

Full Length Research Paper

## Monetary policy in Cape Verde and macroeconomic changes: Empirical evidences

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Received 02 May 2014; Accepted 4 February 2015

The main objective of this study was to analyze Cape Verdean monetary policy, the rules chosen by the decision makers, its changes and its transmission to the economy. Primarily, we analyzed the dynamics of the most important Cape Verdean macroeconomic time series. By using the *Vector Autoregression (VAR)* and the *Markov Switching Vector Autoregression (MS-VAR)* models, we also analyzed and compared how those dynamics were connected to the monetary policy regime adopted during the period of 1991 to 2011. We tried two models, in the second of which was included the effective exchange rate index in order to capture transmissions of the exchange rate channel. Through the MS-VAR, we also estimated two regimes which were statistically identified. The second regime seems to be more persistent and characterized the entire period from 1993 to 2006, which matches with important changes in Cape Verde's economy. We compare the impulse-response functions estimated by using the VAR model and the impulse-response regime-dependent functions estimated by MS-VAR models. The latter indicated that only in the second regime does a positive shock in the residuals of interest rate have the expected effects, decreasing the output level and the price index.

**Key words:** Monetary policy transmission channels, Cape Verde, MS-VAR.

### INTRODUCTION

Monetary policy rules are the main components of economic policy decisions nowadays. Their appropriate use can, at the same time, be a source of stability of expectations and can also be used to stimulate the economy in times of recession and crisis, mainly through the credit channels. In terms of the economy's stability, it has been observed generally among countries, and also

in the case of Cape Verde, that central banks try to merge the monetary policy instruments, for instance, those within Foreign-Exchange Reserves, also named forex reserves, to control the markets' liquidity conditions in the economy. The contribution of this study is to estimate the parameters of stability used to govern monetary policy in Cape Verde, by understanding how

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**JEL code:** C15, C32, E31, E52

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they respond to the transmissions of shocks between the estimated regimes, simulated here using the residues of the interest rate (IR).

In general, the monetary policy is ruled by central banks. They try to affect the economy by controlling some key monetary variables. The main objectives of central banks are: price index stability, long-run economic growth with low levels of unemployment and favorable results in the Balance of Payment (BoP). Due to the importance of this subject, relevant discussions within the economic literature correspond to the accurate management of such instruments, under nominal and real-side economic contexts.

Some of the pioneering studies on effects of monetary policy shocks on macroeconomic variables, in terms of the current research, are Bernanke and Blinder (1992) and Sims (1992). Since then, several other studies such as Bernanke and Gertler (1995), Ganley and Salmon (1997), Eyzaguirre (1998), Martines et al. (2001), Barth and Ramey (2001) have widely used Vector Autoregressive (VAR) methods, developed by Sims (1980), which are recognized to provide more precise parameter estimates than the structural regression models.

Some recent studies<sup>1</sup> embrace the concept that monetary policy affects the direction of the output, here represented by the GDP, in the short term. Thus, they focus their efforts on measuring that effect. Such studies look to answer the following questions: does monetary policy have real effects on the economy? If so, which mechanisms must be transmitted to the real side? Which proportion? And when does the economy start to see the consequences of these effects? Moreover, such studies aim to identify some structural changes in economic series in a similar way to that which will be estimated here. We remember that this issue is quite relevant, which motivated, for example, Chow (1960) to introduce a test based on  $F$  statistics, in order to check the stability of the estimated parameters for different regression models.

Hamilton (1989), on the other hand, investigates time series samples by introducing Markov Switching in autoregressive models, with the purpose of modeling changes in the regimes. With this new technique, dealing with the structural changes in economic time series as random variables, it was possible not only to identify the changing point between regimes, but also the probability of time series remaining in a particular regime, or else changing to another one (Silva et al., 2006).

In this sense, Krolzig (1997) developed the Markov Switching Vector Autoregression (MS-VAR), as a combination of the VAR and the Markov Switching modeling. Thus, if the system is subject to changes in regimes, the parameters of the VAR are time-varying. Since then, several studies have been conducted by adopting the use

of the MS-VAR, such as Gonzalez-Garcia (2006), Sims and Zha (2006), and Tomazzia and Meurer (2010).

Tomazzia and Meurer (2010) pointed out that the consideration of the effects of monetary policy, as well as the changes occurring in their mechanisms, are important to understand how the economy works. This issue has been addressed in several countries, serving as an aid for making decisions by monetary authorities. The case of Cape Verde demonstrates the need for more studies that intend to provide more information about the appropriate management of monetary instruments.

This study aims to investigate the changes in the dynamics of the main macroeconomic variables in Cape Verde and their dynamics, to understand which of those variables are more important for the management of monetary policy in the country, during the period between 1991 and 2011. For both of them, MS-VAR models were estimated. Regimes were also estimated, as well as a matrix of probabilities of transitions from one regime to another. The impulse-response functions were estimated, simulating shocks in terms of residuals of the IR. Thus, the present study attempts to contribute to the existing literature on monetary policy in Cape Verde, by presenting new evidence from parameter estimations of the MS-VAR model.

This research is organized in six more sections, in addition to this brief introduction. In the second section, we present the mechanisms of monetary policy transmission, while the third one provides an analysis of the economy of Cape Verde, focused on its relationship with the management of monetary policy. Regarding the fourth section, it has a description of the methodology that will be used in empirical strategy. In the fifth section the obtained results are laid out. Finally, in the sixth section the final considerations are presented.

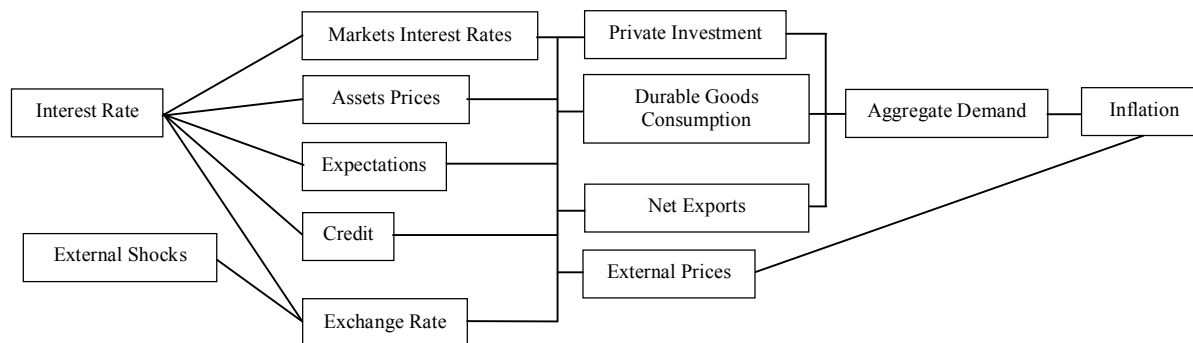
## Monetary policy transmission

In this section, we discuss the theory of monetary policy transmission channels and offer a survey of important empirical works on the measurement of the monetary policy effects and its changes over time.

## Monetary policy transmission mechanism

There is not an agreement or majority of empirical results about the effects of monetary policy on the price index (CPI) or the GDP, a fact that has led to the expansion of modeling with a variety of approaches trying to understand the role of monetary policy. As already emphasized, many of the studies on this subject assume the idea of currency neutrality only in the long term. Since in the short term, due to some degree of nominal rigidity in prices and salaries, there may be real effects on the macroeconomic variables. The main contributions in this

<sup>1</sup> See for example, Ireland (2005), Dabla-Norris and Floerkemeier (2006), Sims and Zha (2006), Al-Mashat and Billemeier (2007), Demchuk et al. (2012).



**Figure 1.** Monetary Policy Transmission Mechanism. **Source:** Adapted from Modenesi (2005).

sense come from works such as Fisher (1977), Sheshinski and Weiss (1977), Taylor (1979; 1980), Calvo (1982; 1983) and McCallum (1986). With the adoption of the Inflation Targeting Regime (ITR)<sup>2</sup> by various countries, the main objective of the monetary policy, which consists of obtaining and maintaining the stability of prices, was viewed as a global concern. Therefore, it is necessary to know the mechanisms of shocks transmission, including its channels.

According to Ramaswamy and Sloek (1997), the existence and efficiency of monetary policy transmission depends on the existence of an appropriate mechanism of shock interactions. An inadequate understanding of the transmission mechanisms can unnecessarily raise the monetary stabilization costs, reducing the GDP and increasing unemployment, as well as generating inefficiency in controlling inflation, here named as CPI. According to Taylor (1995) the monetary transmission mechanism is defined as the process through which monetary policy decisions are transmitted to the real output level and inflation.

Rocha (2008) tries to evaluate the monetary policy mechanisms in Cape Verde by using data from the period of 1991 to 2003. The author estimated a VAR model using quarterly data of GDP, CPI, IR, total domestic credit, M2, exchange rate (ER), private credit and public credit. The results point to a low elasticity of variables adopted as target, in the 'caused by Granger'<sup>3</sup> sense, if compared to those used as instruments, mainly, the IR and ER. So, there was observed a weak, but persistent, mechanism of transmission. The credit channel also did not work as expected by the theory. The author justifies this result with the fact that the imposition of credit limits in the country may cause the same shock effect in the residuals of the IR. The channel of the ER, as our results, had no significant effect for the period under analysis in either study. Finally, it was noted that there is a lag in the

GDP and of the (CPI) responses, due to a shock in terms of residuals of the IR.

Figure 1 elaborated from Modenesi (2005) illustrates the relationship of the macroeconomic variables, allowing us to carry out some intuitive exercises, concerning the effects of shocks in the monetary policy transmission channels.

Concerning the transmission channels, Kuttner and Mosser (2002) identified the following<sup>4</sup>: IR, ER, credit and asset prices. When these variables are affected, monetary policy decisions will influence the levels of savings and investment, and families and firms' expenditures. Thus, the aggregate demand changes and consequently there will not be any changes in the CPI.

### Interest rate channel

The IR is the usual transmission channel in monetary policy. There are propagation mechanisms in the economy which associate variations in the basic IR with other interest rates practiced in the money market. It also affects the long-term IRs, which are relevant to decisions regarding consumption and long-term investments. By supposing that families maintain consumption habits and the demand for money is stable or fixed<sup>5</sup>, a contractionary monetary policy will reduce the level of monetary liquidity in the economy, which would cause an increase of nominal IR in the market. Therefore, there will be an elevation, at least temporarily, of real IR, due to the fact that in the short term, as described by Christiano et al. (2005), there is some degree of rigidity of nominal prices of goods, and of some inputs such as labor. The logic is that this rise in the real cost of capital will reduce investments, as well as expenditures with the consumption of durable goods. Thus, there may be a reduction in aggregate demand and consequently the GDP.

<sup>2</sup> Also known as Inflation Targeting (IT), the Inflation Targeting Regime is the one in which the central bank commits to control the price index using a pre-established target (level) and forecasts to manage it.

<sup>3</sup> Refer to Granger (1969).

<sup>4</sup> In this work, the IR channels and the ER will be studied. For theoretical understanding of other transmission, refer to Bernanke and Blinder (1988), Bernanke and Gertler (1995), Modenesi, 2005.

<sup>5</sup> See for instance Christiano, Eichenbaum and Evans (2005).

### Exchange rate channel

Another important channel of monetary policy transmission, especially in economies with a major dependence on external sector, is through the ER. According to Rocha (2008), it would be one of the most important in Cape Verde, due to the great weight of imports on the country's GDP composition. This channel has been gaining importance due to the increase in the globalization and the adoption of flexible ER in almost all countries in the world.

As already mentioned, in case of a contractionary monetary policy an increase in the IR can happen, which would cause a flow of international capital into the economy, causing pressure on the ER to appreciate. Due to some degree of price rigidity in the short term, the effective ER also could decline, making the Cape Verdeans products less competitive (through prices), thus causing a reduction in the level of net exports and, consequently, in the GDP.

In addition to this direct effect on the CPI, the ER could have indirect effects in two ways, also indicated in Figure 1. The first one is through the goods produced domestically in the country, which make use of imported inputs. With the appreciation of the ER, the costs of these goods decrease, causing the collapse of their prices. The second effect is through the aggregate demand, because when the ER increases, the imported goods would become cheaper. This would encourage the replacement of domestic goods with similar imported goods, a fact that would result in a decrease in aggregate demand and force the CPI.

### CAPE VERDE, ECONOMIC DEVELOPMENT AND MONETARY POLICY

Cape Verde, since colonial times (XV to XX century), was marked by severe conditions with regard to absence of resources, with low productive structure, which is basically supported by the subsistence agricultural sector, and virtually non-existent industry. These facts have caused difficulties in the economic development of the country, as Rocha (2008) points out. Since its independence, Cape Verde has gone through a period of strong centralization of main economic activities. In fact, from 1975 to 1991, it was up to the State, with a left wing government, to develop almost all business activity, important industries and services. The decisions about the role of complementary activities were left to the timid private sector.

And during the period from 1991 to 2000 the government actions had as their main objective the transformation of the nationalized economy to a market economy. The democratization of the institutions, the private sector's changing role in the development of the country, and the growth of foreign direct investment were

the main goals. In the second half of this decade, in agreement with The Major Plan Options 1997-2000, other targets of the government were ensuring the forex reserves, maintain the GDP always higher than 5%, the maintenance of the public deficit below 5%, as well as policies to reduce unemployment, improvement of domestic production and food security, and other themes with respect to the characteristics of the country.

Rocha (2008) also highlights three distinct periods that have influenced the conduct of monetary policy in the country. The first one relates to the period up to 1993, when there was a separation of the functions of the central and commercial bank and the creation of two independent institutions. The monetary policy was exercised mainly by establishment of limits to credit expansion. The IRs were fixed administratively and used as an instrument of credit distribution. The performance of the monetary policy was intended to protect the Balance of Payments and to ensure stability in the CPI, in addition to controlling the internal liquidity to ensure the forex reserves growth.

The second period is from 1993 to 1999, in which some tax and exchange reforms had the purpose of inserting the country into the world economy, by means of economic stabilization, in order to increase productivity, reduce unit costs per output unit produced by households, and maintain the stability of prices. It was also marked by a change in the ER regime in 1998 and the adoption of mechanisms of indirect control of the monetary policy management in 1999. In March, 1998, Cape Verde and Portugal have signed the Exchange Rate Cooperation Agreement (ACC). It aimed to connect the Cape Verdean currency to the Portuguese currency, by means of an ER regime of fixed parity, the creation of conditions that would guarantee the convertibility of the Cape Verdean Escudo (CVE), the stability of the CPI, protecting the value of the national currency, and serving as credible nominal anchor for monetary policy. Since 1999, the Portuguese currency was replaced by the Euro, which has allowed Cape Verde to have, through the Portuguese currency, access to the entire Euro area.

According to the Bank of Cape Verde (BCV) (2008), the objectives of the ACC were reflections of the macroeconomic scenario prevailing then. This period was characterized by unsustainable imbalances, having as great restriction the large ER instability, putting at risk the country's external reserves. Furthermore, as already emphasized, Cape Verde has a wide open and vulnerable economy, seriously dependent on cash inflows, resulting from current transfers, leaving the fluctuations for the ER.

This fact has allowed the country as a small open economy to improve its economic relations with Portugal and Europe. This has ensured some favorable conditions for the deployment of structural reforms, with a view to adjust and transform the economy (BCV, 2012). The country has committed itself to adopting the criteria of convergence of EU countries, as a reference for the

conduct of their economic policy. On the other hand, Cape Verde gained larger credit facility for the consolidation of foreign-exchange reserves.

After the creation of the ER regime of fixed parity, inflation took a clearly descending trajectory, with levels comparable to those of Portugal, a country with a preponderant weight in imports from Cape Verde. This suggests that the ER has worked to some degree, such as an effective nominal anchor, in the sense of promoting the stability of prices (DELGADO and SANTOS, 2006).

And finally, after 1999, the third period, pointed out by Rocha (2008), comprises the period in which adjustment of monetary policy was obtained, currently through open market operations, changes in coefficients of reserves and adjustments in the discount rate of the BCV (WORLD TRADE ORGANIZATION, 2007). In the period from 2001 to 2011 the government's efforts have been concentrated on repairing the imbalances of public accounts to lay the foundations for sustained growth through structural reforms and poverty assistance, development of basic infrastructure, and promotion of spatial planning. The stability of prices and the consolidation of forex reserves were the monetary policy priorities.

Cape Verde in 2004 was contemplated in the North-American aid development program, the Millennium Challenge Corporation<sup>6</sup> (MCA), with an aid of 117.8 million dollars, for a period of five years. At the end of 2007, the country began to benefit from a special partnership with European Union (EU) settled on the Maastricht<sup>7</sup> criteria, aiming at providing the country with economic governance addressed to the balance of public finances and stability in prices.

In 2008 the country joined the World Trade Organization (WTO), as recognition for its ability to follow the rules of international trade. In that year, there was a change in status from Cape Verde's status, moving to the group of Medium Development Countries. This requires the country to make structural changes in order to make it more competitive and create its own resources to finance the development process. On the other hand, there is also a process of a gradual reduction of aid, which it has been receiving since the independence, a fact that represents one of the greatest challenges to the country.

The BCV, as the main regulatory body and executive of the country in relation to the management of monetary policy, performs the functions of the central bank, according to the Law N<sup>o</sup> 10/VI/2002, of July 15<sup>th</sup>, 2002, and works together with the government, in the definition and implementation of monetary and ER policies, and as supervisor of financial and foreign currency markets. The

monetary policy of the BCV has as its main objective the maintenance of CPI stability, i.e., to maintain the currency purchasing power, in order to promote economic growth and jobs creation (BCV, 2012). The operational framework of monetary policy assumes the IR as the operating target, the ER stability as the short-term goal and the preservation of CPI stability, as the final objective.

It is not always possible taking the monetary policy as the main instrument of economic policy, to be able to change the conditions of the markets of Cape Verde (ROCHA, 2008). This is due to the presence of a too restricted financial system, composed only of a bank that developed, at the same time, the functions of the central bank, commercial bank, and a small mailbox.

According to Marta (2006) is possible to identify a stable trajectory of the ER over the past few years, since the period after 1998, with some gains for the domestic economy, with emphasis on CPI stability. Other gains that were expected with the PEG<sup>8</sup>, such as the convergence of domestic IR in the direction of the rate of the Euro Zone, and a strategic access of the country to the international capital market, have not yet reached the desired extent.

The BCV itself recognizes that the adoption of this ER regime assumes a theoretical loss of local control of monetary policy, since the entire economic policy and, particularly, monetary and fiscal policy, become subordinate to the goal of preserving ER stability, i.e., the currency parity defense. Even so, one of the most important contemporary issues is the option for euroization<sup>9</sup> of the economy, as one of the ways to be successful in those objectives.

Cape Verde is a country where the productive structure is fragile, which makes it more dependent on imports of goods and goods with emphasis on food and fuels, which represent 2/3 of domestic needs. According to Tavares (2012) the structural external deficit has risen in recent years. Few products are made and exported in the country, which keeps the coverage rate very low.

According to the data from the World Bank, during the period from 1990 to 2011, imports and exports had an average growth rate of 7.6 and 7.8%, respectively. Imports had an average weight in GDP of 66.4%, while exports registered an average weight of 26.5%. Since the imports have a greater weight in the GDP than the exports, it is clear that the trade balance does not sustain the needs of external financing. Cape Verde is known as a country that depends on income flows from tourism services, migrant transfers, foreign direct investment and foreign aid. Thus far, during the period from 1987 to 2011, a positive trend of the capital flows to the country was observed, with an average rate of growth of 40.9%, which was reflected in the inflow of foreign capital, in

<sup>6</sup> Aim the economy sustainable development, turning the country into the least dependent from abroad. Due to good performance and results, the MCA was renewed at the end of 2009.

<sup>7</sup> Criteria which Member States of the European Union must possess for achieving the Economic and Monetary Union (EMU) and then they can adopt the Euro. Cooperation at the political level, public security, regional integration and the fight against poverty are the priorities.

<sup>8</sup> Fixed exchange rate.

<sup>9</sup> Decision by which a country officially abandons its own currency and adopts the Euro, for being more stable and advantageous.

particular, foreign direct investment, as described by Semedo (2007).

Despite the long term goals, monetary policy depends on the ER regime. In the short term, the country offers some degrees of freedom, which can be quite useful in stabilizing situations resulting from the so-called asymmetric shocks. Those degrees of freedom, in the short term, largely depend on the robustness of the country's forex reserves (MARTA, 2006).

## METHODOLOGY

### Regimes and parameters stability

Before the 1970s, the macroeconomic instruments were based on simultaneous equations, that is, linear systems with endogenous and exogenous variables which use classifications to specify structural restrictions and identify the matrix of parameters estimated (Hoover, 2006). Some studies, such as Christ (1994), for example, evaluate the background of monetary policy offered by Cowles Commission and its contributions to econometrics. This interaction allows us choose an approach that solves the problem of structural restrictions and for instance, innovates in the sense of estimating a nonlinear system with time varying parameters.

Sims (1980) argued that the problem of structural restrictions, named on some occasions as 'incredible restrictions', is one of the main problems of monetary policy. Used to estimate large econometric models, they reduce the veracity of the parameters' estimations. To increase the confidence of monetary policy recommendations based on stochastic models, Sims (1980) proposed Vector Autoregression (VAR) as an alternative modeling strategy. This model is an extension of the methodology of univariate autoregressive models developed by Box and Jenkins (1976) and in the macroeconomic literature of empirical studies. Among the ways in which VAR modeling aids the study of aspects of variables' relationships are possible estimate causalities among variables, impulse-response functions and the forecast error variance decomposition of variables.

The introduction of nonlinearity in a context of regimes and time varying parameters put forward by the Markov Switching Vector Autoregression (MS-VAR) was developed by Krolzig (1997). It was the combination of the VAR introduced by Sims (1980), and models with the possibility of estimating regime changes, governed by Markov Switching. The MS-VAR enlarged its importance in studies of monetary policy due to the frequent criticism that the VAR model found over the last decades, related to the parameters' stability and linearity (GONZALEZ and GONZALEZ-GARCIA, 2006).

For this study, the use of the VAR model assumes, at least, in an indirect way, only one monetary policy regime, since the matrix of parameters obtained through the equation system is static for the period of the sample. In agreement with Tomazzia and Meurer (2010) if there is a change in the monetary policy, the formation of expectation changes; thus, its necessary time-varying parameters. The authors also emphasize other sources of changes that would reflect changes in parameters over time, i.e., the structural changes in the financial system, changes in the preferences of policy makers and of economic agents, which can be misestimated through a VAR model, due to the complexity of acquisition of knowledge *a priori* to specify those changes in an appropriate way.

The models MS-VAR can be formally described as processes of vector autoregressions of the time series observed  $y_{1t}, y_{2t}, y_{3t}, \dots, y_{kt}$ , whose parameters are unconditionally variant in time,

but constant when conditioned to some discrete variable and non-observable of a regime  $s_t \in \{1, 2, \dots, m\}$  (KROLZIG, 1997):

$$Y_t - \mu(s_t) = A_1(s_t)(Y_{t-1} - \mu(s_{t-1})) + A_p(s_t)(Y_{t-p} - \mu(s_{t-p})) + B(s_t)u_t \quad (1)$$

where  $u_t$  is the term of error conditioning to the regime, i.e.,  $u_t | s_t \sim \text{NID}(0, \Sigma(s_t))$ . Here  $p$  corresponds to the number of autoregressive lags,  $m$  is the number of non-observed regimes and  $k$  is the dimension of the vector of variables.

This model can be denoted by MS( $m$ )-VAR( $p$ ), i. e., a MS-VAR of  $p$  order with  $m$  regimes. The terms  $\mu(s_t)$ ,  $A_p(s_t)$ , e  $\Sigma(s_t)$  represent the functions of change in the matrix of parameters of intercept, autoregressive parameters and variance, respectively, conditional upon the regime. In other words, as the parameters of the VAR depend on the variable regime  $s_t$ .

One of the peculiar characteristics of a model with Markovian changes is due to the fact that the non-observed realizations of the regime  $s_t \in \{1, 2, \dots, m\}$  are generated by a discrete "time", constituting a stochastic process governed by Markov Switching, with discrete states. The probability of transition between the regimes is given by:

$$P_{ij} = Pr(s_{t+1} = j | s_t = i), \sum_{j=1}^m p_{ij} = 1 \forall i, j \in \{1, 2, \dots, m\} \quad (2)$$

where the probability  $p_{ij}$  represents the probability that at time  $t+1$  the chain changes to the regime  $j$ , given that it is located in  $i$  at time  $t$ .

By means of an algorithm for filtering and smoothing for obtaining the probabilities, it is possible to statistically identify regimes in a system, enabling the inference about the probability distribution of the non-observed variable regime  $s_t \in \{1, 2, \dots, m\}$ , given the set of observed variables  $Y_t$ . Regularly, the filtering method used is the Hamilton's algorithm (1989), but other filters such as Filter (1960) can also be used.

The conventional procedure to estimate the parameters of the model is to maximize the log-likelihood function, and then use the parameters to estimate the probabilities filtered and smoothed for the regimes. However, this method is not recommended in small samples, since the number of parameters to be estimated is considerably high. We used the Expectation-Maximization (EM) algorithm, originally described by Dempster et al. (1977). This technique begins with the initial estimations of the non-observed regimes, and the parameters of the model are estimated from the probabilities smoothed to the last stage of expectation. These two steps are referred to as steps of expectation and maximization<sup>10</sup>.

Table 1 shows the different specifications of the MS-VAR model.

### Model specification for Cape Verde

Based on the empirical study performed by Rocha (2008), we estimated relations and structural changes in major macroeconomic time series in Cape Verde. As well, we analyzed which of these changes are related to the management of monetary policy during the period from 1991 to 2011. These improvements try to go in the direction of the arguments of the author about the limitations of his work, with emphasis on the fact that the monetary policy demonstrated changes in the 1990s, as already presented in section 3.4.

For this study we used as variables the Output Level (Gross

<sup>10</sup> See Hamilton (1990) for more details.

**Table 1.** Types of MS-VAR Models.

Notation	$\mu$	$\nu$	$\Sigma$	$A_t$
MSM( $M$ )-VAR( $p$ )	varying	-	invariant	invariant
MSMH( $M$ )-VAR( $p$ )	varying	-	varying	invariant
MSIA( $M$ )-VAR( $p$ )	-	varying	invariant	varying
MSI( $M$ )-VAR( $p$ )	-	varying	invariant	invariant
MSIH( $M$ )-VAR( $p$ )	-	varying	varying	invariant
MSIAH( $M$ )-VAR( $p$ )	-	varying	varying	varying

$\mu$  : mean,  $\nu$  : intercept  $\Sigma$  : variance  $A_t$  : matrix of autoregressive parameters.  
**Source:** Krolzig, 1997.

**Table 2.** List of the variables used.

Variable	Code	description
Interest Rate	IR	Active rate for 91-day operation
Economic Activity Level	GDP	Gross Domestic Product in natural logarithm
Internal Price Level	CPI	CPI - overall - index (2011=100) in %
Exchange Rate	ER	Effective exchange rate index (2001 = 100), in natural logarithm

**Source:** Bank of Cape Verde and World Bank.

Domestic Product - GDP), the Consumer Price Index (CPI), the Exchange Rate (ER), and the Interest Rate (IR). As in Rocha (2008), the active rate for 91-day operations was used as a variable representative of monetary policy. The reason for this choice lies in the fact that the IR determined on the market responds more quickly to changes in the monetary policy management. The ER used was the nominal effective ER of the BCV, with base year in 2011.

The data sample used for the analysis was obtained from the BCV, between 1991 and 2011, with quarterly frequency. The times series behaviors can be checked in Figure 1 of the Appendix. Only the GDP variable was collected from the World Bank, with annual frequency. With the purpose of obtaining a greater number of observations, by using the method proposed by Lisman and Sandee (1964), the data sample of observations of GDP was converted to quarterly frequency and seasonal adjustments patterns, removed. The summary of abbreviations of variables used is shown in Table 2.

### Model 1: Simple model

The initial model is parsimonious and formed by the variables CPI, GDP and IR. This model is intended to draw basic lessons between targets and monetary policy instrument in Cape Verde. Here, the IR is interpreted as being the reaction function of the BCV, insofar as it is influenced by changes in the GDP and on the CPI in the economy. It is described by the relationship (3):

$$Y_t = [GDP_t, CPI_t, IR_t]^T \quad (3)$$

### Model 2: Exchange Rate Model

As previously argued, since 1990, the Cape Verdean economy entered a gradual process of economic openness, inserting,

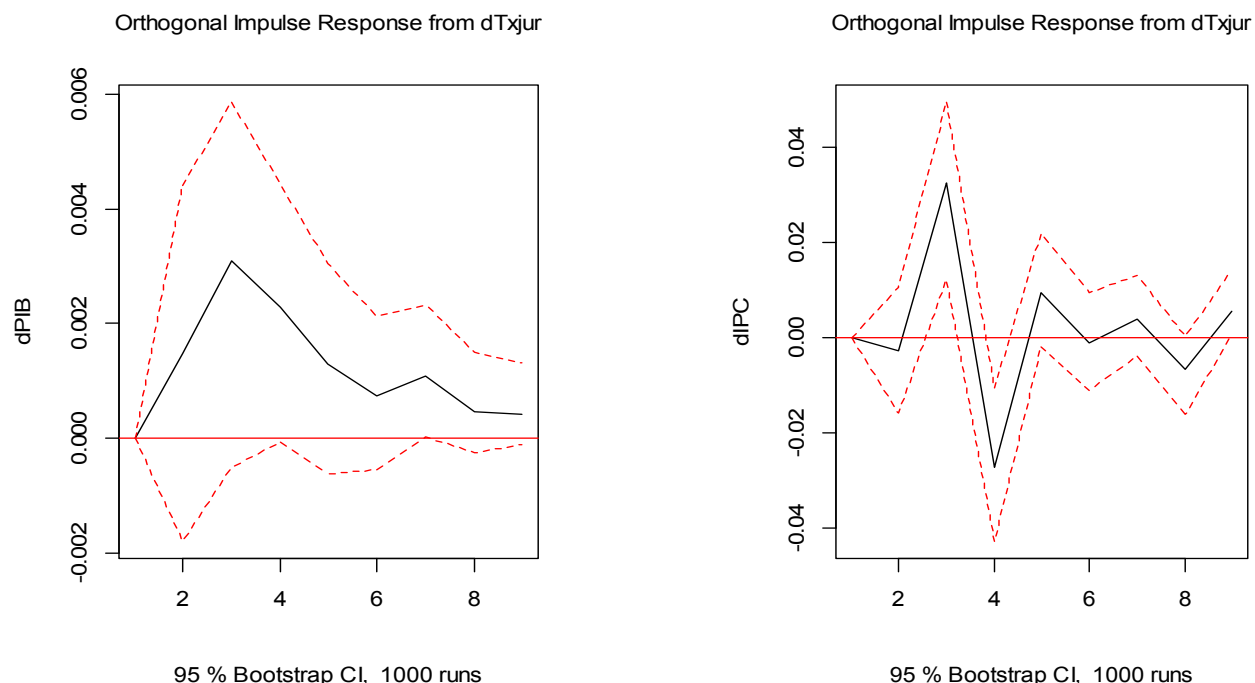
therefore, the country in the world scenario, with an objective of raising its productivity, foreign direct investments, and CPI stability. Thus, from the first model to the variable ER was introduced in order to obtain alternative results.

$$Y_t = [GDP_t, CPI_t, ER_t, IR_t]^T \quad (4)$$

Both models MS-VAR follow the nomenclature developed by Krolzig (1997) and as estimated in the form MSIA( $m$ )-VAR( $p$ ), i.e., the intercepts and parameters are time-varying. Both are composed of two regimes ( $m=2$ ), for a number of lags equal to one ( $p=1$ ). It is worth pointing out that such choices are derived from the criterion of parsimony, considering a limited number of observations. Soon, given the fact that the data are quarterly and the period was from 1991 to 2011, 32 parameters were estimated and this number represents 38% of the sample. Besides, if we increase the numbers of regimes, lags, or both, the model could not be estimated for any algorithm.

## RESULTS

As already presented in section 3, the results of Rocha (2008) did not perform very well in the monetary policy transmission channels in Cape Verde. In this sense, we characterized the Cape Verdean economy by using the MS-VAR model. In order to compare the progress of MS-VAR model we also estimated a VAR model. To proceed with the estimations, we tested if the time series used were stationary. We used Augmented Dickey-Fuller (ADF) proposed by Dickey and Fuller (1979), the Phillips-Perron (PP) test, proposed by Phillips and Perron (1988) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test



**Figure 2.** Model 1 impulse-response functions by using the VAR. **Source:** Elaborated by the authors.

**Table 3.** Tests of stationary (p-values).

Variables	ADF	PP	KPSS
GDP	0.01	0.8256	0.01
PCI	0.01	0.01	0.1
ER	0.7167	0.9685	0.01
IR	0.6088	0.665	0.01
DGDP	0.01	0.01	0.01
DPCI	0.01	0.01	0.1
DER	0.01	0.01	0.01918
DIR	0.03907	0.01	0.1

**Source:** Bank of Cape Verde and World Bank.

proposed by Kwiatkowski et al. (1992). The results are in Table 3.

**Model 1**

To analyze the monetary policy rule and its channels we estimate impulse-response functions by using the VAR model. The results of the estimations can be found in Table 1 of the Appendix. In addition, we also estimated the Variance Decomposition. Figure 2 illustrates the impulse-response functions of IR on GDP and CPI:

Through Figure 2 we can check that the impulse-response of IR on GDP is quite low and its sign is the opposite of the register in the literature. The results

obtained by using the simple VAR model shows that a shock on residues of the IR leads to GDP growth. For the CPI we can verify that the magnitudes of the effects are near zero. In Table 4 it is possible to see the Forecast Error Variance Decomposition (FEVD) of GDP and CPI by Cholesky factorization.

The results obtained are important if we think in terms of impulse-response functions estimated. Most of the deviations caused by GDP variations are explained by variations in the same variable (91.1%), during the period of 8 quarters. On average CPI and IR respond with 2.1 and 6.4%, respectively, through variations in GDP. On the other hand, on average CPI is explained 23.5% by variations in IR. This indicates that IPC could be more affected by the IR channel than the GDP.

Anyway, the results provided by the VAR model also assume that the relations among variables are all linear. This can be rejected if we pay attention to the dynamics of the period of the data used, and the historical characteristics of Cape Verdean Economy during the same period.

The linearity LR test, denoted in Table 5, was performed and indicates that the relations among variables are non-linear and that the parameters change significantly during the regimes. This fact is one of several that justify the MS-VAR model due to VAR.

After we performed the test with the results described in Table 5, the model was estimated. Due to the parsimony criterion, we tried a model with two regimes, one lag and varying intercepts and parameters. As mentioned,



**Table 4.** Forecast error variance decomposition of GDP and CPI of Model 1.

Period	GDP			CPI		
	GDP	CPI	IR	GDP	CPI	IR
1	1.00000	0.00000	0.00000	0.00316	0.99684	0.00000
2	0.96900	0.02199	0.00901	0.01677	0.98186	0.00137
3	0.93734	0.01989	0.04277	0.01738	0.82676	0.15586
4	0.92197	0.01904	0.05899	0.02408	0.74274	0.23318
5	0.91560	0.02128	0.06312	0.03676	0.72475	0.23849
6	0.91455	0.02123	0.06422	0.04181	0.72346	0.23473
7	0.91145	0.02104	0.06751	0.04308	0.72239	0.23453
8	0.91093	0.02108	0.06799	0.04346	0.71804	0.23850

Source: Elaborated by the authors.

**Table 5.** Model 1 linearity test.

H0= model is linear			
LR Test: 113.4055	$\chi^2 (12)$ =[0.0000]	$\chi^2 (14)$ =[0.0000]	DAVIES=[0.0000]

Source: Elaborated by the authors.

for this model, 32 parameters were estimated. Mainly due to this reason, we preferred a simple system characterized by the MSIA(2)-VAR(1)<sup>11</sup>.

The results of the estimations are in Table 2, and the residues of the presented model are shown in Figure 2, both in the Appendix. As the transition probabilities, the results are represented in the following transition matrix:

$$P = \begin{bmatrix} 0.4674 & 0.5326 \\ 0.0748 & 0.9252 \end{bmatrix}$$

When analyzing the results it is clear that regime 2 is more persistent than regime 1. That is, once the economy is ruled by regime 1, the probability of its continuing in the current regime is 46.74%. As a consequence, it has 53.26% probability of changing to regime 2. While for regime 2, the probability of persistence is 92.52%, and 7.48% probability of switching regime. Figure 3 illustrates the estimated probabilities for both regimes:

With this instrument it was possible to determine the classification of regimes throughout the sample period, as shown in Table 6.

The predominance of regime 2 is clearly observed, as already emphasized. The period from 1993:1 to 2006:2 was exclusively marked by regime 2. It occurred during the period of separation of the functions of the central and commercial banks and the creation of two independent institutions. It is worth remembering that prior to 1993 the monetary policy was exercised primarily

**Table 6.** Regimes estimated ranking.

Regime 1	Regime 2
1991:2 - 1991:4	1992:1 - 1992:2
1992:3 - 1992:4	1993:1 - 2006:2
2006:3 - 2006:3	2006:4 - 2006:4
2007:1 - 2007:3	2007:4 - 2010:4
2011:1 - 2011:1	2011:2 - 2011:2
2011:3 - 2011:3	2011:4 - 2011:4

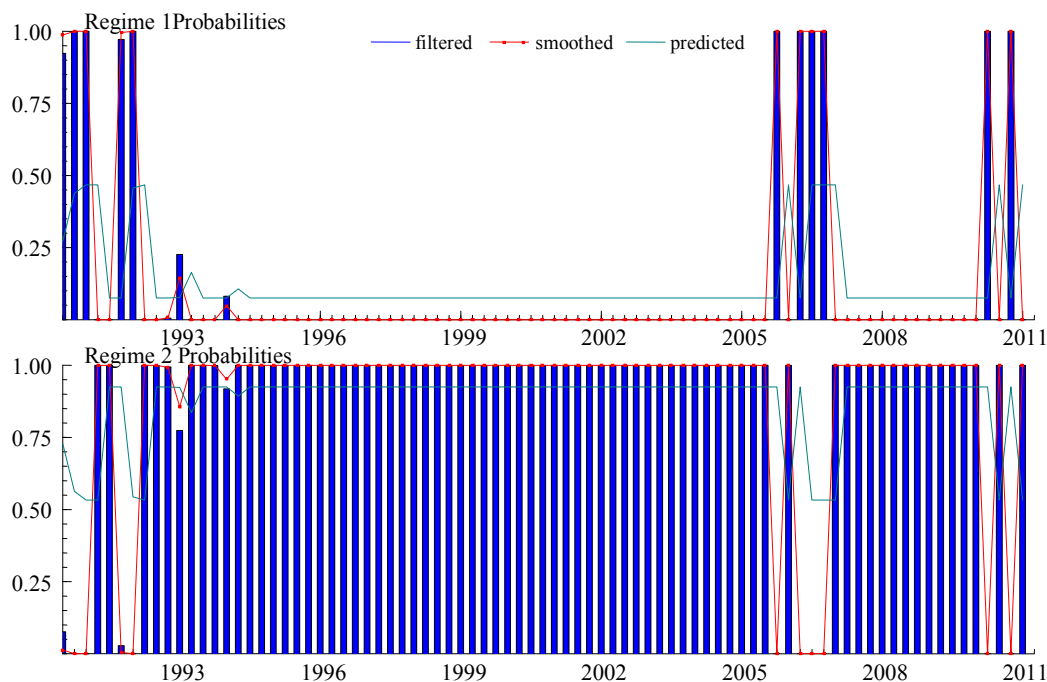
Source: Elaborated by the authors.

through the establishment of limits to the expansion of credit, IRs were fixed administratively and used as an instrument in credit distribution. In addition to this change, in 1998, some others occurred in the forex reserves system.

Regime 1 was observed during the period from 1991 to 1992. It is worth remembering that the high inflation registered in the late 1980s, linked to strong macroeconomic imbalances, pushed the government at that time. In this direction, through a budget plan, the fiscal and ER system required reforms that could deal with the inflationary process.

By analyzing Figure 1 in the Appendix, we can see that the classification of regimes, in some ways, follows the changes in the structure of the series of IRs. Regime 1 is more often observed in periods of lower IRs, whereas regime 2 remains in the periods associated with higher rates. This shows, therefore, that the classification of

<sup>11</sup> See Krolzig (1997) for more details.



**Figure 3.** Predicted, filtered and smoothed probabilities of Model 1. **Source:** Elaborated by the authors.

regimes has a higher elasticity to changes up to some value of IR. This result is combined with the fact that, due to the structure of the domestic financial market and the low domestic savings, the interest rates practiced in Cape Verde are relatively high.

In Figure 4, the impulse-response functions depend on each regime estimated through the MS-VAR model. Notice that a shock in residues of the IR causes different effects on variables, if we compare two regimes. The impact of residues of the IR on the GDP causes its reduction on both regimes, as conventional literature highlighted in section 2 registered. For regime 1, this reduction in the GDP extends until the end of the fourth quarter. While for the second regime, the effect is more persistent, considering that the GDP presents a negative signal, even after ten quarters. Another difference lies on the shock magnitude, because in regime 2, the impact is higher.

Analyzing the CPI case, it is noticed that the results of the impact on residues of the IR in regimes estimated were totally different, i.e., they are the opposite in terms of magnitude and in their sign.

The shock effect on both regimes remains until the tenth quarter. The effect of this shock is more intense in the first regime.

However, in this regime the results estimated are not in the same direction as the traditional literature in terms of the decline in the CPI. What is observed is that this shock causes a rise of 3% in the CPI, which lasts until the end of the second quarter. This result is known as price

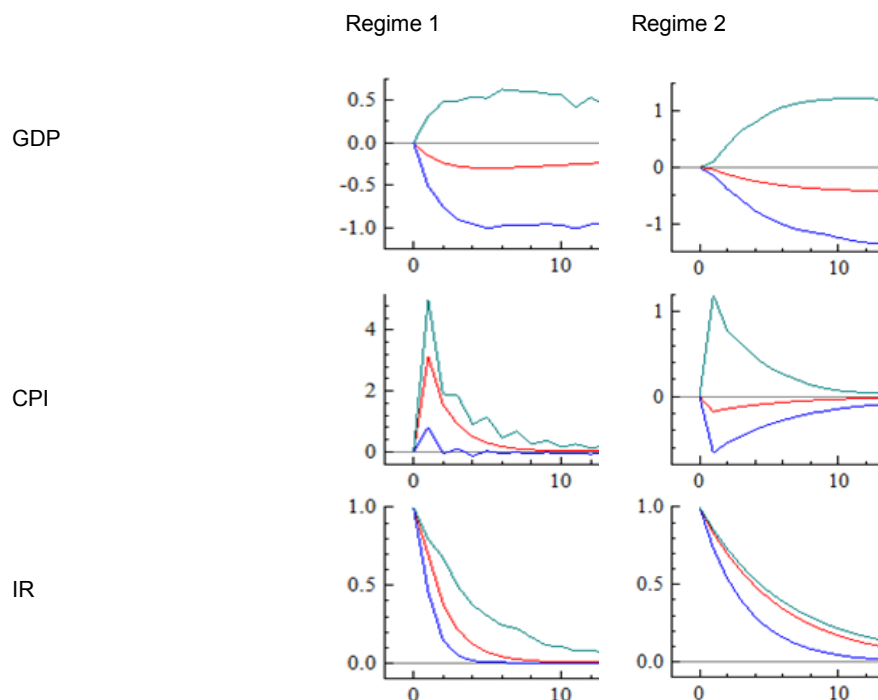
puzzle effect and was described by Sims (1992). In a general way, the result found signs that regime 1 is classified as the one in which the monetary policy is less effective. This is different from regime 2, when the monetary policy was more effective.

## Model 2

Since the 1990s, the ER policy has become more important to policy makers due to the countries' need to elevate their share of the international trade system. Cape Verde, as well as other small economies, demands conditions to balance its relations with developed countries. Another fact is that many young countries with fragile external accounting passed through reforms in that period. In many cases with the objective of stabilizing those economies' outputs, controlling the CPI and creating some protection against international crisis.

In this sense, we estimated the VAR and MS-VAR models, including the ER as well. The results of the VAR model are in Table 7 of the Appendix. Figure 7 illustrates the impulse-response functions of shocks in residues of the IR on the GDP, PCI and ER. In general, they were similar to the model 1, i.e., magnitudes and directions. The difference is that a positive shock leads to a rise in the IR, as well an injection of international capital in the country and a decrease in the ER.

If we observe Figure 5, we can see that the response of shocks in residues of the IR on the ER is statistically



**Figure 4.** Model 1 impulse-response functions by using the MS-VAR. **Source:** Elaborated by the authors.

**Table 7.** Forecast Error Variance Decomposition of GDP, CPI and ER of Model 2.

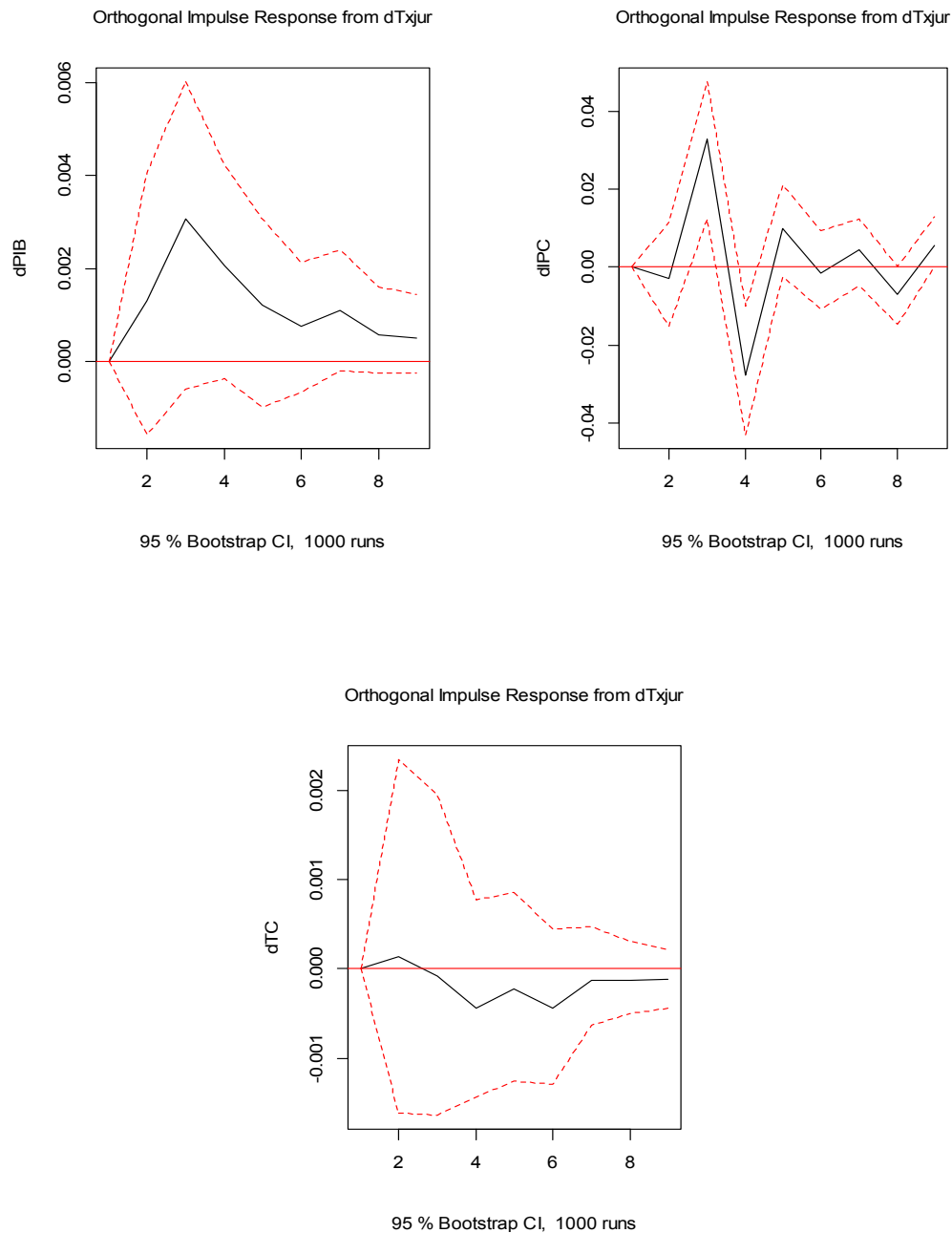
Period	GDP				CPI			
	GDP	CPI	ER	IR	GDP	CPI	ER	IR
1	1.00000	0.00000	0.00000	0.00000	0.00331	0.99669	0.00000	0.00000
2	0.96924	0.01882	0.00462	0.00733	0.01544	0.97721	0.00586	0.00149
3	0.90866	0.01644	0.03425	0.04065	0.01459	0.82402	0.00540	0.15599
4	0.89134	0.01569	0.03938	0.05359	0.01783	0.74046	0.00636	0.23535
5	0.88664	0.01682	0.03988	0.05667	0.02868	0.72144	0.00873	0.24115
6	0.88576	0.01676	0.03997	0.05752	0.03361	0.71940	0.00978	0.23721
7	0.88240	0.01656	0.04037	0.06067	0.03495	0.71768	0.01004	0.23733
8	0.88146	0.01654	0.04063	0.06137	0.03529	0.71313	0.01006	0.24152

**Source:** Elaborated by the authors.

insignificant. We could find the same result in Eyzaguirre (1998) for the Chilean economy. A possible explanation is that countries with characteristics of Cape Verde have a need for amounts of foreign-exchange reserves to protect themselves from international crisis.

The results provided for Variance Decomposition, displayed in Table 7, are in line with the impulse-response functions estimated in model 1. The average of deviations caused by IR on GDP variations is 5.8% and

has a null effect of ER. The deviations of ER in general explain 4.0% of deviations in GDP. In case of the CPI the results are different from the rest of the variables of the linear system. Since the third quarter, the variable CPI is affected by the IR and its percentage of explanation of CPI is approximately 23.8%. The contribution of ER to explain the deviations in the CPI is on average 1%. Comparing both models we can verify that impacts of shocks are pretty similar.



**Figure 5.** Model 2 impulse-response functions by using the VAR Source: Elaborated by the authors.

The model MSIA(2)-VAR(1) presenting the ER is an attempt to capture the effects of international trade on the rule of monetary policy in Cape Verde. The linearity test denoted by LR test (Table 8), was performed and indicates that model 2 is also non-linear and that the parameters change significantly between regimes 1 and 2.

$$P = \begin{bmatrix} 0.4754 & 0.5246 \\ 0.0719 & 0.9281 \end{bmatrix}$$

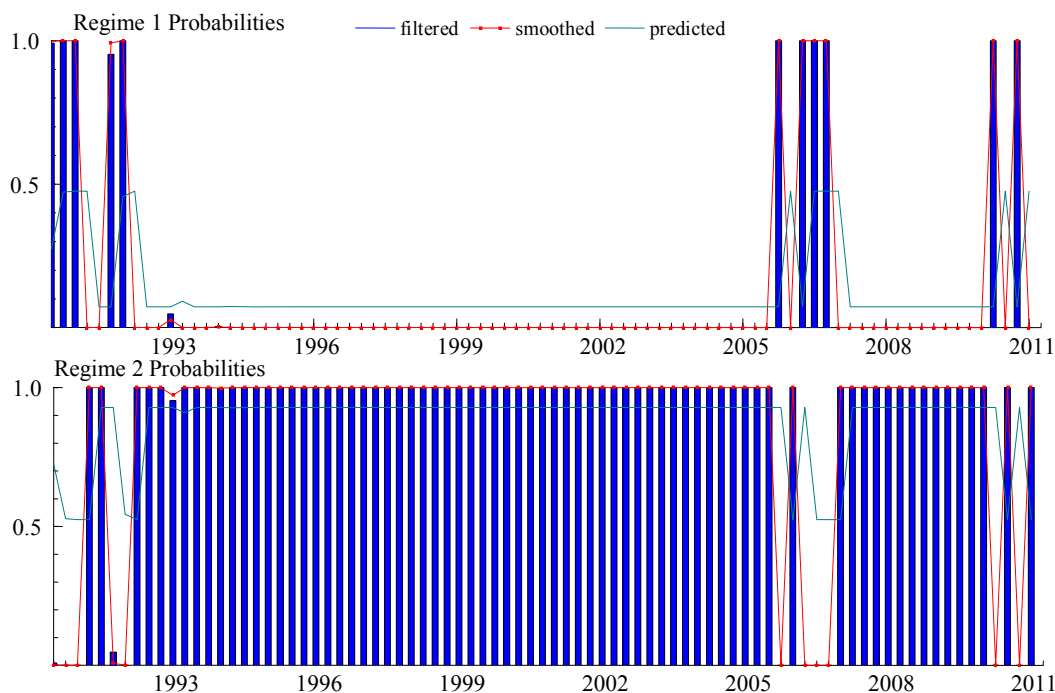
As in model 1, the results found in this model indicate that regime 2 is more persistent than regime 1. With the introduction of the ER, once at regime 1, the probability of permanence in the current regime is 47.54% with 52.46% of probability to change to regime 2. But, if the current regime is the second one, the probability to remain in this regime is 92.81% and the probability of change to regime 1 is 7.19%.

In Figure 6 we have the estimated probabilities for both regimes. The results are near values of the parameters to

**Table 8.** Model 2 linearity test.

<b>H0= model is linear</b>			
LR test: 125,8876	$\chi^2 (20) = [0.0000]$	$\chi^2 (22) = [0.0000]$	DAVIES = [0.0000]

Source: Elaborated by the authors.



**Figure 6.** Predicted, filtered and smoothed probabilities of Model 2. Source: Elaborated by the authors.

those obtained in model 1. It is realized as before the predominance of regime 2. We also observed that the period 2 occurs from 1993:1 to 2006:2. Again, the distribution of regimes shows a robust relationship with the IR level in Cape Verde, as found in model 1.

In Figure 7 the impulse-response functions depends on each regime estimated by using the MS-VAR model. The parameters estimated in this model emphasize those who had already been estimated in model 1. In both regimes, the more the negative shock effects in residues of the IR on the GDP, the more the increase in the CPI in the first regime. In the second one, the monetary policy seems to be more effective, by reducing the CPI. For the ER case it is detected that the response to a shock in residues of the IR in regime 1 is small. Either, for regime 2 the results show that after the shock, the ER reduces, indicating an appreciation that lasts until the fourth quarter.

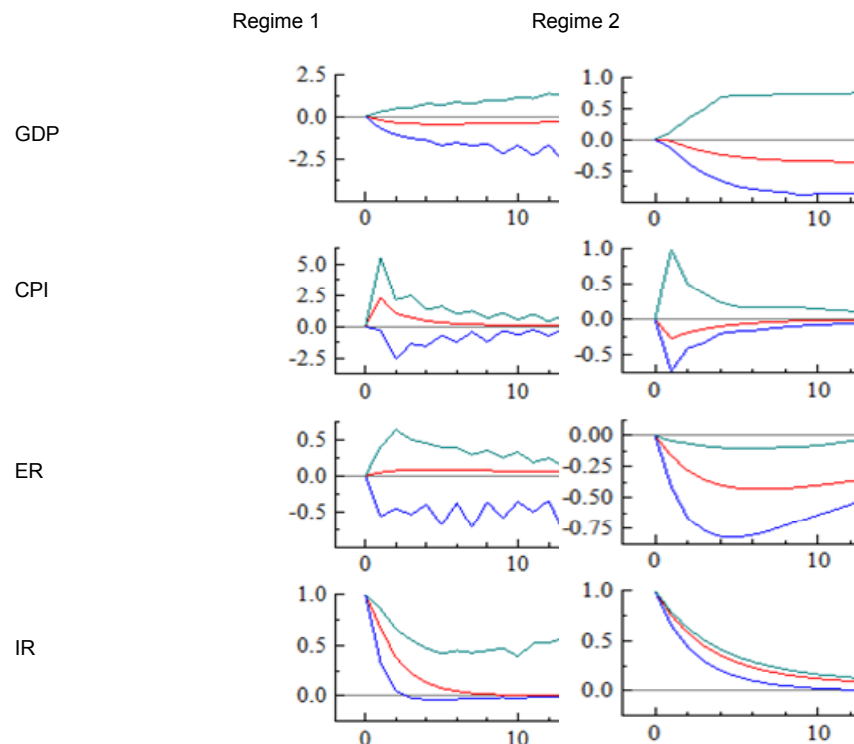
The introduction of the ER in the model has presented some changes in the results of the impulse-response functions, when compared with those obtained in model 1. For regime 1 this reduction in the GDP is until the second quarter, while in regime 2, the negative effects

persist until the eighth quarter. Therefore, it is seen that in both cases, the decrease was less persistent, if we compare with the results of model 1.

With the addition of the ER in model 2, the estimated impact of the IR on the CPI is from 3 to 2.5% in relation to the model 1. For the second regime, even with the ER appreciation, there were not observed any changes in the CPI. Indirect effects were expected, such as, for example, the reduction in CPI, due to the fact that Cape Verde imports the majority of its goods, which in the presence of the ER appreciation, would lead imported products to become relatively cheaper.

## Conclusion

Depending on the approach to be adopted, the various objectives of economic policy of a country can be analyzed. For this, is necessary that the State has a set of instruments, which are usually employed to achieve such objectives. Highlights go to fiscal, monetary and ER policy. In this work we have chosen to study the monetary



**Figure 7.** Model 2 impulse-response functions by using the MS-VAR.  
**Source:** Elaborated by the authors.

policy in Cape Verde. It was observed that the monetary policy produces some degree of effects on the economy of Cape Verde. However, this occurs under certain circumstances, indicated mainly by the estimated regimes of the MS-VAR model.

It is usual in the literature to find empirical works that deal with this issue, but applied to the industrialized countries. For emerging countries in the process of development, such studies are quite scarce. Among the reasons for this, some lie in the issue of access to information, linked to economic instability that such countries experienced in last decades of the 20<sup>th</sup> century. In Cape Verde's case, the access to information is a major obstacle to academic advancement in practically all knowledge areas. Due to this, research related to the subject proposed has not yet been explored with the same intensity as in other countries. This is the main reason that in this study we used as data a relatively a short period sample, which goes from 1991 to 2011. The model assumes the GDP and the CPI as targeting variables, active rates for 91-day operations as an instrument of the monetary policy, and, finally, the ER as the intermediate objective of monetary policy.

The VAR and MS-VAR models estimations allowed us to investigate the changes observed in the main macroeconomic variables of Cape Verde during the period mentioned. As well, they also allowed us to

understand what relations these changes preserved, important for management of monetary policy. The MS-VAR modeling has an important contribution in this sense, due to its capability of statistically identifying regimes in the time series used. The time-varying parameters help us to understand changes in the formation of expectations, due to the structural changes in the financial system, changes in the preferences of policy makers and of economic agents, which can be misestimated through a VAR model. It cannot describe the complexity of acquisition of knowledge *a priori* to specify those changes, as emphasized in section 4.

As the main result, the estimation of the MSIA(2)-VAR(1) model produced some information about the probabilities of transition from both models. We saw that regime 2 is the most persistent and prevails during the entire period from January 1993 to February 2006. This period matches with the one in which there was a separation in the central bank functions of central bank and commercial bank, and the creation of two independent institutions. In the period that preceded 1993, the monetary policy was ruled primarily by the creation of limits for credit expansion; also, the IRs were fixed administratively, and used as an instrument of credit distribution. In addition to this change, in 1993, still during the period, there was a change in the forex reserves system, which happened in 1998.

Taking a look at the results of the Cape Verdean economy, we highlight, as we did in section 2, small economies with external sector dependence, especially the role of foreign direct investments as a key for the country's development process. Thus the increasing of the IR works as an attractor for foreign capital and consequently increasing the GDP. Taking for instance the null initial effect of a shock of the IR on the CPI and afterwards followed by a rise in the latter, we can find a possible explanation through the presence of the price puzzle, described by Sims (1992).

Another question is due to the presence of price rigidity in the very short term and the menu costs, as argued by the new Keynesian literature, such as Calvo (1983) and Christiano, Eichenbaum and Evans (2005), for example. The rise in the CPI can also be explained by the costs channel, in the sense that when the IR elevates due to the shock, the contracts that were signed may not have been adjusted; nevertheless futures contracts were targeted with those adjustments, incorporating the growth in the capital cost, and being transmitted to the CPI.

An econometric examination lies in the fact that the classification of regimes is elastic to changes up to a certain value of the IR. It was observed that this value is relatively high in Cape Verde, and this is due to the domestic structure of the national financial system and weak internal savings, as mentioned earlier. Impulse-response regime-dependent functions were useful tools in the analysis of the changes in the patterns of monetary policy. The results indicate that in regime 2 the BCV failed to practice an effective monetary policy, by completing the objectives according to the literature. On the other hand, we also observed that in regime 1 a rise occurs in the CPI, due to a positive shock in residues of the IR. By introducing the ER in the model, in regime 1, the impact of former on the CPI reduces from 3 to 2.5%. Another change in the results was the duration of the negative effect of the positive shock in residues of the IR on the GDP, which was small in both regimes.

### Conflict of Interests

The author(s) have not declared any conflict of interests.

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## APPENDIX

Table 1. Results of VAR for Model 1.

	DPIB	DIPC	DTXJUR
	0.874535	-0.58132	-0.099674
DGDP(-1)	(0.11664)	(0.58741)	(0.0486)
	[7.49774]*	[-0.98964]	[-2.05086]**
	0.094006	0.542543	0.095033
DGDP (-2)	(0.11334)	(0.5708)	(0.04723)
	[0.82940]	[0.95049]	[2.01223]**
	0.028145	-0.071255	-0.006483
DPCI(-1)	(0.02252)	(0.11339)	(0.00938)
	[1.25000]	[-0.62838]	[-0.69101]
	-0.010949	-0.057126	0.024885
DPCI(-2)	(0.02272)	(0.11443)	(0.00947)
	[-0.48186]	[-0.49921]	[2.62833]**
	-0.250441	-1.998303	0.724111
DIR(-1)	(0.2572)	(1.29528)	(0.10717)
	[-0.97372]	[-1.54276]	[6.75669]*
	-0.043529	2.936582	0.162716
DIR(-2)	(0.26859)	(1.35263)	(0.11191)
	[-0.16207]	[2.17102]**	[1.45393]
Const.	0.365014	0.277196	0.060449
	(0.0489)	(0.24627)	(0.02038)
	[7.46445]*	[1.12560]	[2.96670]**

Source: Elaborated by the authors. \*1% significance. \*\*5% significance. \*\*\*10% significance. Standard deviation in brackets.

Table 2. Results of MSIA-VAR for Model 1.

	Regime 1			Regime 2		
	DGDP	DPCI	DIR	DGDP	DPCI	DIR
	0.95942	-0,056821	-0.009031	0.981886	-0.007954	-0.000968
GDP_1	(0.0028913)	(0.019489)	(0.001331)	(0.0021193)	(0.014053)	(0.00095392)
	[331.8281]*	[-0.98964]	[-2.05086]**	[463.3017]*	[-0.566]	[-1.0144]
	0.004778	-0.198357	-0.032395	0.285631	-0.031121	-0.01172
CPI_1	(0.016395)	(0.11151)	(0.007563)	(0.050367)	(0.33712)	(0.022827)
	[0.2914]	[-1.7788]***	[-4.2833]**	[5.671]*	[-0.0923]	[-0.5134]
	-0.151747	3135919	0.691321	-0.039259	-0.178207	0.834332
IR_1	(0.29009)	(1.9751)	(0.14384)	(0.083277)	(0.56153)	(0.038078)
	[-0.5231]	[-2.0000]***	[4.8063]**	[-0.4714]	[-0.3174]	[21.9112]*
Const.	0.441166	0.148309	0.111419	0.199362	0.107302	0.030178
	(0.04368)	(0.29335)	(0.020197)	(0.025157)	(0.16632)	(0.011304)
	[10.1001]*	[0.5056]	[-5.5167]*	[7.9247]*	[0.6451]	[2.6698]**

Source: Elaborated by the authors. \*1% significance. \*\*5% significance. \*\*\*10% significance. Standard deviation in brackets.

**Table 3.** Results of VAR for Model 2.

	DGDP	DPCI	DER	DIR
DGDP(-1)	0.828756 (0.11505) [7.20374]*	-0.597101 (0.59445) [-1.00446]	-0.031632 (0.09785) [-0.32329]	-0.094509 (0.04849) [-1.94894]***
DGDP(-2)	0.139291 (0.11235) [1.23985]	0.600586 (0.5805) [ 1.03461]	0.026152 (0.09555) [ 0.27370]	0.085012 (0.04735) [1.79523]***
DPCI(-1)	0.028022 (0.02191) [1.27923]	-0.079131 (0.11319) [-0.69911]	0.000272 (0.01863) [ 0.01460]	-0.00556 (0.00923) [-0.60244]
DPCI(-2)	-0.00889 (0.0221) [-0.40231]	-0.060173 (0.11418) [-0.52700]	0.00241 (0.01879) [0.12823]	0.025088 (0.00931) [2.69346]**
DER(-1)	0.348007 (0.13913) [2.50136]**	-0.225652 (0.71888) [-0.31389]	1.015342 (0.11833) [ 8.58078]*	0.000732 (0.05864) [0.01249]
DER(-2)	-0.326003 (0.13683) [-2.38255]**	0.626829 (0.70701) [ 0.88659]	-0.10755 (0.11637) [-0.92418]	-0.04877 (0.05767) [-0.84558]
DIR(-1)	-0.23528 (0.25918) [-0.90777]	-1.484008 (1.33923) [-1.10811]	-0.122287 (0.22044) [-0.55475]	0.663482 (0.10925) [6.07318]*
DIR(-2)	-0.004233 (0.26885) [-0.01575]	3.384348 (1.38919) [2.43621]**	-0.147419 (0.22866) [-0.64471]	0.108027 (0.11332) [0.95326]
Const.	0.262205 (0.32821) [0.79890]	-2.119666 (1.69587) [-1.24990]	0.514876 (0.27914) [1.84451]*	0.345354 (0.13834) [2.49639]**

**Source:** Elaborated by the authors. \*1% significance. \*\*5% significance. \*\*\*10% significance. Standard deviation in brackets.

**Table 4 .** Results of MSIA-VAR for Model 2.

	Regime 1				Regime 2			
	GDP	CPI	ER	IR	GDP	CPI	ER	IR
GDP_1	0.979474 (0.014) [70.1755]*	0.189117 (0.0849) [2.227]**	-0.014083 (0.0163) [-0.863]	-0.008652 (0.004) [-2.1814]**	0.982433 (0.0045) [219.5404]*	-0.012046 (0.0298) [-0.4045]	-0.002887 (0.0052) [-0.557]	-0.004662 (0.0021) [-2.1897]**
CPI_1	0.000394 (0.0165) [0.0238]	-0.251322 (0.1084) [-2.3177]**	-0.001421 (0.0193) [-0.0737]	-0.03266 (0.0074) [-4.4195]*	0.288199 (0.0491) [5.8662]*	-0.038126 (0.3215) [-0.1186]	0.012144 (0.057) [0.2129]	-0.01224 (0.0221) [-0.555]
ER_1	0.20506 (0.14) [1.4643]	2.520064 (0.8506) [2.9626]**	0.846884 (0.1637) [5.174]*	0.003271 (0.0397) [0.0825]	0.006189 (0.0384) [0.161]	-0.041244 (0.2537) [-0.1626]	0.910791 (0.0442) [20.585]*	-0.035482 (0.0182) [-1.9472]**
IR_1	-0.223808 (0.2939) [-0.7616]	2.267515 (1.9264) [1.1771]	0.043816 (0.3425) [0.1279]	0.672602 (0.1321) [5.0901]*	-0.025789 (0.1182) [-0.2182]	-0.268521 (0.7795) [-0.3445]	-0.166075 (0.1369) [-1.2132]	0.755568 (0.0549) [21.9112]*
Const.	-0.708536 (0.7859) [-0.9016]	-13.97748 (4.7728) [-2.9286]**	0.850837 (0.9187) [0.4239]	0.094322 (0.2225) [0.4239]	0.163581 (0.2293) [-0.2182]	0.350171 (1.5169) [-0.3445]	0.461863 (0.2643) [-1.2132]	0.240935 (0.109) [13.7657]*

**Source:** Elaborated by the authors. \*1% significance. \*\*5% significance. \*\*\*10% significance. Standard deviation in brackets.

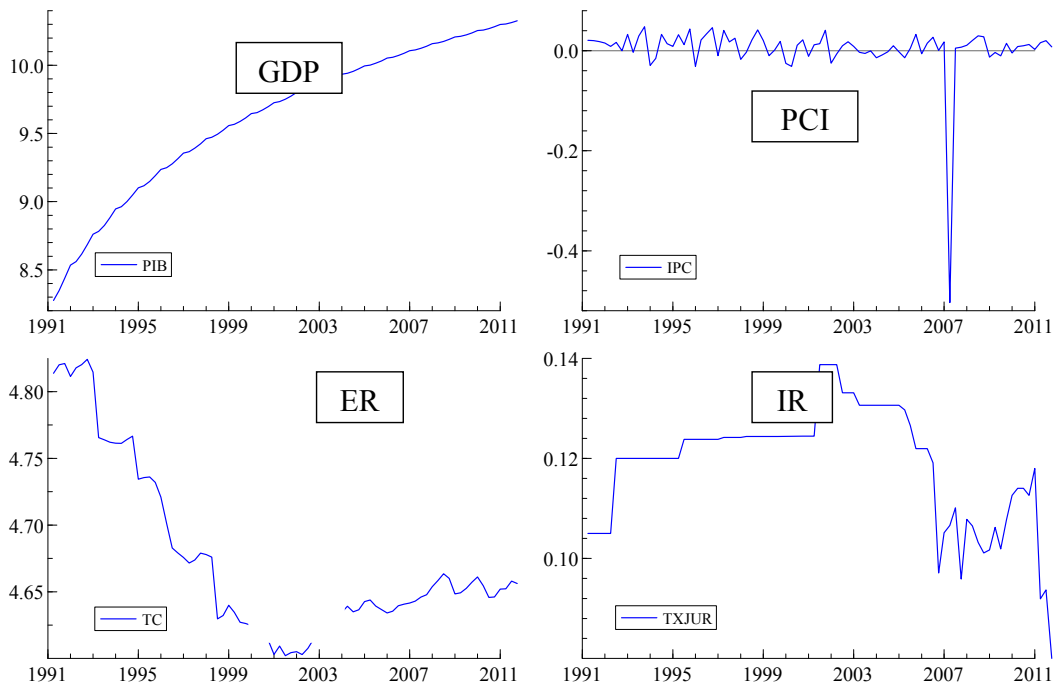


Figure 1. Times series used. Source: Elaborated by the authors.

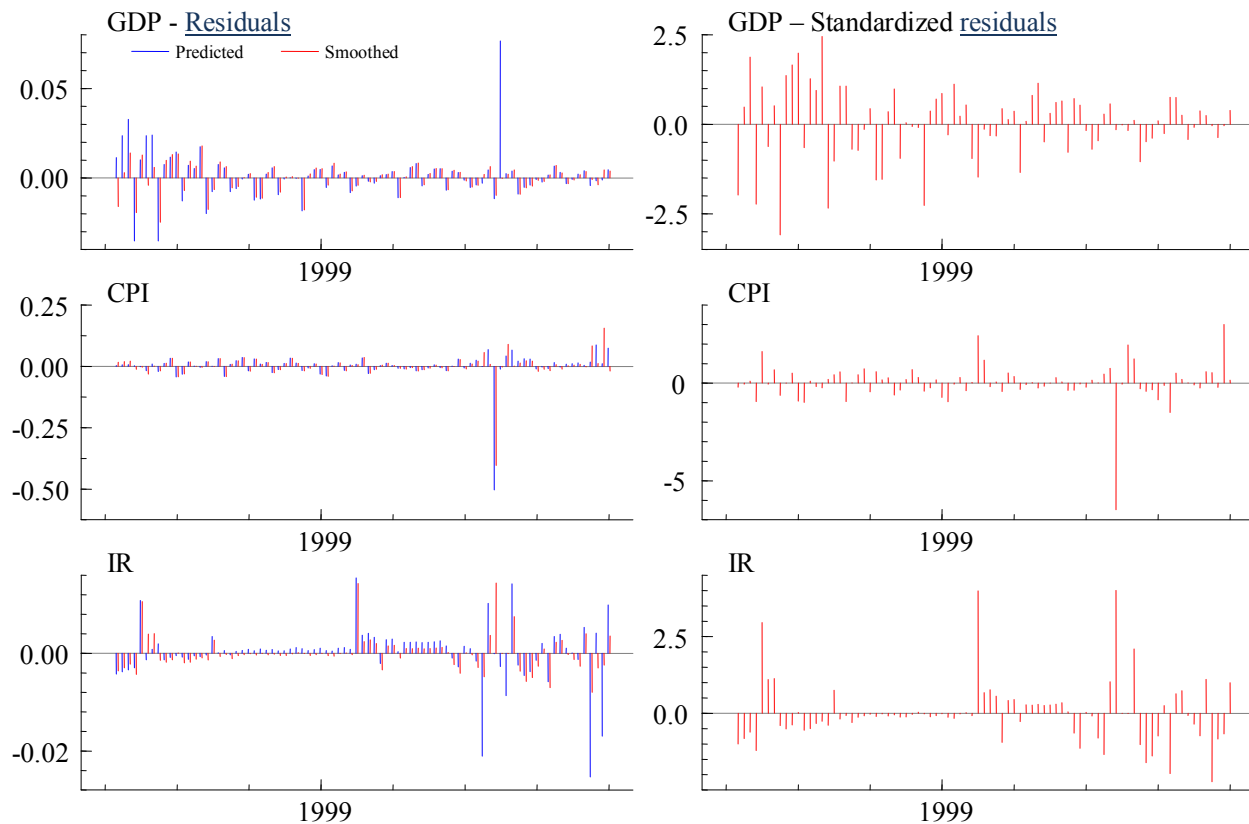
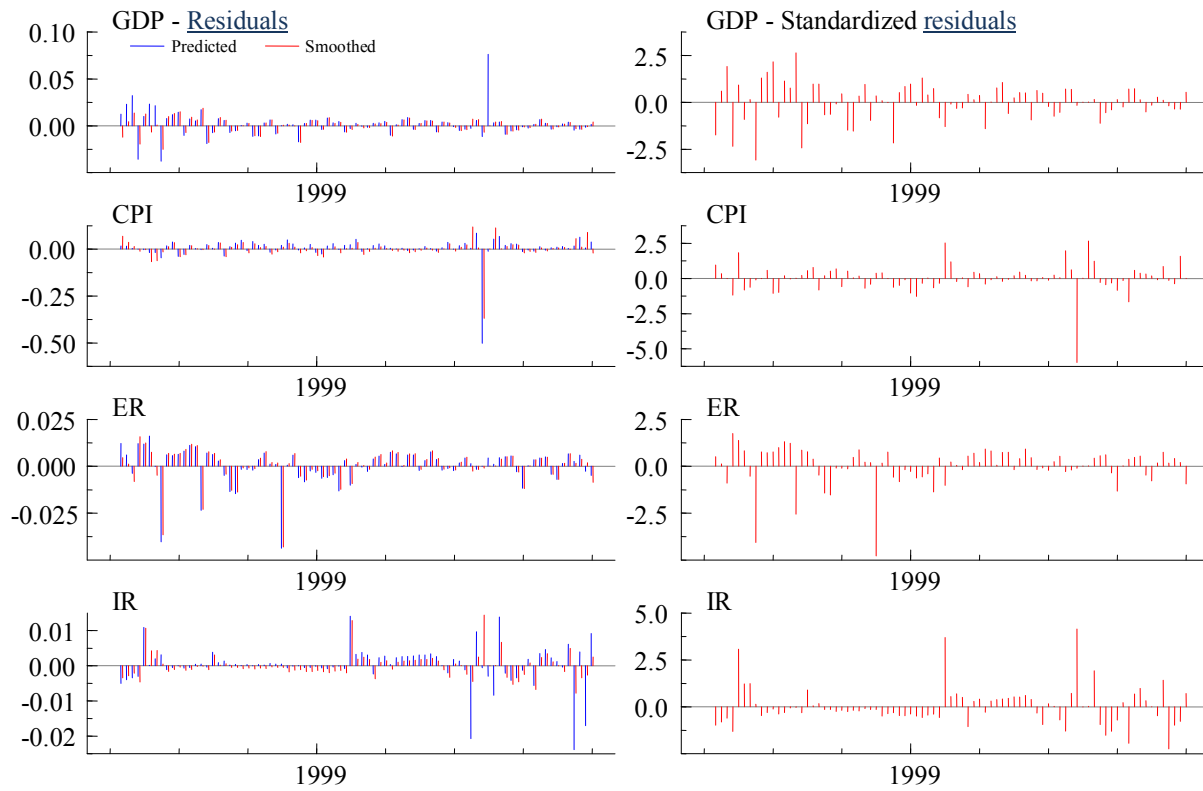


Figure 2. Residuals of the MSIA(2)-VAR(1) for Model 1. Source: Elaborated by the authors.



**Figure 3.** Residuals of the MSIA(2)-VAR(1) for Model 2. Source: Elaborated by the authors.