mu$  and  $\xi$  parameters  $> 0$ ,  $\beta^t$  subjective factor discount. The last parameter would suggest household's rationality of the economy that would be related to poverty structure or income distribution.

In the budget restriction:  $P_t$  represents Price on the economy,  $I_t$  investment,  $inom_t$  nominal interest rate,  $B_t^T$  total debt stock,  $M_t$  nominal Money holding by households,  $W_t$  wages,  $N_t$  labor,  $Z_t$  capital return,  $K_t$  capital stock of the economy.

Capital law of movement doesn't include adjustment cost, so our model does not suppose firm's sunk costs.

$$K_{t+1} = (1 - \delta)K_t + I_t \quad 3$$

From maximization process we obtain the consumption Euler equation that contains the effect of labor supply, since the no separable characteristic.

$$\left(C_t (1 - N_t)^\varphi\right)^{-\sigma} = \beta \left(C_{t+1} (1 - N_{t+1})^\varphi\right)^{-\sigma} \left[\left(\frac{Z}{P}\right)_{t+1} + (1 - \delta)\right] \quad 4$$

The labor supply is:

$$\varphi C_t^T (1 - N_t^T)^{\varphi-1} = \left(\frac{W}{P}\right)_t^T \quad 5$$

Micro funded demand of real balances of households is:

$$\mu \xi \left(\frac{M}{P}\right)_t^{\mu-1} = (C_t^T (1 - N_t^T)^\varphi)^{-\sigma} - \beta (C_{t+1}^T (1 - N_{t+1}^T)^\varphi)^{-\sigma} \frac{1+r_t}{1+inom_t} \quad 6$$

## FIRMS

The production function is Cobb Douglas having capital, labor and technology.

$$Y_t = A_t K_t^\alpha N_t^{1-\alpha} \quad 8$$

Where  $Y_t^T$  is the total production,  $A_t$  the productivity that follows an AR(1) process.

$$A_t = \rho_t^A A_{t-1} + \varepsilon_t^A \quad 9$$

$\varepsilon_t^A$  is the productivity shock. We suppose that market failure, so firms minimize costs. The last is used to obtain labor and capital demand.

$$\alpha \frac{Y_t}{K_t} = \left( \frac{Z}{P} \right)_t \quad 10$$

$$(1 - \alpha) \frac{Y_t}{N_t} = \left( \frac{W}{P} \right)_t \quad 11$$

### PRICES

Prices on the economy are composed by domestic and foreign inflation.

$$\pi_t^T = \lambda \pi_t^{dom} + (1 - \lambda) \pi_t^{ext} \quad 12$$

Where  $\lambda$  is the proportion of domestic inflation and  $1 - \lambda$  the proportion of foreign inflation.

Since the market is imperfect, the economy has rigidities in prices and under the assumption of monopolistic competition, following Galí and Gertler (1999), an application for Bolivia, Valdivia (2008), applying the long-term relationship between the product and marginal costs,  $Y_t = \lambda^{\theta^A} mc_t$ , domestic inflation is:

$$\pi_t^{dom} = \xi_t^f \pi_{t+1}^{dom} + \xi_t^b \pi_{t-1}^{dom} + \lambda^{\theta^A} \lambda^A y_t \quad 13$$

$\xi_t^f$ ,  $\xi_t^b$  are forward y backward looking components of the Phillips Curve and  $\lambda^A$  marginal cost effect on the inflation.

### FISCAL SECTOR

Fiscal sector is explained by budget restriction in term of GDP.

$$b_{t+1}^T \dot{y}_{t+1} - b_t^T = g_t + inom_t b_t^T + \tau_t^T \quad 14$$

Total debt is composed by internal and external debt in terms of GDP.

$$b_t^T = b_t^{int} + b_t^{ext} \quad 15$$

External debt responds to investment in the economy and fiscal expenditure.

$$b_t^{ext} = \phi I_t^T + (1 - \phi)g_t \quad 16$$

Tax revenue in terms of GPD is in function of dynamic of the economy, economic growth, and domestic inflation.

$$\tau_t^T = \omega \pi_t^{dom} + (1 - \omega)y_t^T \quad 17$$

Where  $\omega < (1 - \omega)$  represents the second round effect of inflation on tax revenues.

### MONETARY POLICY

Monetary policy is characterized by two instruments: i) nominal interest rate<sup>1</sup> and, ii) the quantity of money fixed by a monetary rule. Monetary policy's response follows a modified version of Henderson – McKibbin – Taylor (HMT) rule.

$$inom_t = \rho^{inom} inom_{t-1} + \lambda^\pi \pi_t^T + (1 - \lambda^\pi)y_t^T + \chi^s \Delta s_{t+1} \quad 18$$

$$m_t = \rho^m m_{t-1} - \chi^\pi \pi_t^T + (1 - \chi^\pi)y_t^T + \varepsilon_t^m \quad 19$$

A main feature between the above two instruments for the monetary policy is time transmission. The transmission of interest rate changes of monetary policy will take longer than the withdrawal or introduction of liquidity on the economy by OMO.

### EXTERNAL SECTOR

External inflation and production follow an AR(1) process.

$$\pi_t^{ext} = \rho^{ext} \pi_{t-1}^{ext} + y_t^{ext} \quad 20$$

$$y_t^{ext} = \rho^{yext} y_{t-1}^{ext} + \varepsilon_t^{ext} \quad 21$$

Exchange rate variation is explained by power purchase parity (PPP).

$$\Delta s_t = \pi_t^{ext} - \pi_t^{dom} \quad 22$$

Exports and imports respond negatively to external inflation and production.

$$x_t = \rho^x x_{t-1} - \pi_t^{ext} + y_t^{ext} \quad 23$$

$$im_t = \rho^{im} im_{t-1} + \pi_t^{ext} - y_t^{ext} \quad 24$$

### CLOSING THE MODEL

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<sup>1</sup> Under the assumption that this rate affects the economy, there is no financial system.

In order to close the model, we use the Fisher equation and GDP measured by total spending of the economy.

$$Y_t^T = C_t^T + I_t^T + X_t - IM_t + G_t \quad 25$$

$$\frac{1+inom_t}{1+r} = 1 + \pi_t^T \quad 26$$

## V. DATA AND CALIBRATION

For parameter calibration and measure the degree of policy coordination in selected economies, we use CEPALSTATS database, Key Labor Market Indicators (ILO) and quarterly and annual data of the International Monetary Fund, understanding that the "deep" parameters are stable in the long run.

The series used cover the period 2000 – 2012: consumption, gross fixed capital formation in national currency, consumer price index (normalized for all countries base don2005), monetary policy rates, trade balance (exports and imports), exchange rate of local currencies against the US dollar, monetary aggregate (M2, given the continued availability to all countries), government spending, and estimated working population, per capita GPD as proxy by wages and GDP growth.

Before data used, there were pre-whitening by applying X-12, methodology proposed by NBER, and through the combination of filters, Christiano Fitzgerald and HP<sup>2</sup>. In addition, some parameters associated with unobservable variables were taken from DSGE models made for selected economies and Hybrid New Keynesian Phillips curves<sup>3</sup>.

Country calibration is consistent with other papers done for these economies; however, in some cases it was different from that found, for example backward looking parameter of the Colombian economy, which had negative values in the document prepared for this. In this case, given the temporality of the model structure in nonlinear difference equations and solving stochastic nature of 2nd order, the structure of the model imposes limits consistent with the theory, this reason led to the re calibration of Phillips curve for the Colombian case.

Calibration results are presented in table 4.

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<sup>2</sup> In both cases to keep the parsimony at the moment of comparing the results, default values suggesting by both filters are applied.

<sup>3</sup> The documents taken are part of the bibliographic.



**Table 4: Computed and calibrated parameters for selected economies**

	Bolivia			Brazil			Chile			Colombia			Peru			Uruguay			Venezuela		
Parameters	00-12	07-08	09-10	00-13	07-08	09-10	00-13	07-08	09-10	00-13	07-08	09-10	00-13	07-08	09-10	00-13	07-08	09-10	00-13	07-08	09-10
$\beta$	0,929	0,994	1,002	0,894	0,905	0,944	0,973	0,968	0,988	0,972	0,965	0,989	0,972	0,951	0,99	0,928	0,997	0,985	1	1	1
$\varphi$	0,620	0,571	0,578	0,836	0,813	0,815	0,739	0,701	0,700	0,871	0,749	0,850	0,899	0,880	0,879	0,658	0,594	0,595	0,758	0,718	0,720
$\sigma$	1,5	1,3	0,8	1,3	1,22	1,38	0,998	0,865	1,34	0,212	0,221	0,35	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
$\xi$	1,9	2	1,8	1,5	1,8	1,3	1,5	2,3	1,6	1,8	2,1	1,6	1,6	1,7	1,4	1,9	2,3	1,8	1,5	1,6	1,4
$\mu$	1,597	1,37	1,27	1,25	1,171	1,254	1,255	1,263	1,252	1,146	1,214	1,159	1,26	1,201	1,238	1,386	1,306	1,322	1,404	1,348	1,3804
$\delta$	0,025	0,025	0,025	0,015	0,015	0,015	0,019	0,019	0,019	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025
$\alpha$	0,66	0,66	0,66	0,448	0,448	0,448	0,7	0,7	0,7	0,38	0,38	0,38	0,26	0,26	0,26	0,3	0,3	0,3	0,35	0,35	0,35
$\rho^a$	0,75	0,8	0,6	0,7	0,8	0,6	0,5	0,6	0,4	0,5	0,5	0,5	0,6	0,65	0,55	0,6	0,68	0,58	0,5	0,5	0,5
$\lambda$	0,85	0,7	0,95	0,79	0,5	0,79	0,96	0,8	0,96	0,5	0,3	0,6	0,6	0,3	0,6	0,6	0,5	0,6	0,4	0,3	0,5
$\xi^f$	0,5	0,5	0,5	0,442	0,442	0,442	0,543	0,543	0,543	0,946	0,946	0,946	0,66	0,66	0,66	0,65	0,65	0,65	0,58	1,58	2,58
$\xi^b$	0,4	0,4	0,4	0,45	0,45	0,45	0,496	0,496	0,496	0,108	0,108	0,108	0,388	0,388	0,388	0,55	0,55	0,55	0,42	-0,58	-1,58
$\lambda^{\theta A}$	1,1	1,1	1,1	1,2	1,2	1,2	0,186	0,186	0,186	0,159	0,159	0,159	1	1	1	0,26	0,26	0,26	0,084	0,084	0,084
$\lambda^A$	0,3	0,3	0,3	0,15	0,15	0,15	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
$\phi$	1,8	1,8	1,8	1,5	1,5	1,5	0,8	0,8	0,8	1,1	0,8	0,8	1,5	0,8	0,8	1,4	0,8	0,8	1,3	0,8	0,8
$\omega$	0,5	0,5	0,5	0,7	0,7	0,7	0,65	0,65	0,65	0,55	0,65	0,65	0,57	0,65	0,65	0,45	0,65	0,65	0,3	0,65	0,65
$\rho^{inom}$	0,967	0,976	0,967	0,983	0,99	0,7	0,97	0,98	0,84	0,972	0,99	0,95	0,964	0,98	0,93	0,975	0,986	0,953	0,974	0,981	0,951
$\lambda^\pi$	2,5	2,8	2	2	2,5	1,832	2	2,5	2	1,9	2,167	1,893	1,6	1,8	1,2	1,7	1,9	1,3	2	2,5	2,1
$\chi_s$	0,19	0,19	0,19	0,07	0,07	0,07	0,05	0,05	0,05	0,08	0,08	0,08	0,05	0,05	0,05	0,08	0,08	0,08	0,5	0,5	0,5
$\chi_\pi$	2,3	3	0,5	1,6	2	1,2	1,5	1,6	1,3	1,516	1,517	1,45	1,9	2,3	1,652	1,65	1,85	1,326	0,66	0,88	0,33
$\rho^m$	0,923	0,954	0,903	0,961	0,976	0,931	0,97	0,986	0,925	0,961	0,985	0,925	0,948	0,968	0,935	0,953	0,985	0,924	0,895	0,933	0,8751
$\rho^{\pi ext}$	0,97	0,99	0,98	0,99	0,999	0,989	0,99	0,989	0,21	0,98	0,99	0,97	0,989	0,995	0,981	0,978	0,99	0,978	0,988	0,993	0,9789
$\rho^{y ext}$	0,98	0,99	0,97	0,99	0,995	0,986	0,996	0,999	0,991	0,984	0,99	0,97	0,997	0,996	0,987	0,983	0,996	0,954	0,99	0,99	0,99
$\rho^x$	0,99	0,99	0,99	0,995	0,995	0,995	0,993	0,993	0,993	0,996	0,996	0,996	0,989	0,989	0,989	0,988	0,988	0,988	0,987	0,987	0,987
$\rho^{imp}$	0,99	0,99	0,99	0,991	0,991	0,991	0,987	0,987	0,987	0,989	0,989	0,989	0,995	0,995	0,995	0,986	0,986	0,986	0,996	0,996	0,996

Source: Authors computations

## VI. MAIN RESULTS OF POLICY COORDINATION

We used Dynare to obtain the results. The moments estimated by the models are testable with the results observed in the series, Table 5.

**Table 5: Average computed by simulation for selected economies (2000-2012)**

	<b>Bolivia</b>	<b>Brazil</b>	<b>Chile</b>	<b>Colombia</b>	<b>Peru</b>	<b>Uruguay</b>	<b>Venezuela</b>
<b>btot</b>	0,5003	0,4996	0,5005	0,5001	0,5004	0,4995	0,4895
<b>ktot</b>	3,0067	2,9907	2,9960	3,0016	2,9965	2,9961	2,8755
<b>ntot</b>	0,4000	0,4001	0,4000	0,4000	0,4000	0,4000	0,4011
<b>ctot</b>	0,8003	0,7992	0,7997	0,8000	0,7997	0,7996	0,7899
<b>wptot</b>	2,5002	2,4993	2,4998	2,5000	2,4997	2,4997	2,4916
<b>md</b>	0,1504	0,1487	0,1577	0,1468	0,1531	0,1477	0,1479
<b>zptot</b>	3,0042	3,0425	3,0160	3,0201	3,0160	3,0126	3,1846
<b>pitot</b>	0,0802	0,0797	0,0798	0,0800	0,0799	0,0801	0,0770
<b>pidom</b>	0,0704	0,0694	0,0698	0,0700	0,0695	0,0702	0,0615
<b>g</b>	-0,0003	0,0009	0,0001	-0,0001	-0,0001	0,0006	0,0124
<b>piext</b>	0,0100	0,0100	0,0100	0,0100	0,0100	0,0100	0,0100
<b>ytot</b>	0,0302	0,0297	0,0298	0,0299	0,0300	0,0300	0,0288
<b>i</b>	0,1502	0,1496	0,1500	0,1500	0,1503	0,1498	0,1465
<b>bint</b>	0,2997	0,3007	0,3005	0,3001	0,2999	0,3000	0,2979
<b>bext</b>	0,2006	0,1989	0,2000	0,2000	0,2005	0,1995	0,1917
<b>tau</b>	0,1503	0,1495	0,1498	0,1500	0,1497	0,1501	0,1466
<b>yext</b>	0,0400	0,0400	0,0400	0,0400	0,0400	0,0400	0,0400
<b>v_s</b>	0,0396	0,0406	0,0402	0,0400	0,0405	0,0398	0,0485
<b>inom</b>	0,1217	0,1224	0,1225	0,1204	0,1212	0,1218	0,1272
<b>ms</b>	0,1310	0,1256	0,1433	0,1185	0,1345	0,1214	0,1262
<b>ba</b>	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000	0,1000
<b>x</b>	0,3000	0,3000	0,3000	0,3000	0,3000	0,3000	0,3000
<b>im</b>	0,2700	0,2700	0,2700	0,2700	0,2700	0,2700	0,2700
<b>r</b>	0,0414	0,0425	0,0425	0,0404	0,0413	0,0416	0,0498

Source: Authors calculation

Shocks introduced responds to business cycle characteristics. In whole sample, only the conventional policies act: increases in interest rates, control of quantity of money and introduction of fiscal spending to boost the economy.

The second period is explained by global economy inflationary period, strong external shock prices, which resulted in a pass-through effect on domestic and total inflation in the economies and domestic shocks prices. In this scenario, the two instrument of political economy act counter-cyclically to safeguard the welfare loss of the economy: i) monetary policy increases interest rates and contracts liquidity of the economy and ii) fiscal policy spending reduce.

The third phase is characterized by an adverse scenario of the world economy, low growth rates of the relevant external outcome for selected economies, which results in negative external shocks. In this case, monetary policy enforces the dynamics of the economies through interest rates reduction and introduces liquidity, while fiscal policy to address the decline in economic injected higher spending.

**Table6: Simulated scenarios**

Period	Monetary Policy		Fiscal Policy	Domestic Shock Price	External Shock Price	External GDP Shock
	i	M				
<b>2000-2012</b>	+	-	+			
<b>2007-2008</b>	+	-	-	+	+	
<b>2009-2010</b>	-	+	+			-

Source: Authors

In order to capture the degree of policy coordination, we compute the degree of correlation that would be present in adverse periods (2007-2008 and 2009-2010), which is obtained by capturing the correlation of monetary aggregate and fiscal spending changes, and interest rates and government spending, table 7 and table 8.

**Table7: Monetary and fiscal shock correlation**

Period	Bolivia	Brazil	Chile	Colombia	Peru	Uruguay	Venezuela
<b>2007-2008</b>	-0,263	0,746	0,217	0,081	-0,354	0,018	0,873
<b>2009-2010</b>	-0,963	0,392	-0,998	-0,450	-0,017	0,142	0,863

Source: Authors calculation

**Cuadro8: Interest rate and fiscal shock correlation**

Period	Bolivia	Brazil	Chile	Colombia	Peru	Uruguay	Venezuela
<b>2007-2008</b>	0,568	0,980	-0,444	0,962	-0,840	-0,759	-0,739
<b>2009-2010</b>	-0,256	0,898	0,896	0,919	0,638	0,194	0,995

Source: Authors calculation

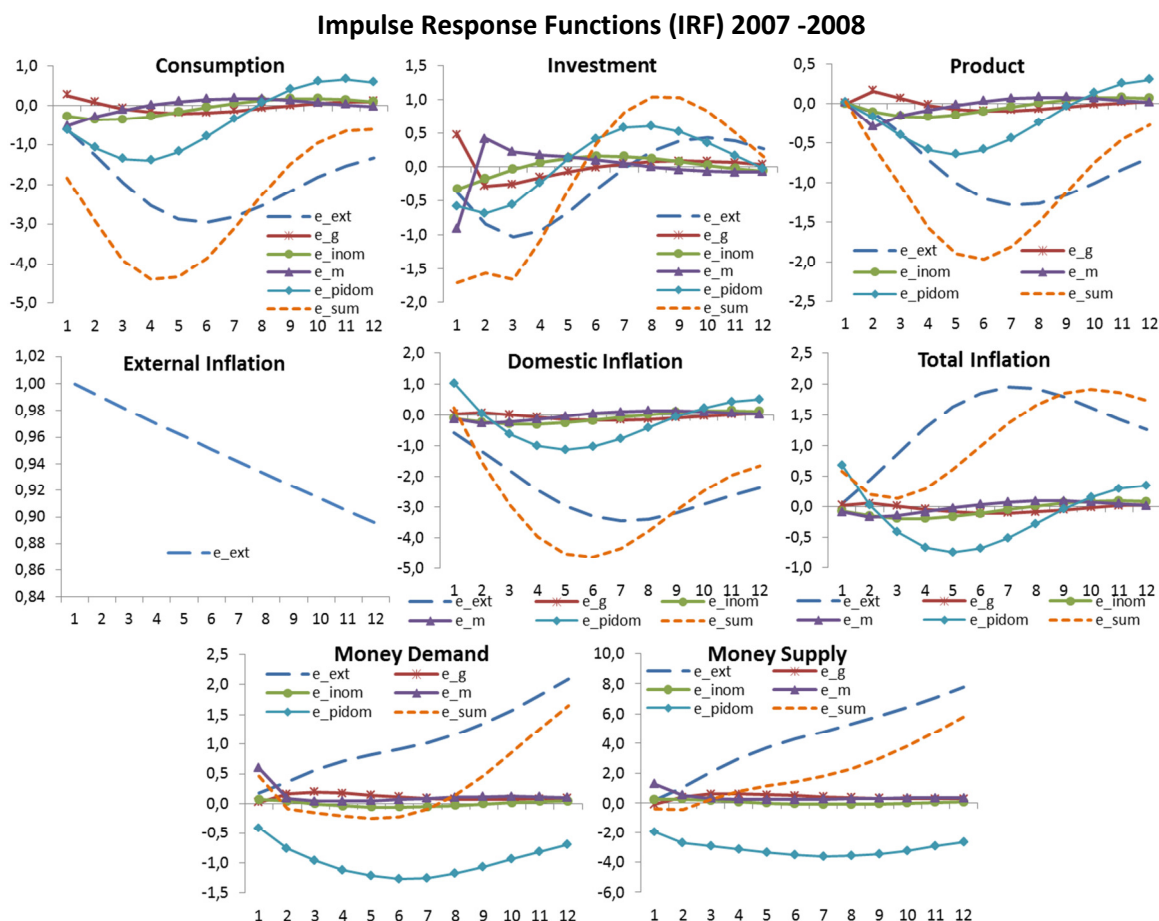
Since we don't have certainty of the size of shock that hit the economies and the responsiveness of policies, despite being described in previous sections, to compute the results it is assumed 1% of adverse shocks and 1% policy responses. The differences in the results are given by the structure of the parameters that characterize each economy and periods, also by the sign of shock policy.

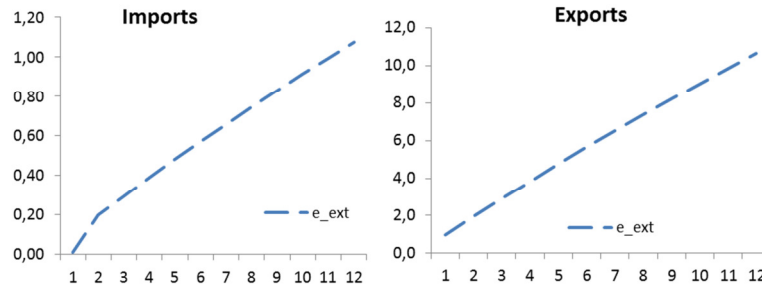
The main results are shown on the following variables: consumption, investment, imports, exports, demand and supply of money, internal, external and total inflation and output growth.

Each model is subjected to different shocks and we obtain a total outcome ( $e_{sum}$ ) as a consequence of the sum of the shocks.

## Bolivia

The results for the first phase, 2007-2008, show that the efforts made by the coordination of monetary and fiscal policy managed the inflation and control it; however, this had consequences in the level of outcome, it reduced. 6 quarters ahead can be seen that this level reached about 2%. An interesting result is the response of total inflation against external inflation, the IRF total inflation shows that the shock occurred in this period it was mainly due to external reasons and it was offset by the combination of policies applied.

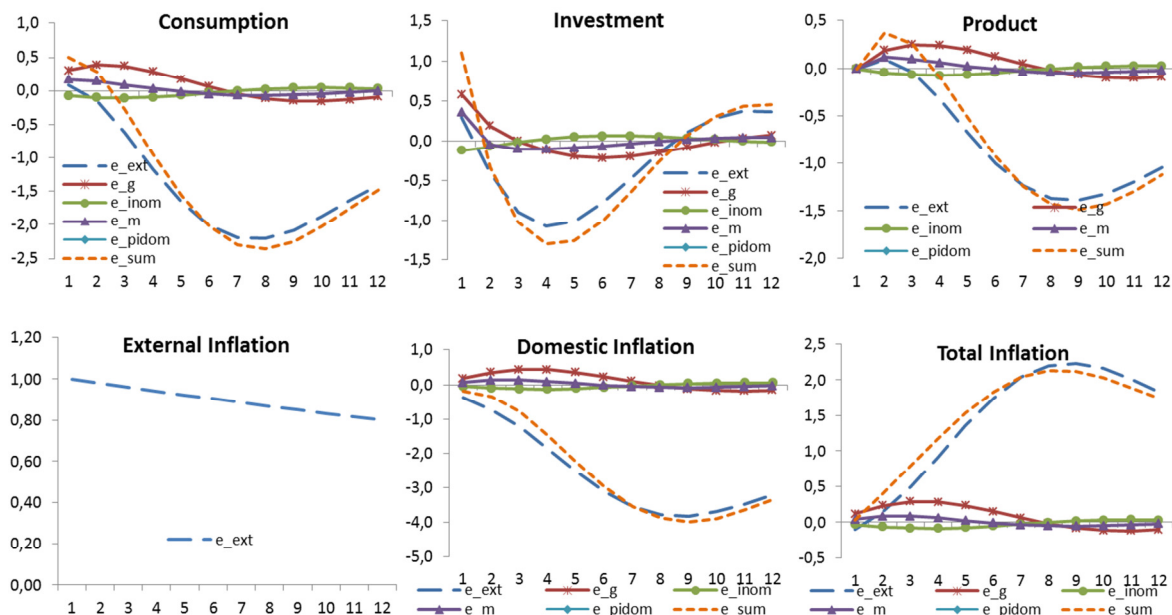


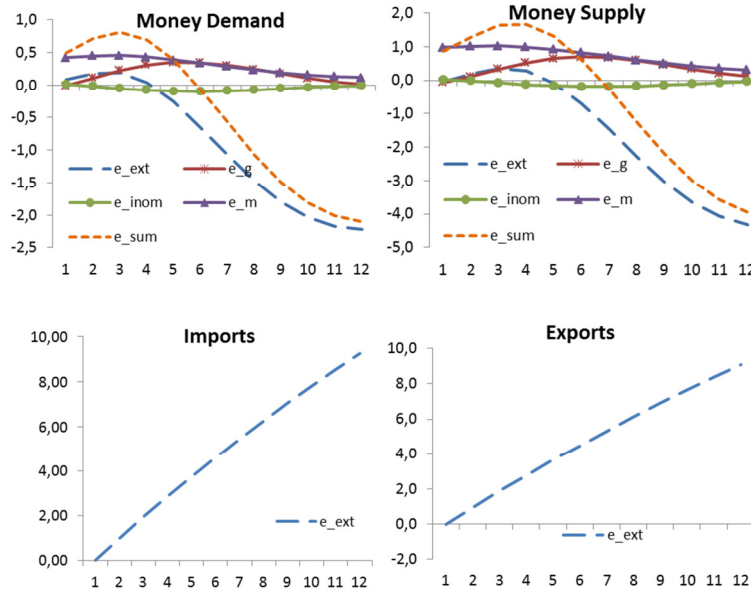


Additionally it shown that the demand of money was offset, this effect is reflected after one quarter and lasted for four consecutive quarters, effect which contributed to inflation moderation.

In the second period, 2009 -2010, the Bolivian economy suffers external shocks that affect economic activity; in this case, both policies act counter-cyclically to mitigate the negative effect, boosting the economy through low interest rates and injecting liquidity; as well as increased fiscal spending. In this scenario, higher fiscal expenditure does have a greater effect on consumption, about 0.25%, and added the monetary policy effort, this variable raises around 0.5%, outcome that allow sustain positive growth rates for the next four quarters. To this result, additionally we observe a positive effect on the investment.

### Impulse Response Functions (IRF) 2009 -2010

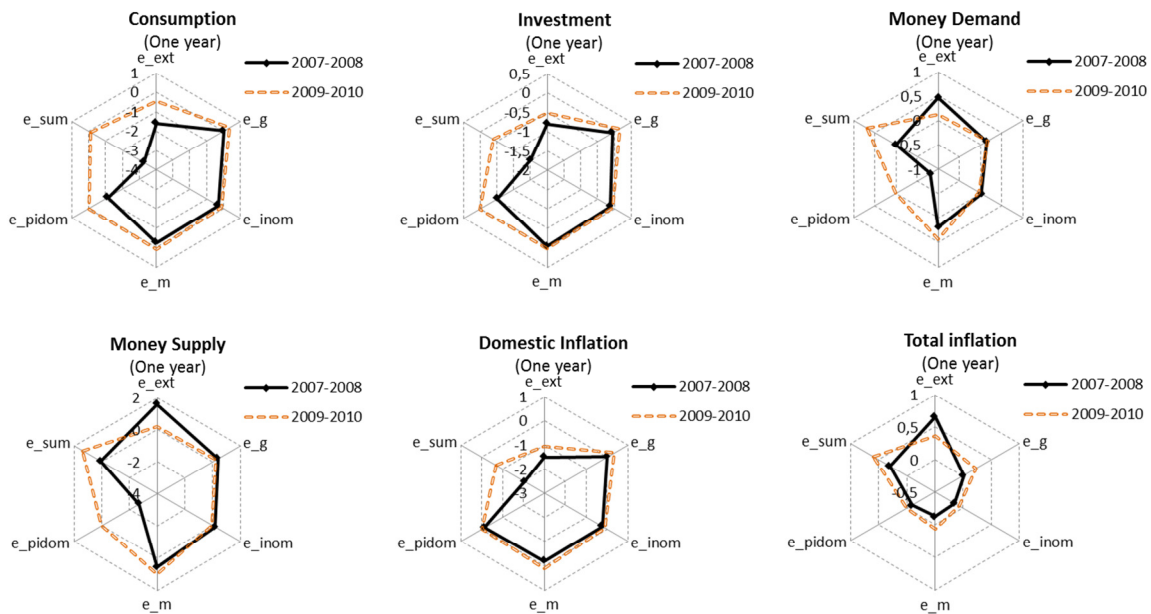


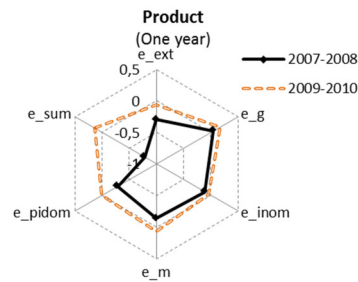


In this period, the liquidity in the economy contributes adequately to fiscal effort, while maintaining inflation at stable levels.

Comparison of these policies is through radial charts, allowing observing a year average effect on the selected variables. Imports, exports and foreign inflation are omitted because they are only affected by external shock.

### A year effect comparison over the selected variables

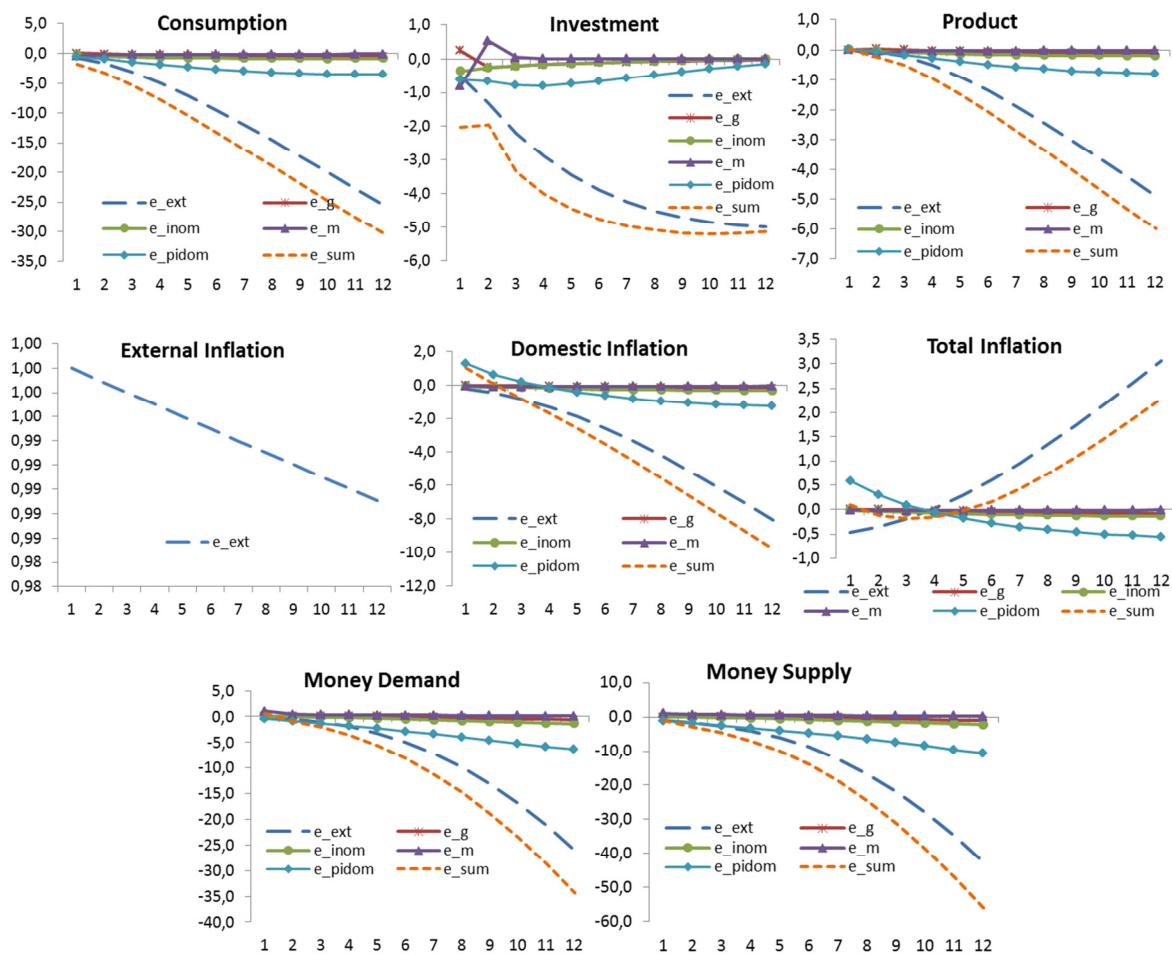


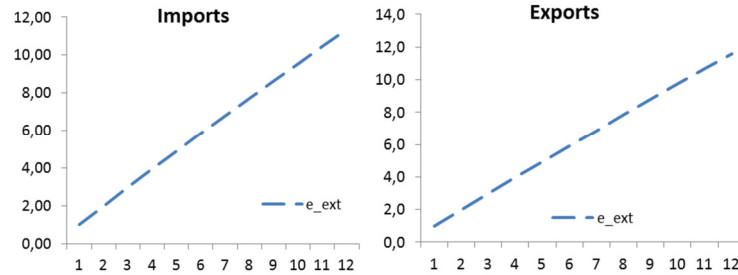


## Brazil

In case of the Brazilian economy, while inflation was under control during the inflationary period, this caused a negative effect on the investment level, -2%. This result would be compared with falling growth expectations by agents. As in the case of Bolivia, the origin of the inflation shock was external.

### Impulse Response Functions (IRF) 2007 -2008



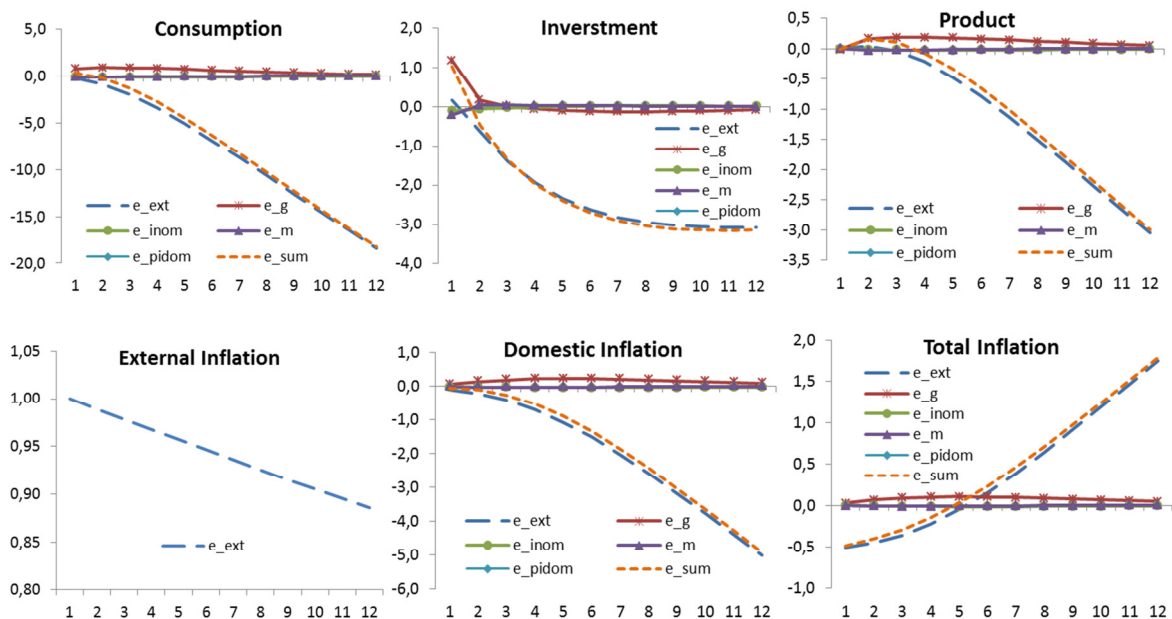


Proper implementation of policies helps to control the demand of money through a sharp contraction in liquidity; however, this resulted in a sacrifice economic growth rate. This policy mix resulted in a more effective control by the monetary policy in contrast to fiscal policy.

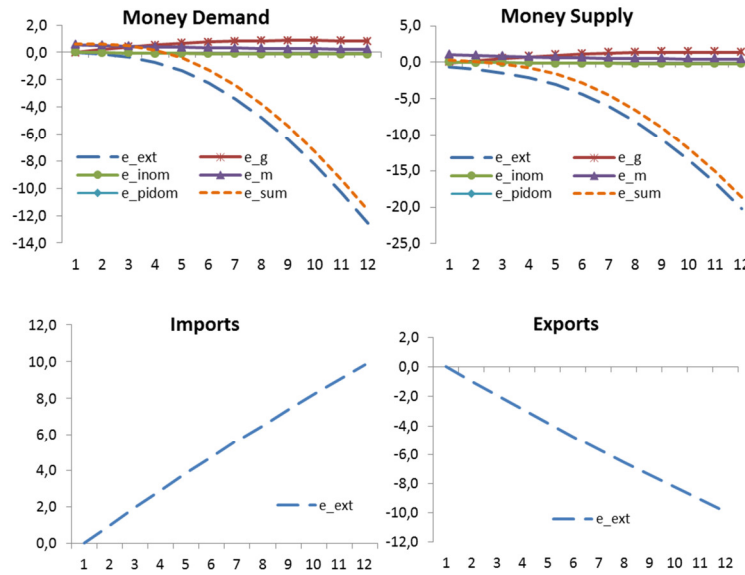
In the period 2009 - 2010, despite the liquidity and interest rate cut by the central bank of each country, it contributes marginally to economic growth. The economic growth is supported mainly by the fiscal shock (almost permanent). The last would sustain the economic growth, despite the negative shock, for at least one year.

In this scenario, policies controlled inflation over the next five quarters, thanks to liquidity control conducting by the monetary authority.

### Impulse Response Functions (IRF) 2009 -2010

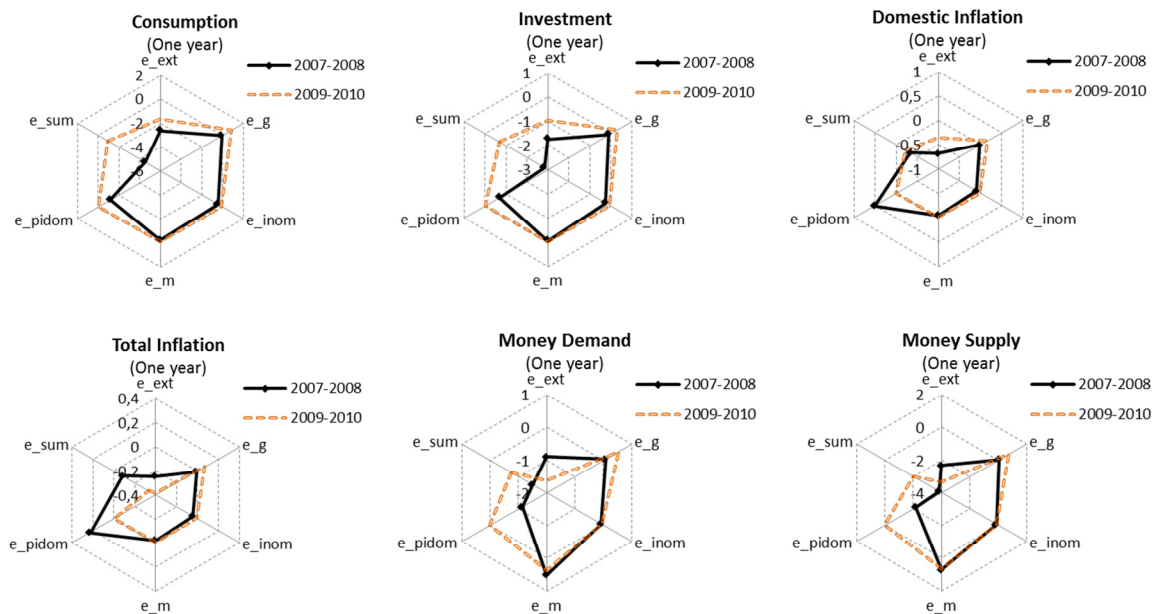


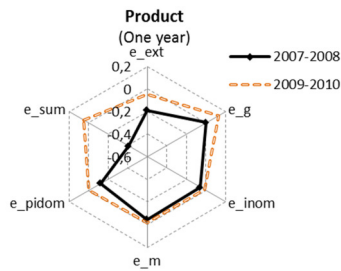




Comparison of these policies in the case of Brazil allows us to observe the effectiveness of fiscal and monetary policy in controlling different shocks on the economy.

### A year effect comparison over the selected variables





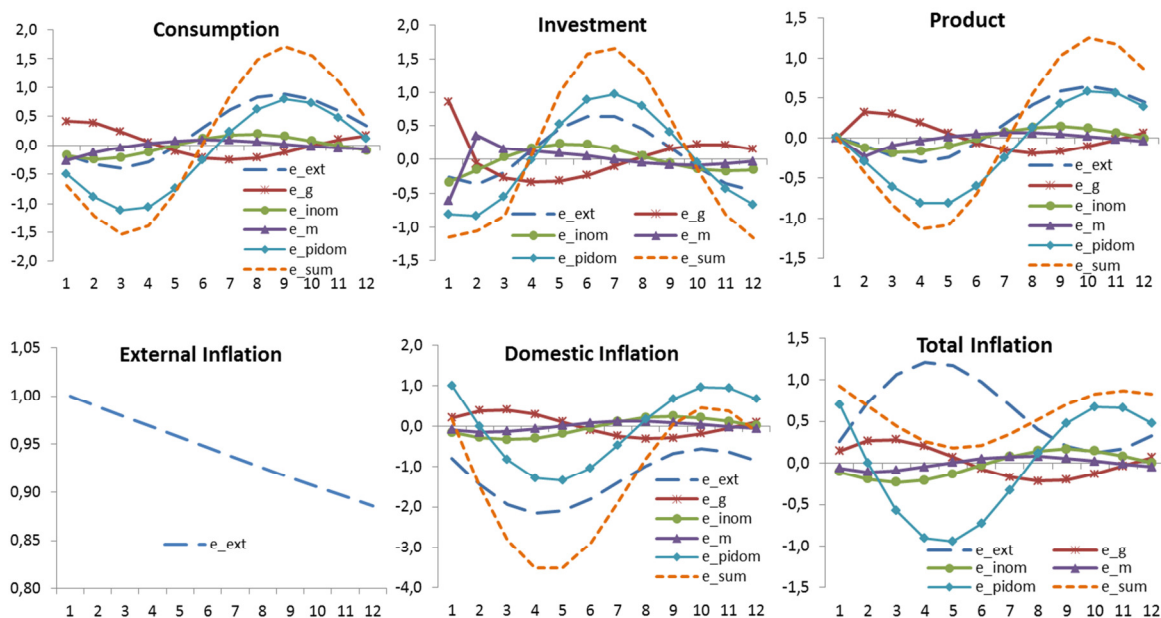
In this case, we can see there was a marginal positive effect on the level of output in the second period.

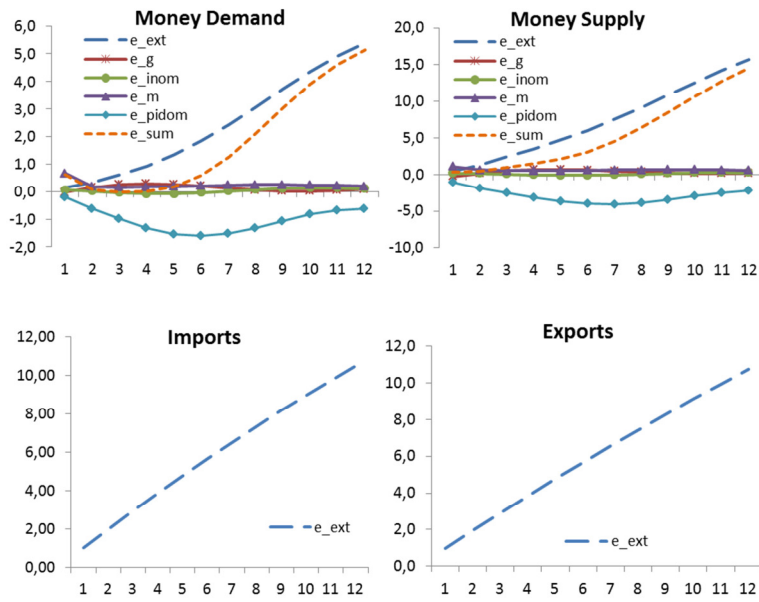
## Chile

In this case, the Chilean economy faces a special situation during the period 2007 – 2008. In 2007 the structural surplus target is reduced to 0.5% of GDP in order to release resources to the economy and be designed to impulse domestic demand through a complex scenario, since this economy is directly subject to international shocks of price and production.

At this stage, monetary policy controls inflation through their instruments, in contrast to fiscal spending, because this instrument introduces successive increments of liquidity to the economy by direct investment and higher transfers.

### Impulse Response Functions (IRF) 2007 -2008





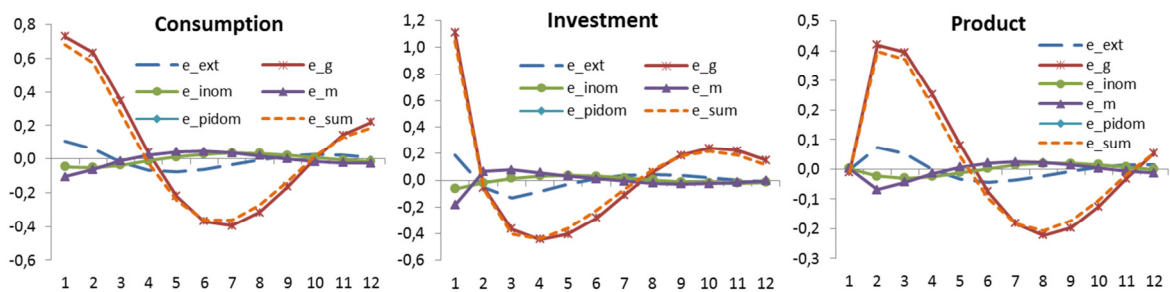
In this period it shows that despite the efforts of fiscal policy to generate higher levels of economic growth, the overall effect of shocks are negative, reducing the level of outcome, at least for the following four consecutive quarters, this effect would be around 1%.

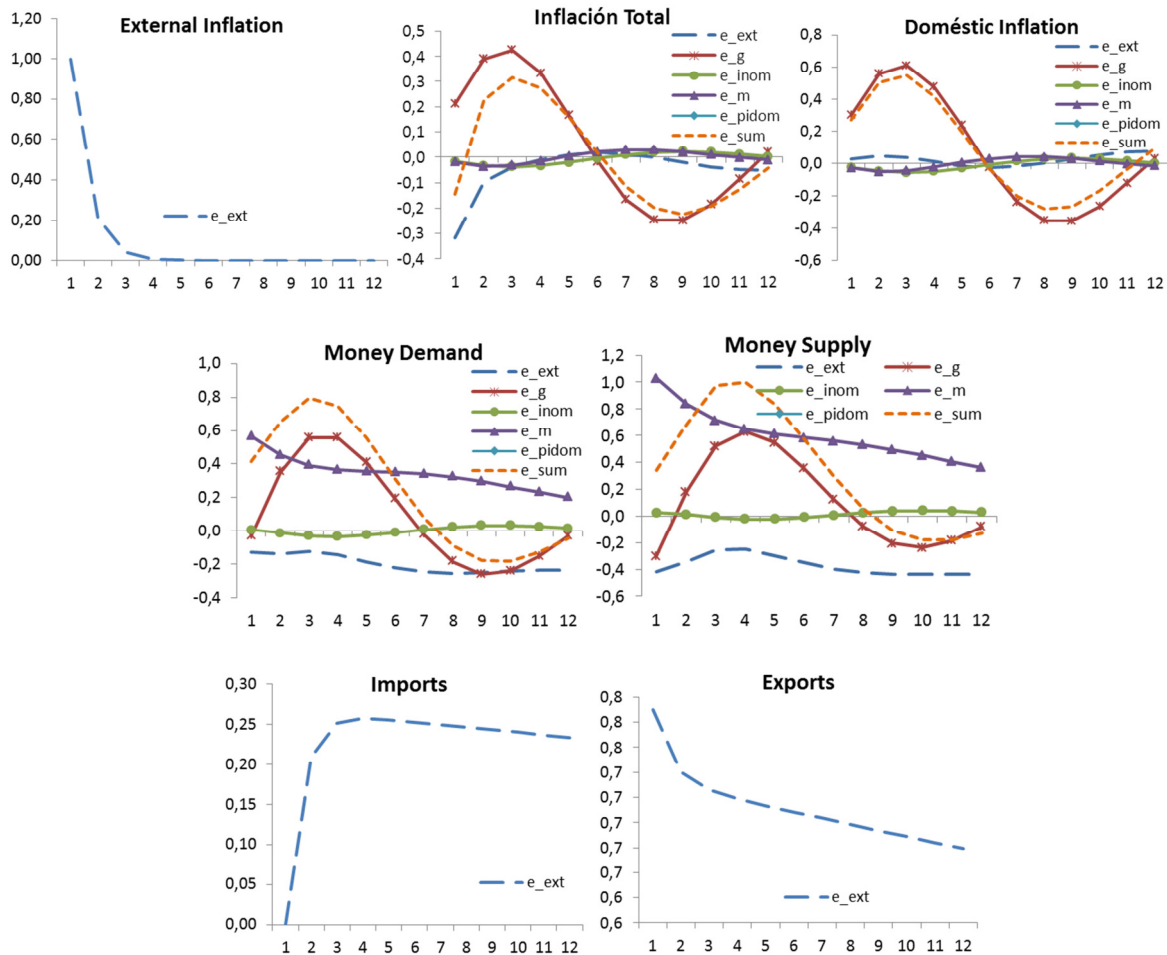
The influx of money since this is an open economy doesn't contribute to control liquidity in the economy. The control of inflation, given the inflation targeting regime implemented through policy interest rates is achieved after four to five quarters.

In the world recession period, 2009-2010, Chile faces a special stage. Introduction of higher fiscal spending in the economy aims to generate higher levels of consumption and investment, 0.7% and 1.1% respectively.

This scenario is contributed with adequate injection of liquidity, under a controlled environment of price level. As the total effect of policies, money in the economy turns -0.15% to positive after two quarters.

### Impulse Response Functions (IRF) 2009 -2010

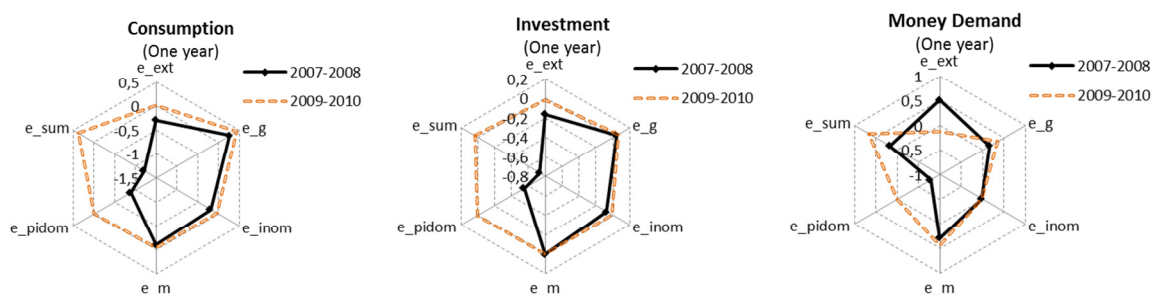


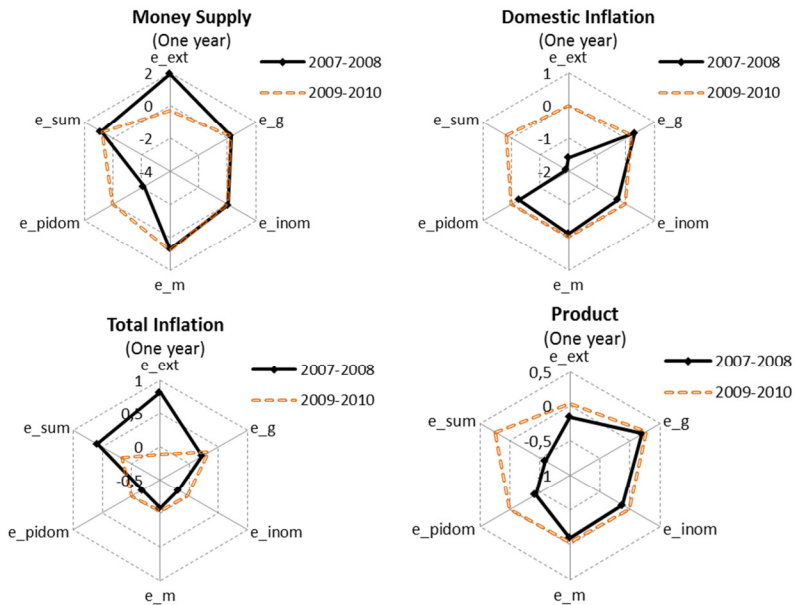


In this scenery, fiscal policy was favorable to maintain the level of economic growth, propelling it at least to 0.4%.

In case Chilean economy, regarding to the comparison of these policies, the effect over one year can permit us to see that the coordination of the two policies was adequate to support adverse scenarios. This effect is reflected in a higher result on the outcome in the second quarter compared to the Brazilian economy.

### A year effect comparison over the selected variables



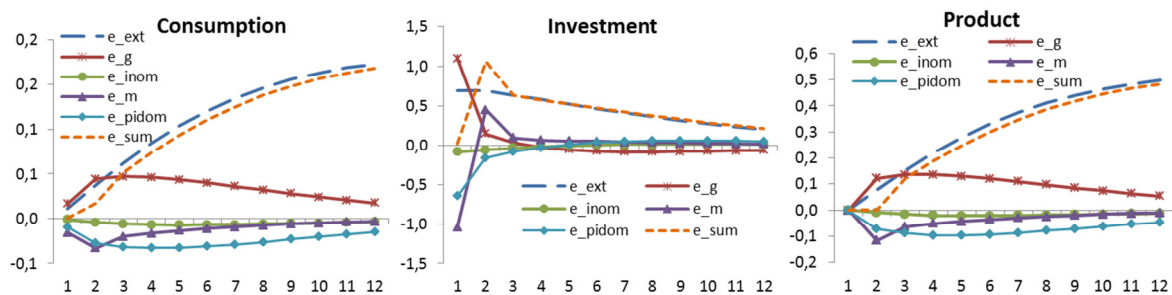


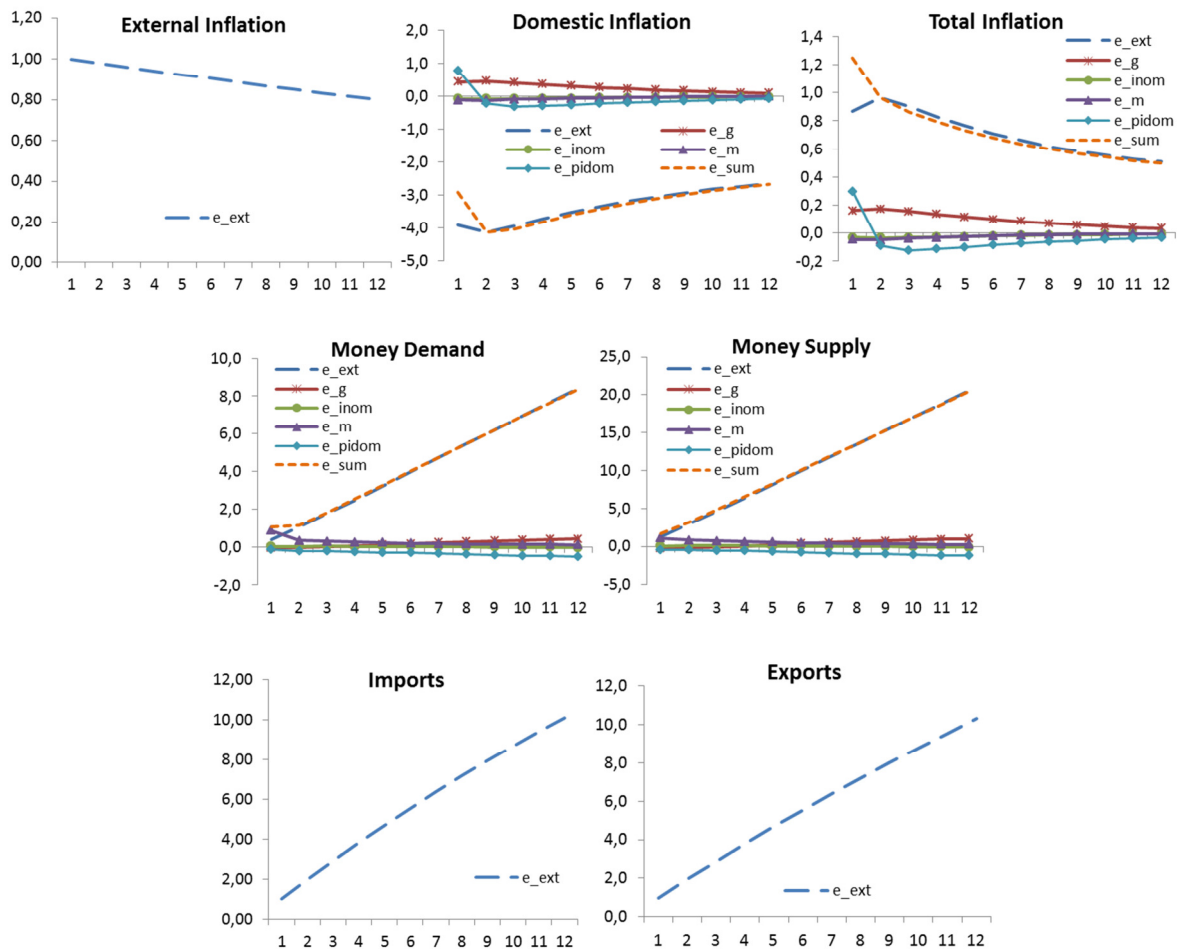
## Colombia

According to model parameters, the Colombian economy in the first period doesn't suffer from negative domestic shocks affecting the purchasing power of agents. In this scenario, only monetary policy controls inflation achieving lowering it. This result comes from the positive dynamics of consumption despite the contraction of liquidity by the central bank; the same behavior presents the total investment in the economy.

The recent results do not imply a sacrifice of the level of GDP; this variable is maintained at 0% for two quarters and then presents positive result.

## Impulse Response Functions (IRF) 2007 -2008

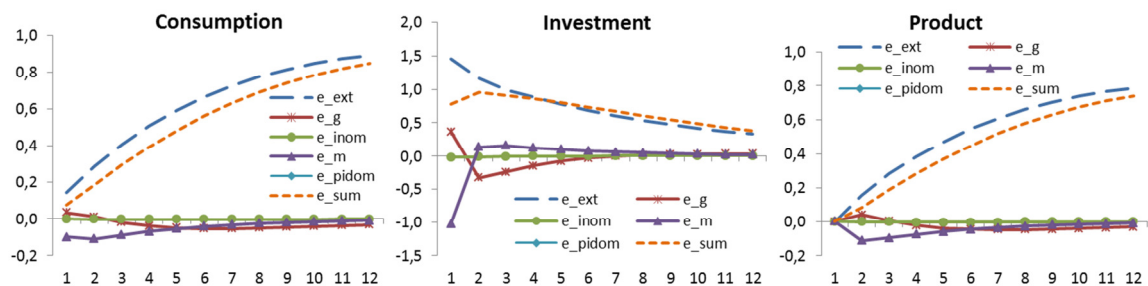


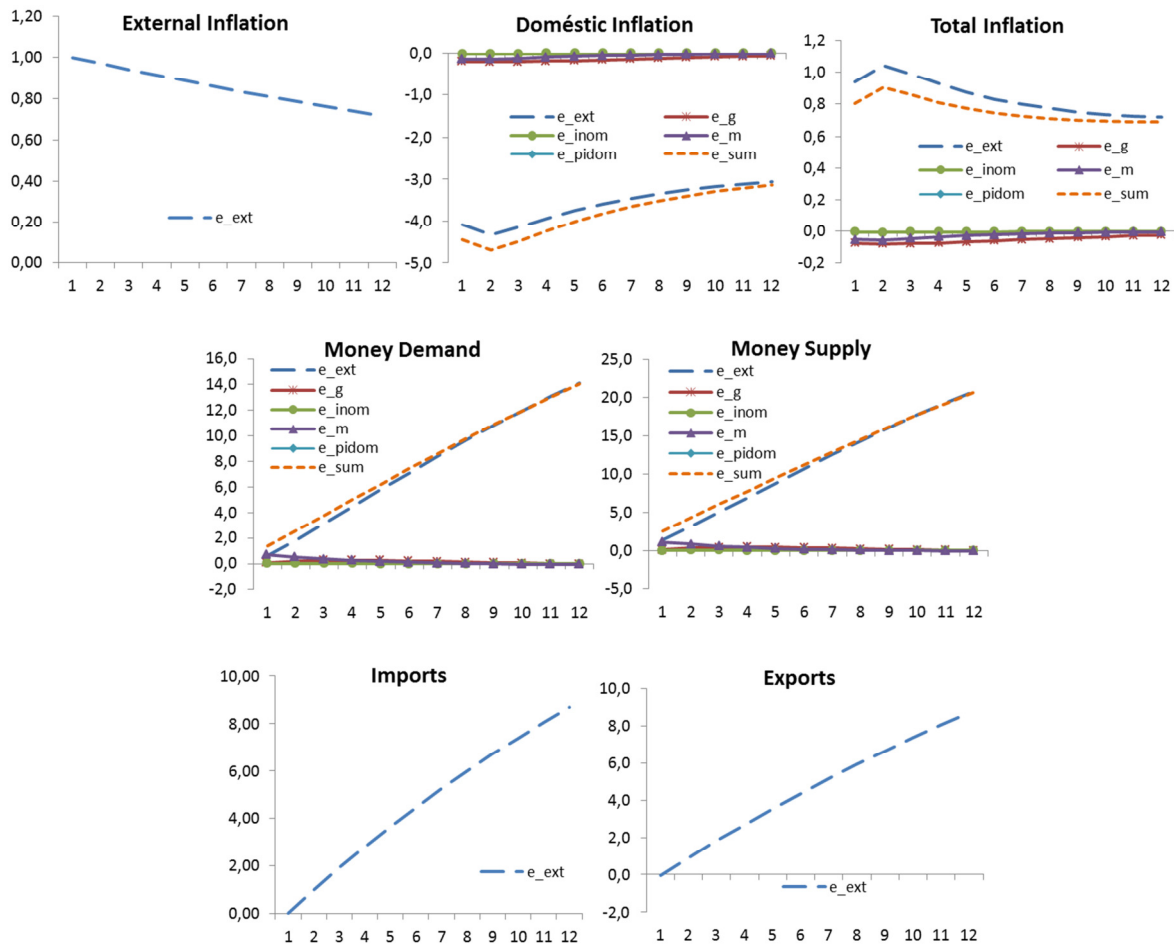


In the case of the Colombian economy, the combined efforts of monetary and fiscal policy can't control the inflationary shock.

The second period is dominating by external effect and fiscal policy has a greater effect than the monetary policy, although temporary effect on the level product.

### Impulse Response Functions (IRF) 2009-2010

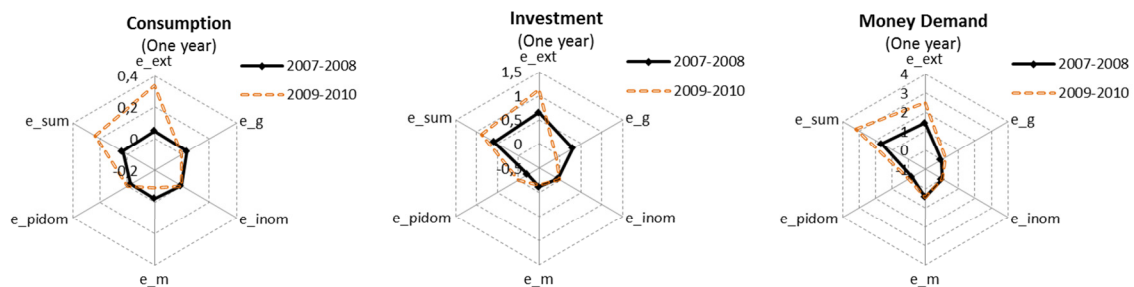




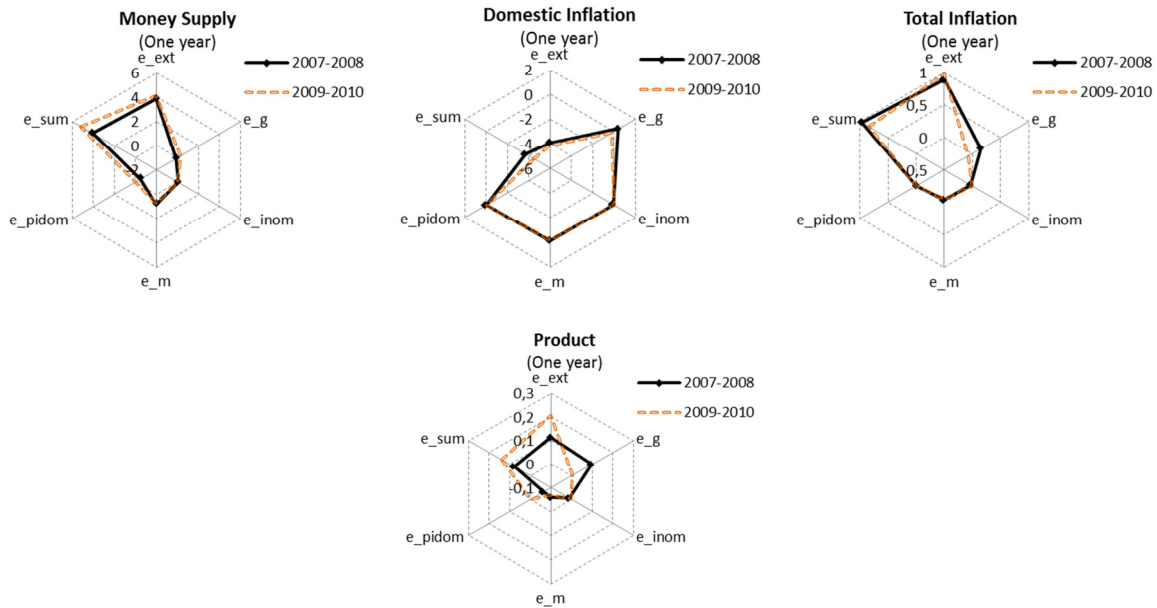
In this period monetary policy acts through interest rates than of liquidity injections.

The comparison of results in different periods, is unclear, as in both scenarios dominates the external environment facing counter cyclical shock of monetary and fiscal policies.

### A year effect comparison over the selected variables





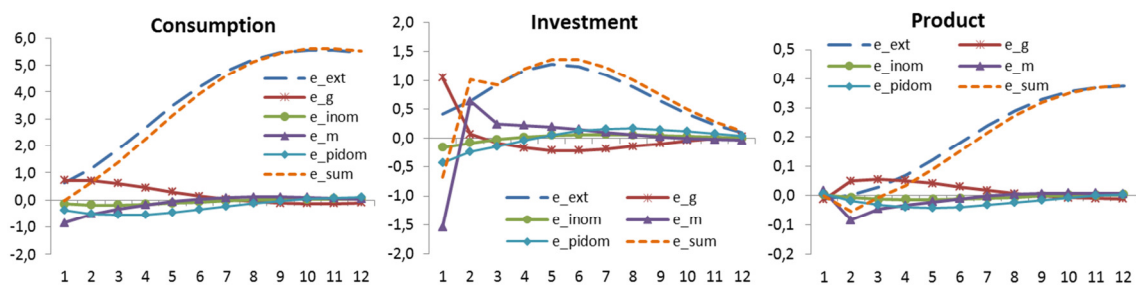


## Peru

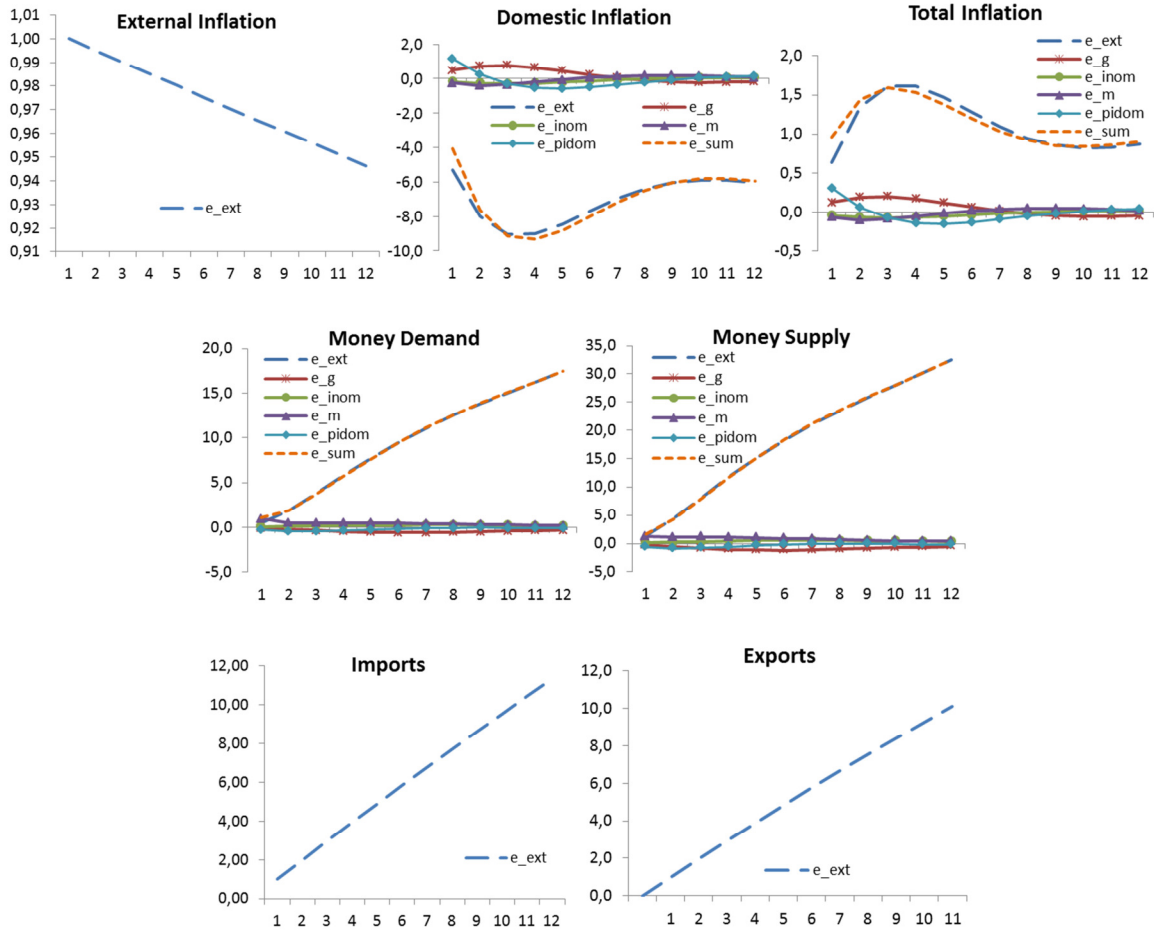
The results of the first period for the Peruvian economy show that coordination in reducing government expenditure, interest rates increases and liquidity contraction contribute to managed to keep inflation around 1% above its steady state value.

This control was affected by the flow of currency into the economy as consumption increases. The last, generates an increasing demand for liquidity, despite the efforts of control demand pressure, since the source of the shock in this period is external and explains increments in inflation. Domestic inflation is fully under control.

## Impulse Response Functions (IRF) 2007-2008



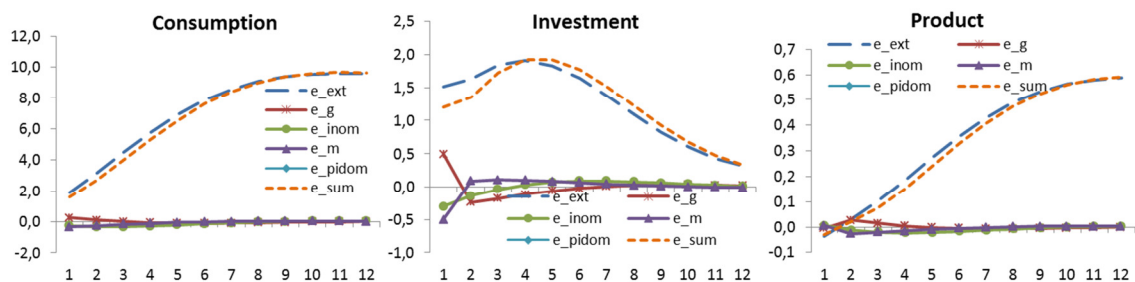


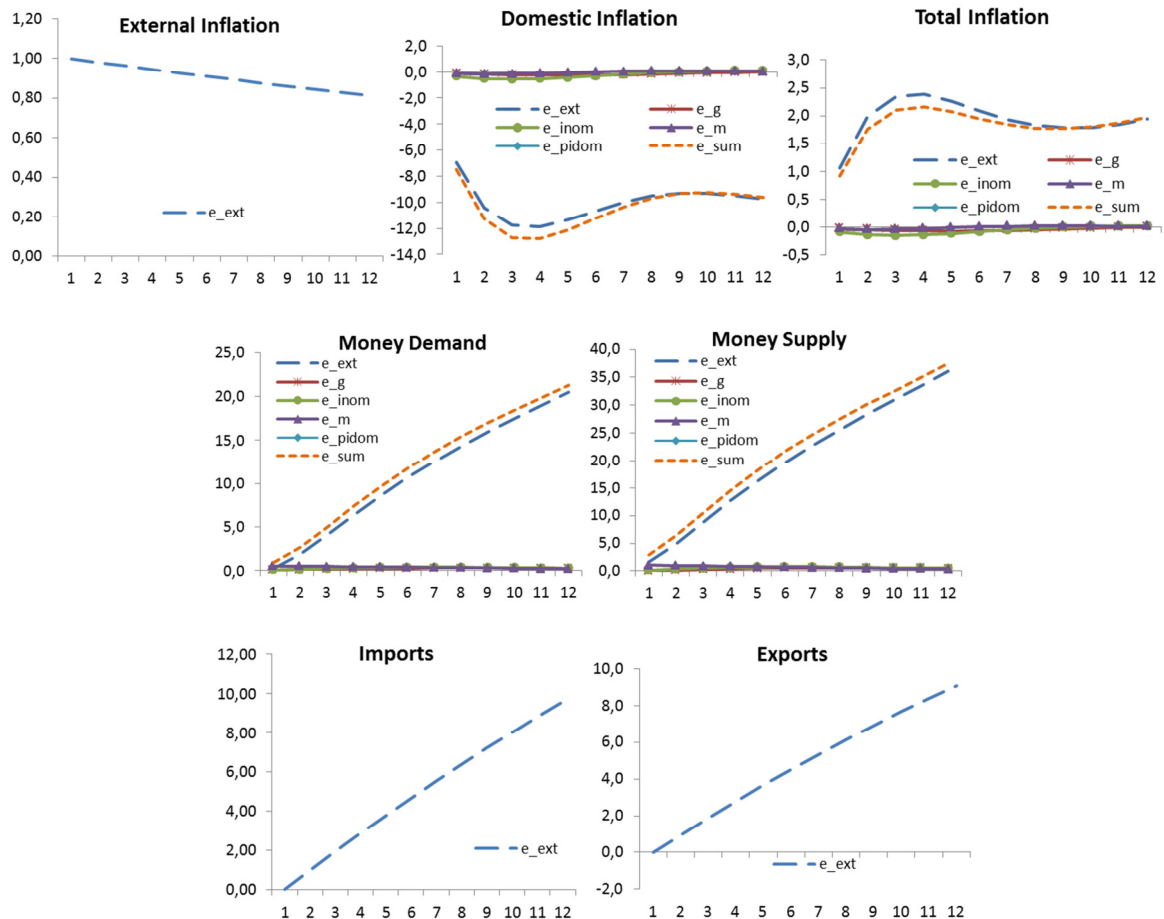


The control of liquidity and domestic inflation meant a sacrifice of level of product around 0.25%; however, this recovers after three quarters.

During 2009-2010, consumption and investment are still reinforced by a favorable external sector, despite the adverse scenario of the world economy. In this case, a countercyclical fiscal spending and monetary policy contribute to economic growth, but facing an increment in total inflation.

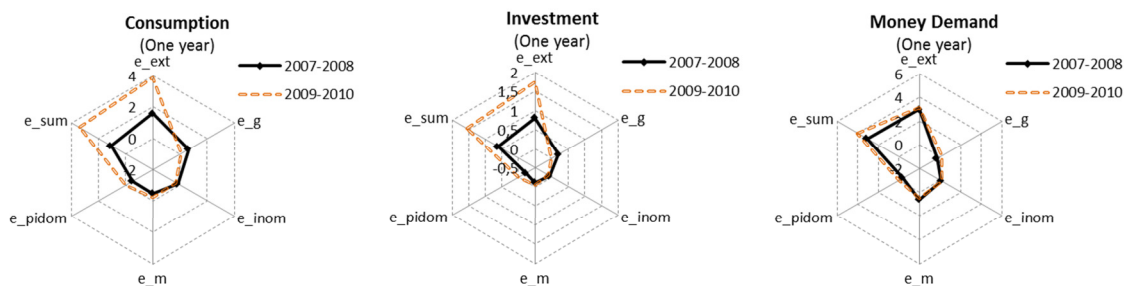
### Impulse Response Functions (IRF) 2009-2010

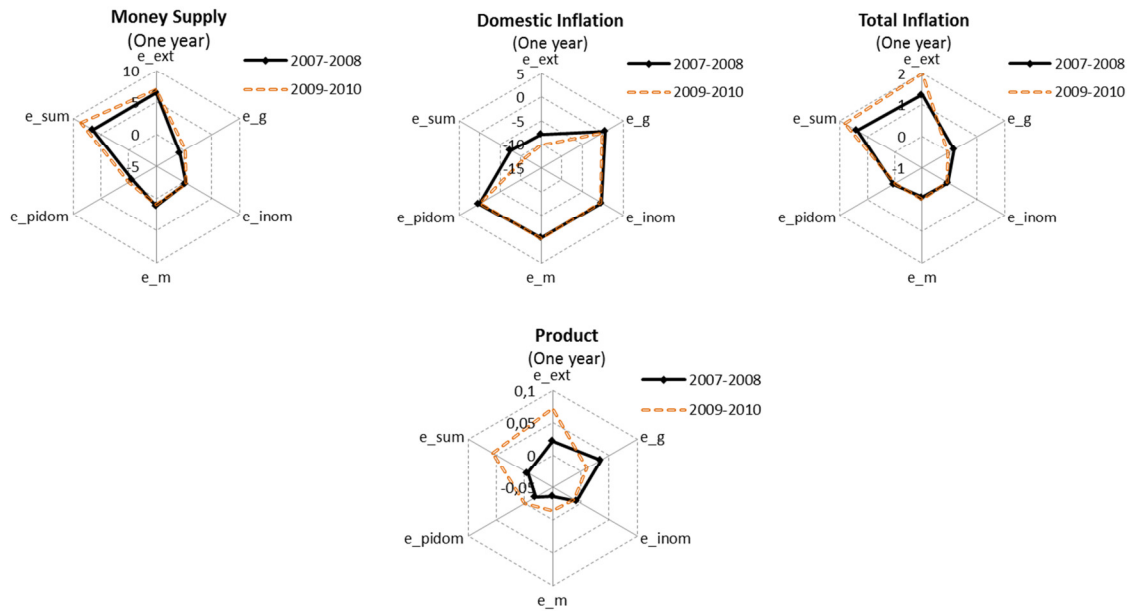




Comparison of the results shows a positive effect on output and a contraction of inflation in the first period.

### A year effect comparison over the selected variables

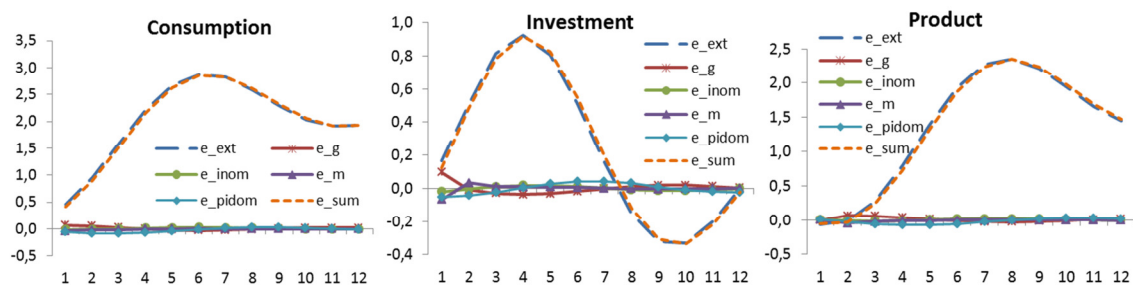


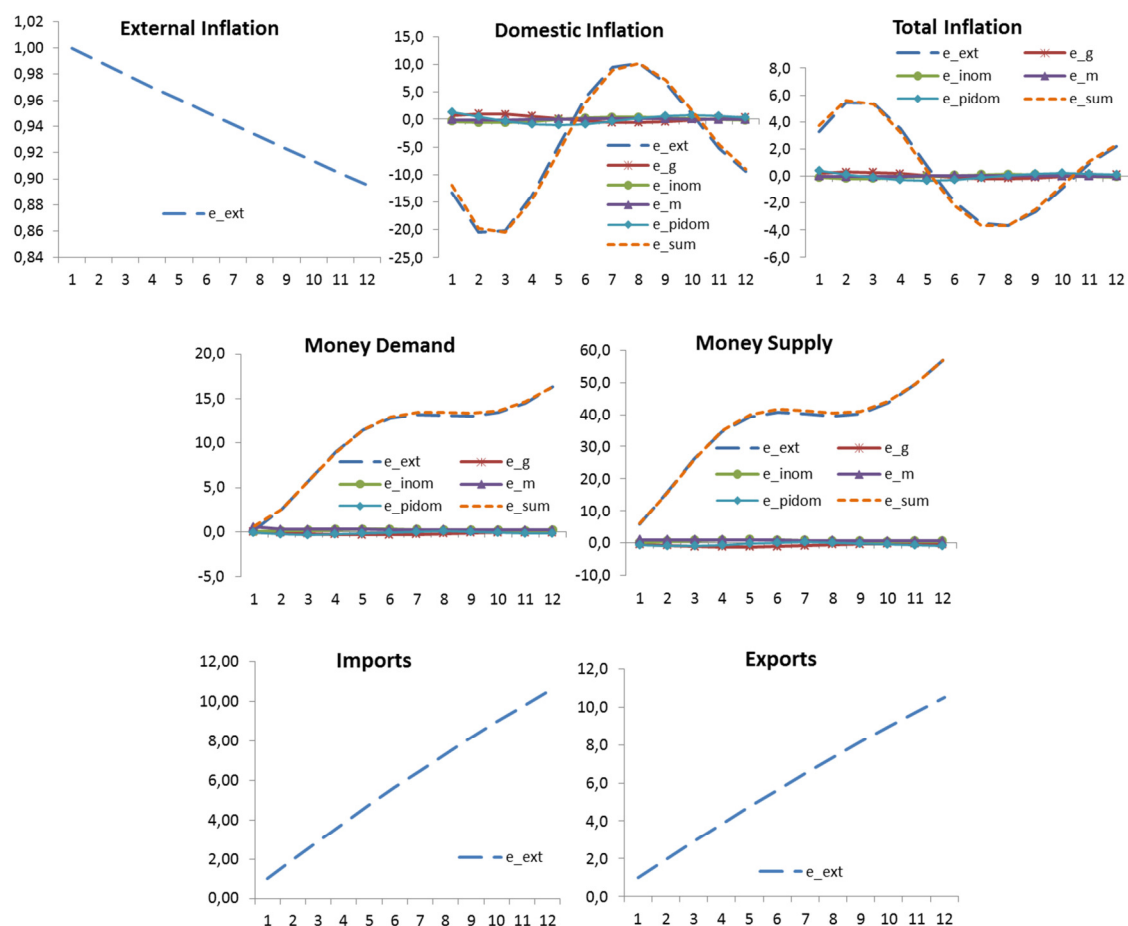


## Uruguay

In 2007-2008, the Uruguayan economy faces a strong external effect on their economy while generating positive growth after two quarters despite of their monetary regime of inflation targeting, controlling liquidity and handling interest rates was not enough to reduce total inflation. Control of this variable would be reached after four to five quarters.

## Impulse Response Functions (IRF) 2007-2008



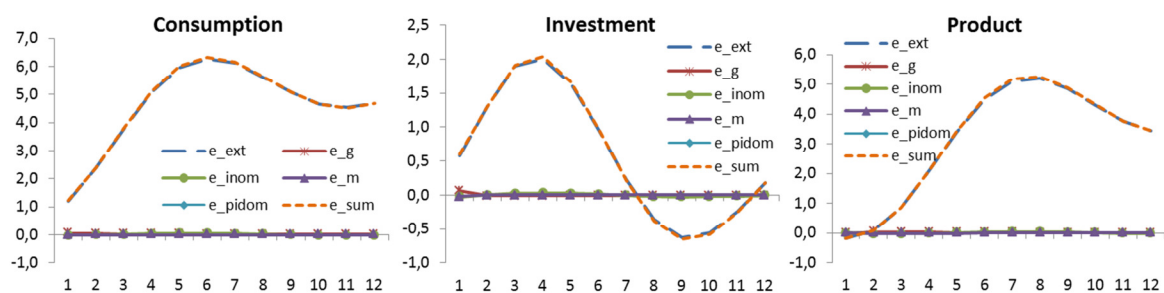


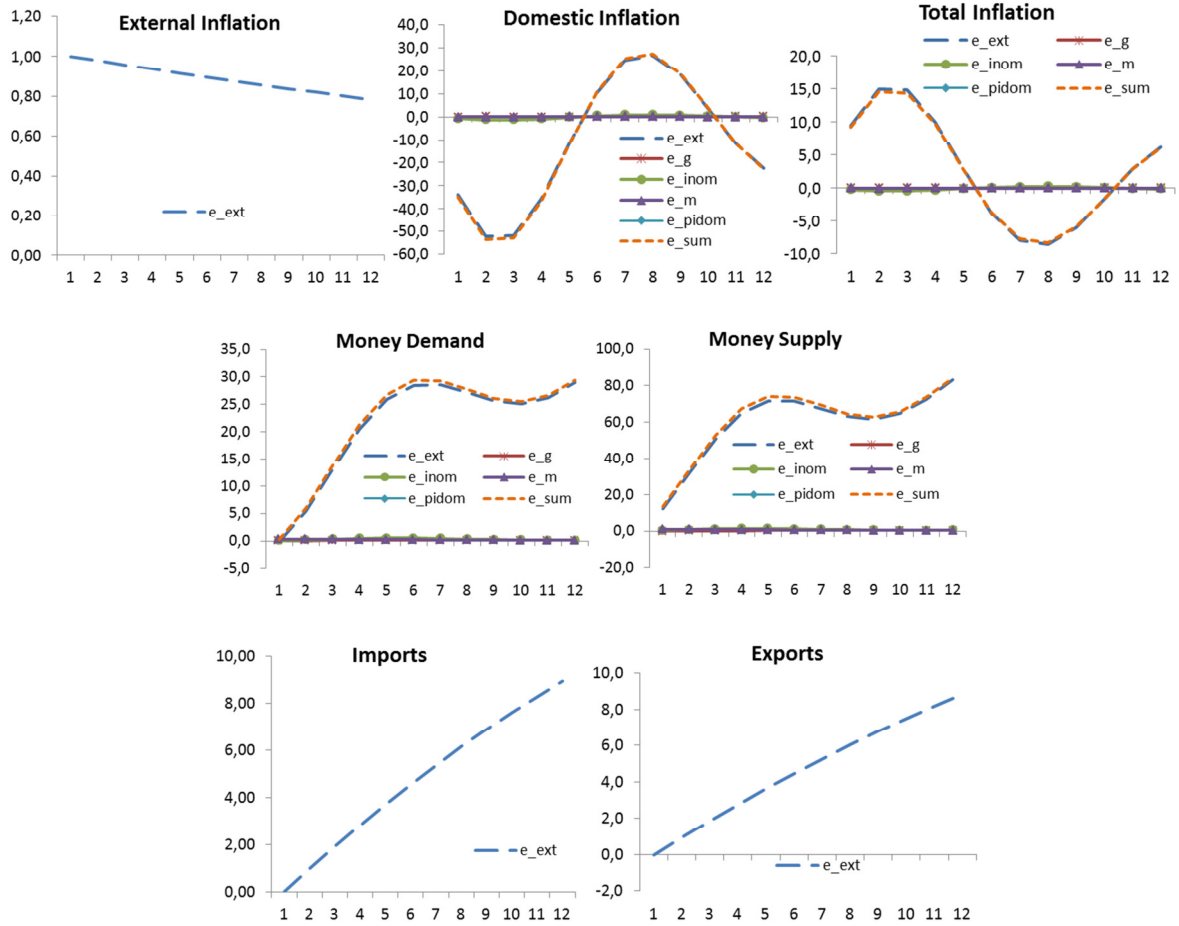
In this case, since the economy is dollarized, somehow captured through its structural parameters, the demand for money fails to be controlled completely.

In the period 2009 - 2010, fiscal policy contributes marginally to the dynamism of the economy, despite introducing similar shocks to other economies.

In this scenario, the Uruguayan economy begins with a marginal sacrifice of output growth to recover after two quarters.

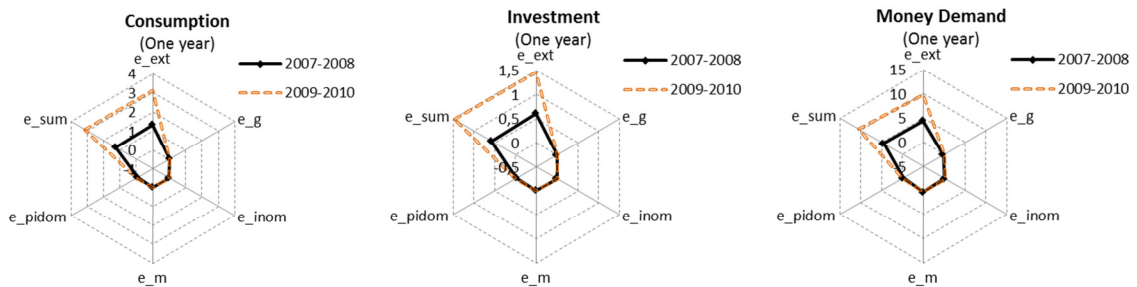
### Impulse Response Functions (IRF) 2009-2010

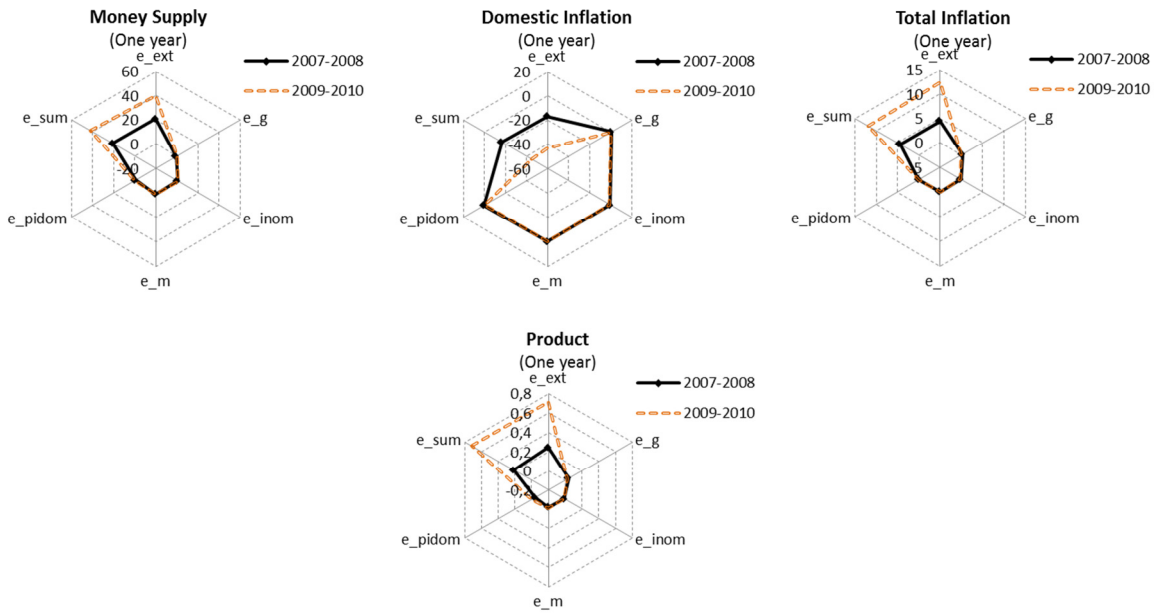




The comparisons of the results show that there is a positive effect on output in the second period, and an effective contraction of inflation in the first period.

### A year effect comparison over the selected variables

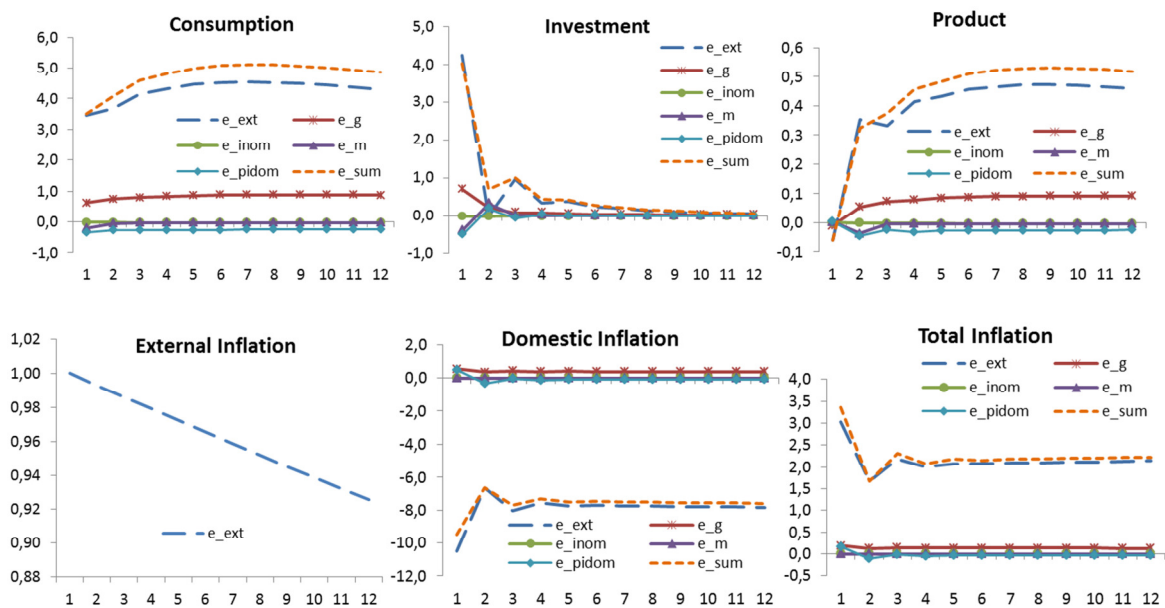


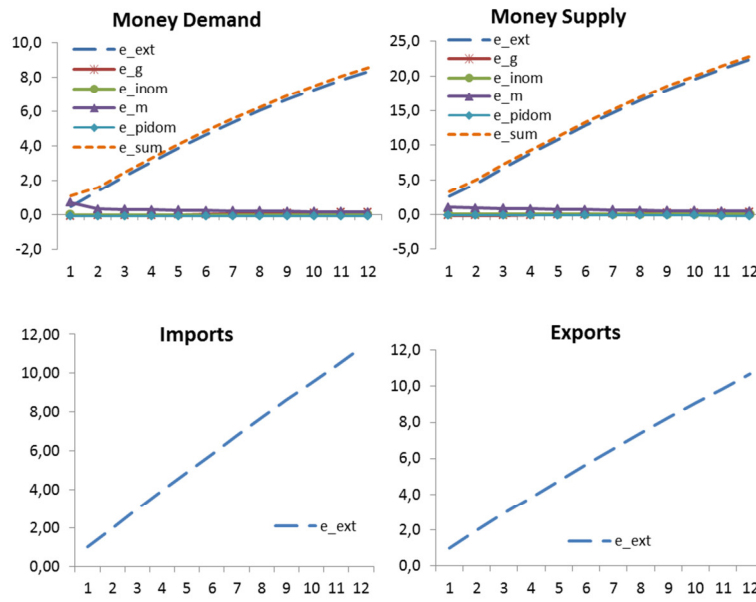


## Venezuela

The Venezuelan economy has structurally higher levels of inflation and control it via interest rates and monetary aggregates in 2007-2008 was not enough as a result of the injection of liquidity by the fiscal sector. In this period, total inflation remains above the structural level without any sacrifice of the level of product.

## Impulse Response Functions (IRF) 2007-2008

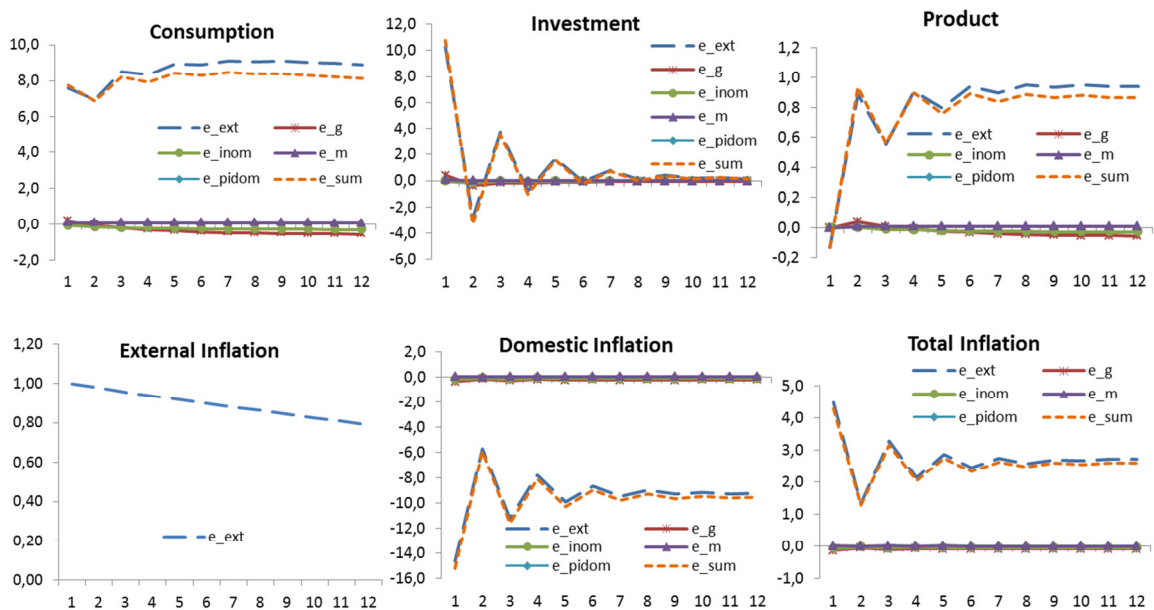




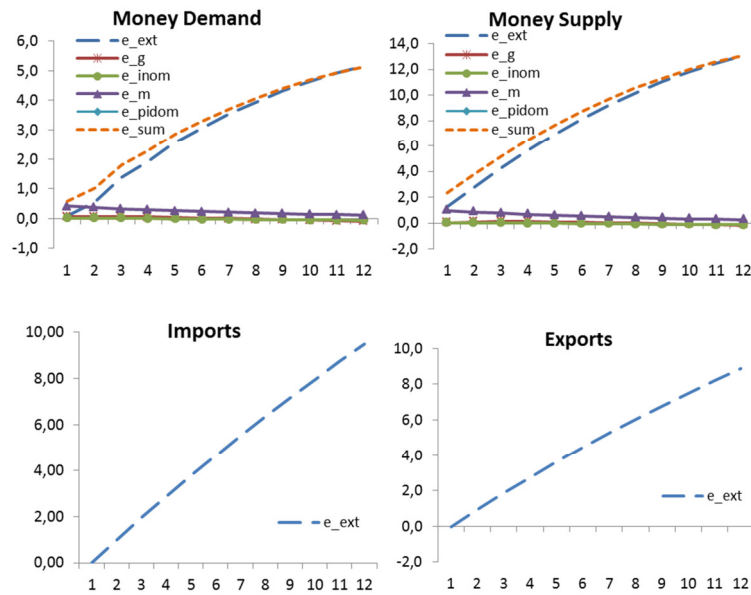
Despite the combination of fiscal and monetary policy, they were not enough to control inflation in the economy.

During the recession in the world economy, the Venezuelan economy still present has levels of inflation from its steady state. The product has a favorable dynamics, contributed marginally by fiscal policy.

### Impulse Response Functions (IRF) 2009-2010



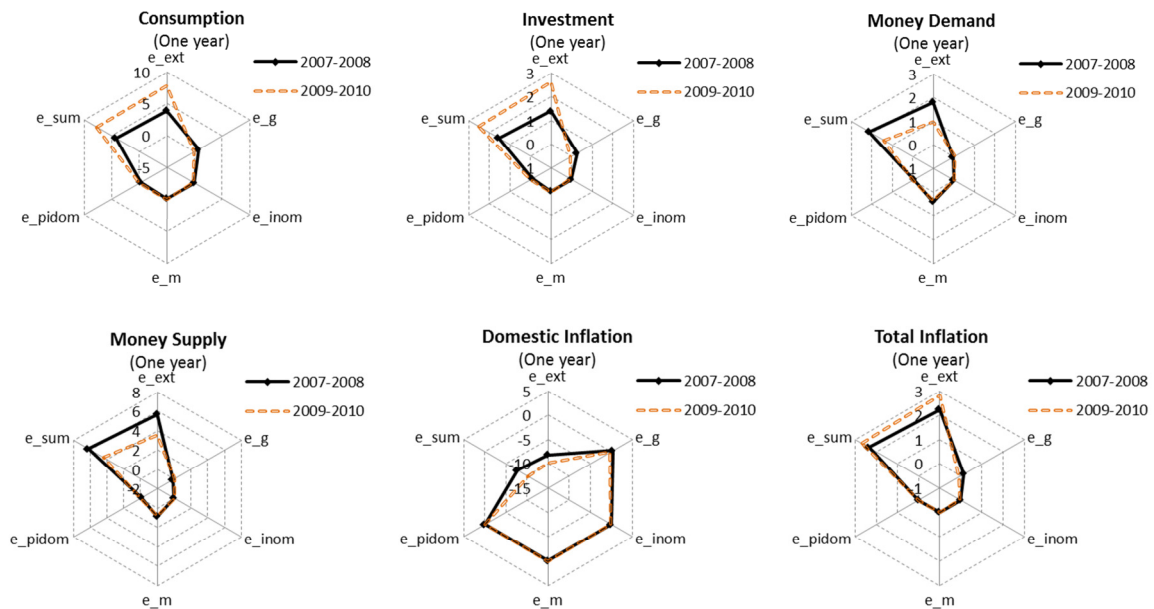




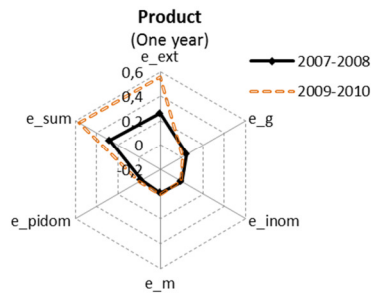
The injection of liquidity by the monetary authority and management of the interest rate has no effect on the product.

Comparison of the results shows that inflation neither could be controlled; however the dynamics of the economy still remains positive.

### A year effect comparison over the selected variables







The above results show that the combination of monetary and fiscal policies and their effectiveness in fighting adverse scenarios dependent and are in function of the particular characteristics of the economies.

## VII. CONCLUTIONS

This paper evaluates the effectiveness of coordinated policies in the monetary and fiscal area. The results show mixed effects according to the monetary and fiscal regime adopted by countries which are captured by the primitive model parameters.

The simulation model allows us to observe at first the empirical regularities of economies, observed through the mean time of the variables in each economy embedded on the model structure.

We evaluate coordination of policies through the application of shocks of 1% according to the period to be evaluated. However, we observe in case of Bolivia and Brazil the control of inflation is timelier in the inflationary period 2007-2008. For other countries the control of this variable responds to the delayed reaction of the target variables and according to the economy regimes. Despite controlling inflation, it would still remain above its structural level.

In 2009-2010, all countries boost their economies achieving important contributions of its policies for this purpose or by receiving external shocks; in the latter case, if the growth was explained outside effect, they paid an inflationary cost effects.

To sum up, the implementation of policies managed to control crisis episodes in different degrees. We show that there is effectiveness in the implementation of coordinated policies through the application of a dynamic stochastic general equilibrium model. Finally, the results suggest that the degrees of policy coordination or correlation are very important to explain the fundamentals of the economies.

Future extensions of this work would be given by modeling the interaction of trade in selected economies and assess its contagion against external shocks.

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