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"The Effects of Monetary Policy in a Small Open Economy: The Case of Portugal"

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The Effects of Monetary Policy in a Small Open Economy: The Case of Portugal

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Abstract

In this paper, I analyze the macroeconomic effects of monetary policy on the Portuguese economy. I show that a positive interest rate shock leads to: (*i*) a contraction of real GDP and a substantial increase of the unemployment rate; (*ii*) a quick fall in the commodity price and a gradual decrease of the price level; and (*iii*) a downward correction of the stock price index. It also produces a "short-lived liquidity effect" and helps explaining the negative comovement between bonds and stocks. In addition, I find evidence suggesting the existence of a money demand function characterized by small output and interest rate elasticities. By its turn, the central bank's policy rule follows closely the dynamics of the money markets. Finally, both the real GDP and the price level in Portugal would have been higher during almost the entire sample period if there were no monetary policy surprises.

Keywords: *monetary policy, Portugal, euro area.*

JEL Classification: *E37, E52.*

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1 Introduction

At an early stage, the most recent financial crisis, which began in the US in the summer of 2007 with the bursting of the sub-prime mortgage market, seemed to be a domestic problem. However, as the collapse of Lehman Brothers in September 2008 unleashed a full-blown systemic crisis with global risk aversion dramatically increasing, asset markets across countries and regions plunged. Stock markets tumbled, spreads on sovereign debt widened and exchange markets came under pressure all over the world.

The initial contagion from the US financial markets to other developed and emerging market economies quickly morphed into real sector problems and revealed the strength of the linkages between the financial system, the housing sector, the banking sector and the credit market (Jawadi, 2010). In addition, its dramatic damage emerged as a key element for evaluating the macroeconomic impact of the credit sector, the stock market, the external imbalances, or even duration dependence.[1]

In this context, the relationship between policy instruments, the real economy, and aggregate wealth received a renewed interest in terms of research agenda (Afonso and Sousa, 2012; Sousa, 2010a, 2010b, 2012a, 2012b, 2012c). In fact, monetary policy interventions might affect the nexus between monetary stability and financial stability (Granville and Mallick, 2009; Sousa, 2010c, 2012d; Castro, 2011) and lead to business cycle de-synchronization (Rafiq and Mallick, 2008; Mallick and Mohsin, 2010).

However, to understand the role of monetary policy, it is crucial to know the models that describe the monetary transmission, where the money demand function and the monetary policy rule are key ingredients. Moreover, while a large body of empirical literature is available in terms of estimating money demand functions (Goldfeld, 1973; Butkiewicz and McConnell, 1995) and assessing the monetary policy rule (Taylor, 1993) for the US or the euro area, the research addressing the effects of monetary policy on a small open economy (such as Portugal) is, by far, less extensive. Indeed, there are just a few exceptions. For instance, Ramaswany and Slok (1998) cluster the European Union (EU) countries into two groups according to the adjustments of economic activity to monetary policy actions: the first group including Austria, Belgium, Finland, Germany, Netherlands and UK, where the impact of monetary policy is gradual but large in magnitude; and the second group including Denmark, France, Italy, Portugal, Spain and Sweden, where the effect is faster although smaller. Similarly, Tremosa-Balcells and Pons-Novell (2001) evaluate if a unique monetary policy

[1] Recently, Castro (2010) shows that the likelihood of an expansion or a contraction ending is dependent on its own duration. In addition, the potentially long-lasting effects of the Great Recession have also started to capture the attention of academics and policymakers towards the detection of change-points in the duration of business cycle expansions and contractions (Castro, 2012).

would have had the same impact across countries in the EU and also suggest that while Germany and the North-Central European countries would be less sensitive to such institutional framework, the Mediterranean countries (and Belgium) would be more sensitive.

In this paper, monetary policy shocks are identified using three major econometric techniques based in parsimoniously restricted multivariate time-series models. First, I consider a recursive partial identification scheme *a la* Christiano et al. (1996) and assess the posterior uncertainty of the impulse-response functions by estimating a Bayesian Structural Vector Autoregression (B-SVAR) model. Second, I allow for simultaneity in the response of money to shocks in the interest rate, and use a Fully Simultaneous System approach in line with the works of Leeper and Zha (2003) and Sims and Zha (2006a, 2006b). Third, I estimate a Vector Autoregressive (VAR) based on a Block Exogeneity framework (Cushman and Zha, 1997; Zha, 1999), which contains a set of domestic variables in a small open economy (Portugal) and a set of external variables in the euro area. This allows one to assess the response of the set of variables describing the dynamics of the Portuguese economy to a shock to the interest rate in the euro area.

The results show that after a monetary policy contraction there is: (*i*) a significant fall of real GDP and a rise of the unemployment rate; (*ii*) a strong and quick fall in the commodity price and a gradual decrease in the price level; (*iii*) a negative impact on the stock price index, although it starts recovering at a fast pace; and (*iv*) a "short-lived liquidity effect" together with a "flight to quality" in asset portfolios. In addition, it generates an increase of the Portuguese government bond yield, thereby, adding further tensions to the bond market in reflex of the deterioration of the conditions for refinancing public debt and the negative comovement between bonds and stocks.

The empirical findings also support the existence of a money demand function for Portugal characterized by small output and interest rate elasticities. By its turn, the policy rule reveals that the monetary authority pays a lot of attention to developments in the monetary aggregates.

Finally, a VAR counter-factual exercise provides evidence of a considerable difference between the actual and the counter-factual series for the interest rate and, therefore, the importance of unexpected variation in monetary policy. Moreover, both the real GDP and the price level in Portugal would have been higher during almost the entire sample period if there were no monetary policy shocks. Similarly, monetary policy had an important asset price effect.

The rest of the paper is organized as follows. Section 2 explains the modeling strategy. Section 3 describes the data and discusses the results. Section 4 provides a counter-factual analysis. Section 5 concludes with the main findings and policy implications.

2 Modelling Strategy

I estimate the following Structural VAR (SVAR)

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t}_{n\times 1} = \Gamma_0 X_t + \Gamma_1 X_{t-1} + ... = c + \varepsilon_t \text{ where } \varepsilon_t | X_s, s < t \sim N(\underline{0}, \Lambda) \tag{1}$$

where $\Gamma(L)$ is a matrix valued polynomial in positive powers of the lag operator L, n is the number of variables in the system, and ε_t is the vector of fundamental economic shocks. The "reduced form" of the system is, therefore,

$$\Gamma_0^{-1}\Gamma(L) X_t = B(L) X_t = a + v_t \sim N(\underline{0}, \Sigma) \tag{2}$$

where $\Sigma := \Gamma_0^{-1}\Lambda\left(\Gamma_0^{-1}\right)'$, the vector $v_t = \Gamma_0^{-1}\varepsilon_t$ contains the innovations of X_t, and Γ_0 captures the contemporaneous relations among the variables in the system..

2.1 Partial Recursive Identification

In this setting, the choice of identification restrictions in the Γ_0 matrix is key. I report results based a recursive partial identification procedure a la Christiano et al. (1996, 2005). The variables in X_t can be split into 3 groups: (i) a subset of n_1 variables, X_{1t}, whose contemporaneous values appear in the policy function and do not respond contemporaneously to the policy shocks; (ii) a subset of n_2 variables, X_{2t}, that respond contemporaneously to the monetary policy shocks and whose values appear in the policy function only with a lag; and (iii) the policy variable, that is, the short term interest rate, i_t. To the set of variables considered in Christiano et al. (1996), I add the commodity price, Pcm, to X_{1t} and the stock price index, SP, to X_{2t}. The recursive assumptions can be represented by $X_t = [X_{1t}',\ i_t,\ X_{2t}']'$ and

$$\Gamma_0 = \begin{bmatrix} \underbrace{\gamma_{11}}_{n_1\times n_1} & \underbrace{0}_{n_1\times 1} & \underbrace{0}_{n_1\times n_2} \\ \underbrace{\gamma_{21}}_{1\times n_1} & \underbrace{\gamma_{22}}_{1\times 1} & \underbrace{0}_{1\times n_2} \\ \underbrace{\gamma_{31}}_{n_2\times n_1} & \underbrace{\gamma_{32}}_{n_2\times 1} & \underbrace{\gamma_{33}}_{n_2\times n_2} \end{bmatrix}. \tag{3}$$

Finally, the posterior uncertainty about the impulse-response functions is assessed by using a Monte Carlo Markov-Chain (MCMC) algorithm. Appendix A provides a detailed description of the computation of the probability bands.

2.2 Fully Simultaneous System of Equations

Leeper and Zha (2003) and Sims and Zha (2006a, 2006b) do not assume that the central bank reacts only to variables that are predetermined relative to policy shocks and assume that there are no predetermined variables with respect to the policy shock. The economy is divided into three sectors: a financial, a monetary and a production sector. The financial sector reacts contemporaneously to all new information and is summarized by the commodity price index, Pcm. The monetary sector allows for simultaneous effects, and includes: (i) the "money supply" function, where monetary policy reacts only to commodity prices, Pcm, the interest rate, i, and monetary reserves, M; and (ii) the "money demand" function that links the short term interest rate, i, GDP, Y, and the GDP deflator, P, and monetary reserves, M.

I depart from Leeper and Zha (2003) in that I assume that stock prices, SP, react contemporaneously to all new information, and I follow Sims and Zha (2006a, 2006b) in the sense that monetary policy reacts only to interest rate and monetary reserves. Therefore, the commodity price index (included in the Leeper and Zha (2003) and the Sims and Zha (2006a, 2006b) specifications) is replaced by the stock price index, as financial prices are observed in real time. As in Sims and Zha (2006b), the model imposes short-run price homogeneity. Finally, the production sector includes GDP, Y, unemployment rate, U, and the GDP deflator, P.

The estimates of Γ_0 are obtained via numerical maximization of the integrated likelihood and probability intervals for the impulse-response functions are constructed by drawing jointly from the posterior distribution of $B(L)$ and Γ_0. Because the integrated likelihood is not in the form of any standard probability density function, one cannot draw Γ_0 from it directly to make inference. Consequently, I take draws for Γ_0 using an importance sampling approach that combines the posterior distribution with the asymptotic distribution of Γ_0, and draw $B(L)$ from its posterior distribution conditional on Γ_0. Then, probability bands are constructed from the weighted percentiles of the impulse-response functions drawn in this fashion. This Monte Carlo approach is explained in detail in the Appendix B.

2.3 Block Exogeneity Approach

Under this framework, the variables in the SVAR represented by (1) are such that X_t can be split into 2 groups: (i) a subset of m_1 domestic variables of the small open economy (Portugal), X_t^{PT}; and (ii) a subset of m_2 variables external to the small economy (i.e., euro area macroeconomic aggregates), X_t^{EA}. As a result, we can partition the model into a domestic and an external block using the notation $X_t = \left[X_t^{PT\prime},\ X_t^{EA\prime}\right]'$ and

$$\Gamma_0 = \begin{bmatrix} \Gamma_{11} & \Gamma_{12} \\ \Gamma_{21} & \Gamma_{22} \end{bmatrix}. \tag{4}$$

The small open economy assumption implies the restriction that $\Gamma_{21} = \mathbf{0}$ (Cushman and Zha, 1997; Zha, 1999). This is the restriction making the $X_t^{EA\prime}$ vector block exogenous, that is, domestic variables are postulated not to enter the external block equations either contemporaneously or with lags. External variables are a linear combination of external shocks only, whereas domestic variables are generated both by domestic and external disturbances. As in the case of the Christiano et al. (1996) specification, the probability bands of the impulse-response functions are computed by using a Monte Carlo Markov-Chain (MCMC) algorithm.

3 Results and Discussion

3.1 Data

This Section provides a summary of the data description, and a detailed one can be found in Section C of the Appendix. The data used in the various estimations refers to the period 1947:1-2007:4.

For the Christiano et al. (1996) identification, the variables in X_{1t} are the commodity price, Pcm_t, the real gross domestic product, Y_t, and the GDP deflator, P_t, while the variables in X_{2t} are the growth rate of M_{2t}, and the stock price index, SP_t. The interest rate (denoted by i_t) is used as the monetary policy instrument. As a result, the recursive assumptions defined in (3) can be represented by $X_t = [X_{1t}',\ i_t,\ X_{2t}']'$, where $X_{1t} = [Pcm_t, GDP_t, P_t]$ and $X_{2t} = [M_{2t}, SP_t]$. I also include in the set of exogenous variables a constant. As advocated by Christiano et al. (1996), the inclusion of the commodity price helps avoiding the "price-puzzle".

For the Leeper and Zha (2003) and the Sims and Zha (2006a, 2006b) approaches, I replace the commodity price index by the stock price index.[2] That is, I consider the stock price index, nominal M_2, the interest rate, GDP, the GDP deflator, and the unemployment rate.

Finally, for the Cushman and Zha (1997) and Zha (1999) frameworks, the domestic variables describing the small open economy (Portugal) are the real GDP, the GDP deflator, the long-term interest rate (proxied by the 10-year government bond yield), the growth rate of M_2, and the stock price index, while the external variables representing the euro area are the commodity price index, the real GDP, the GDP deflator, the short-term interest rate (used as the monetary policy instrument), the growth rate of M_3, and the stock price index. The choice of different monetary

[2] For an interesting assessment of nonlinearity in macroeconomic and financial models, see Jawadi (2009, 2012).

aggregates is dictated by the fact that M_2 was the relevant monetary aggregate when the Central Bank of Portugal was conducting monetary policy, while the ECB closely tracks the dynamics of M_3.

The real GDP, the commodity price index and the stock price index are expressed in natural logarithms and measured at constant prices. The monetary aggregates and the GDP deflator are also expressed in natural logarithms. As for the central bank rate and the government bond yield, they are measured in nominal terms, while the unemployment rate is expressed in levels.

3.2 Partial Recursive Identification

I start by looking at the impact of a positive interest rate shock. Figure 1 plots the impulse-response functions: the solid line denotes the point estimate, the red line represents the median response, and the dashed lines are the 68% posterior probability intervals constructed by using a Monte-Carlo Markov-Chain algorithm based on 10000 draws.

Looking at the macroeconomic effects of the monetary contraction, one concludes that the results are in line with the findings of Christiano et al. (1996). After the positive interest rate shock (of about 30 basis points), real GDP falls and the trough (of -0.15%) is reached after around 12 quarters. The commodity price falls both strongly and quickly. In addition, the price level gradually decreases.

The empirical findings also show a negative effect on the stock price index, which falls on impact and reaches a trough of -2% after 8 quarters. However, the adjustment in this component of financial wealth is quick, as stock prices start recovering at a fast pace. The response of the growth rate of M_2 shows that, as the shock to the interest rate erodes, the liquidity puzzle disappears after 8 quarters. Finally, it can be seen that the interest rate turns negative after 10 quarters, in accordance with the idea of a "short-lived liquidity effect" that is followed by expected inflation and income effects (Friedman, 1968; Cagan, 1972).

Table 1 reports the portion of fluctuations in the data that are caused by a monetary policy shock (variance decompositions), and displays the percentage of variance of the k-step-ahead forecast error in the elements of X_t due to an interest rate shock, for $k = 1$, 4, 8 and 20. It shows that policy shocks account for a relatively small fraction of inflation, commodity price and real GDP (about 5% of the variation 20 quarters ahead). In contrast, unexpected variation in monetary policy explains 8.9% of the variation in the stock price index and 7.9% of the variation in the growth rate of M_2 20 quarters ahead.

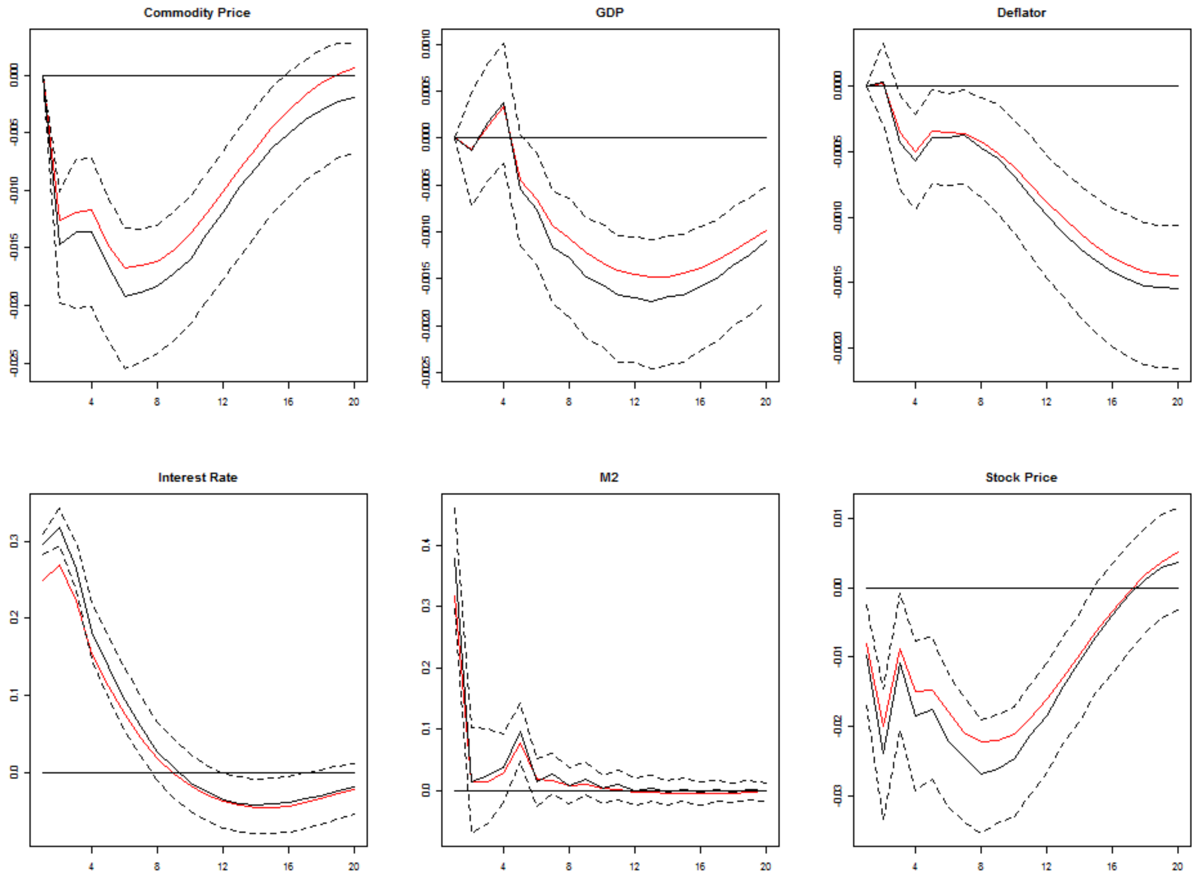

Figure 1: Impulse-response functions to a monetary policy contraction using Christiano et al. (2005) identification.

Table 1: Percentage variance due to a monetary policy shock.

Variable:	1 Quarter Ahead	4 Quarters Ahead	8 Quarters Ahead	20 Quarters Ahead
Commodity price	0.0 [0.0; 0.0]	2.5 [1.4; 4.2]	5.0 [3.0; 7.7]	6.0 [3.9; 8.9]
GDP	0.0 [0.0; 0.0]	1.2 [0.7; 2.1]	2.5 [1.6; 3.9]	5.7 [3.3; 9.3]
Deflator	0.0 [0.0; 0.0]	1.3 [0.7; 2.3]	1.7 [0.9; 3.0]	4.6 [2.6; 7.7]
Interest rate	94.50 [92.1; 96.4]	37.1 [31.9; 43.1]	20.1 [15.7; 24.9]	13.7 [10.3; 18.0]
M_2 growth	7.0 [4.2; 9.9]	7.8 [5.6; 10.3]	8.1 [6.0; 10.6]	7.9 [5.8; 10.2]
Stock price	10.4 [4.1; 20.4]	8.3 [4.7; 13.6]	10.0 [6.0; 15.7]	8.9 [5.7; 13.1]

Note: Median and 68% probability intervals computed using a Monte Carlo Markov-chain (MCMC) algorithm.

I repeat the same empirical exercise but replace the stock price index, SP_t, by the 10-year government bond yield, B_t, in the set of variables of X_{2t}. The goal is to compare the reaction of risky (less liquid) assets *versus* riskless (more liquid) assets to the positive shock in the interest rate.[3] Figure 2 plots the response of the government bond yield to a positive shock to the interest rate. The solid line corresponds to the point estimate, the red line represents the median response, and the dashed lines are the 68% posterior confidence intervals estimated by using a Monte-Carlo Markov-Chain algorithm based on 10000 draws.

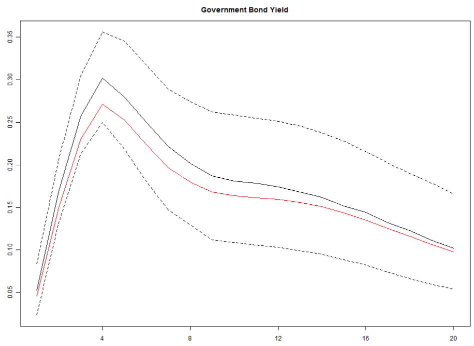

Figure 2: The response of the government bond yield to a monetary policy contraction using Christiano et al. (2005) identification.

The results clearly show that the monetary policy contraction has a positive impact on the government bond yield: it increases by 25 to 30 basis points 4 quarters ahead, after which the yield starts falling. Note, however, that the effect is very persistent: the yield remains 10 basis points above its initial level even 20 quarters ahead. Taken together this result with the negative reaction of the stock price index observed in Figure 1, we find support for the negative comovement between bonds and stocks that one typically observes.

3.3 Fully Simultaneous System of Equations

I now consider the effects of a monetary policy contraction using the Leeper and Zha (2003) and the Sims and Zha (2006a, 2006b) identification schemes. Figure 3 plots the impulse-response functions to a positive shock in the interest rate. The solid line corresponds to the point estimate, the red line represents the median response, and the dashed lines are the 68 percent posterior probability intervals estimated by using a Monte-Carlo importance sampling algorithm based on 10000 draws.

[3] For an evaluation of the impact of wealth shocks on portfolio allocation, see Sousa (2012e).

The results show that, after a positive 25 basis points interest rate shock, output negatively responds and the trough (of -0.15%) is reached after 10 quarters. Accordingly, unemployment significantly rises. As for the price level, it seems to exhibit strong persistence. The stock price index quickly falls after the shock and the trough - of around -2% - is achieved after 2 quarters. In addition, there is a significant decline in M_2, but the effect erodes after 12 quarters.

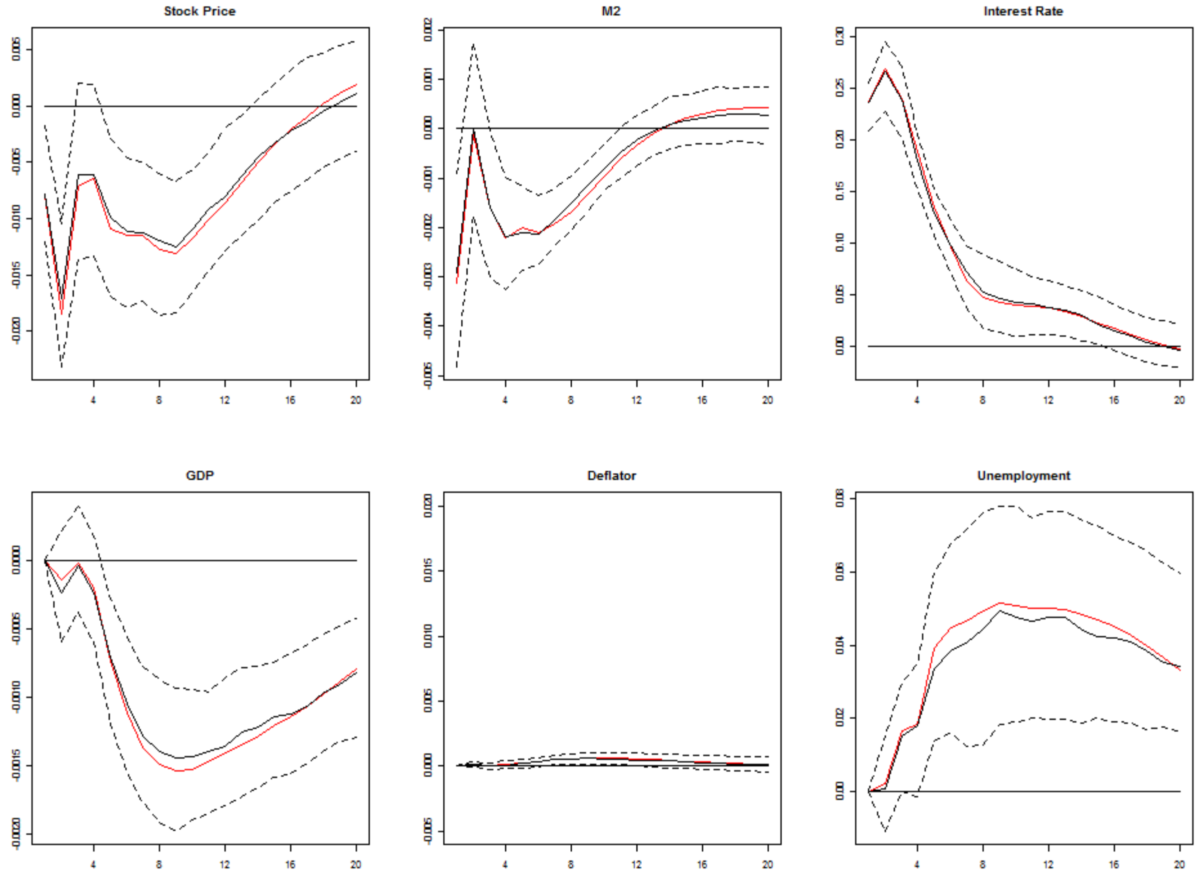

Figure 3: Impulse-response functions to a monetary policy contraction using the Leeper and Zha (2003) and Sims and Zha (2006a, 2006b) identification.

The estimated contemporaneous coefficients along with 68 percent equal-tailed probability intervals (in brackets) allow one to write the equations that describe the behavior of the money market, namely, the money demand equation

$$\underset{[68.2;\ 84.28]}{77.21} M_{2t} + \underset{[0.31;\ 1.61]}{0.98} i_t \underset{[-9.66;\ 5.67]}{-2.26} Y_t \underset{[-84.28;\ -68.17]}{-77.21} P_t = \varepsilon_t^{MD},$$

and the monetary policy rule

$$\underset{[-56.16,\ -29.80]}{-43.19} M_{2t} + \underset{[3.38;\ 3.73]}{3.57} i_t = \varepsilon_t^{MP}.$$

The money demand equation exhibits very plausible estimates: the interest elasticity of demand is negative and relatively small in magnitude; and the output elasticity is positive and also small. By its turn, the policy rule suggests that the monetary authority strongly responds to the money stock: when M_2 increases, the interest rate is substantially raised.

Table 2 reports variance decompositions. Interest rate shocks account for about 3.9% of the variation in the stock price index 20 quarters ahead. They are also responsible for a relatively large fraction of the variation in M_2.

Table 2: Percentage variance due to a monetary policy shock.

Variable:	1 Quarter Ahead	4 Quarters Ahead	8 Quarters Ahead	20 Quarters Ahead
Stock price	0.8 [0.3; 1.7]	2.0 [1.3; 3.3]	2.9 [1.7; 4.6]	3.9 [2.5; 5.8]
M_2	10.2 [4.0; 21.4]	9.8 [5.2; 17.6]	10.7 [6.6; 16.9]	7.9 [5.3; 11.6]
Interest rate	74.9 [53.8; 89.5]	48.3 [32.9; 60.2]	33.8 [26.2; 41.1]	16.9 [12.9; 21.5]
GDP	0.0 [0.0; 0.0]	0.7 [0.4; 1.3]	2.1 [1.2; 3.5]	4.1 [2.4; 6.6]
Deflator	0.0 [0.0; 0.0]	0.9 [0.5; 1.5]	1.8 [1.0; 3.1]	2.2 [1.2; 3.7]
Unemployment	0.0 [0.0; 0.0]	0.6 [0.3; 1.1]	1.3 [0.6; 2.4]	2.6 [1.4; 4.3]

Note: Median and 68 percent probability intervals computed using a Monte Carlo Importance Sampling algorithm.

3.4 Block Exogeneity Approach

Figure 4 suggests that, after the monetary policy contraction (a rise of about 25 basis points in the interest rate), real GDP falls in both the euro area and Portugal. However, the trough of -0.15% occurs somewhat later for Portugal (12 quarters ahead) than for the euro area as a whole (8 quarters). The response of the price level is also similar for the two economic blocks: it remains almost unchanged over the first few quarters and then gradually and persistently falls. Interestingly, the findings show that while the growth rate of M_2 in Portugal increases, the growth rate of M_3 for the euro area as a whole rises, thereby, reflecting important changes in asset portfolio composition.

The positive interest rate shock also leads to: (*i*) a sharp decrease in the commodity price; and (*ii*) an increase of the Portuguese government bond yield (for about 8 quarters), in accordance with a larger tension in the bond market and a deterioration of the conditions for refinancing public debt.

Finally, the stock prices in the euro area and Portugal fall after the unexpected change in monetary policy and the trough of -1% is achieved after 6 quarters. However, while the stock price index for the euro area negatively reacts on impact, the effect on the Portuguese stock market is gradual.

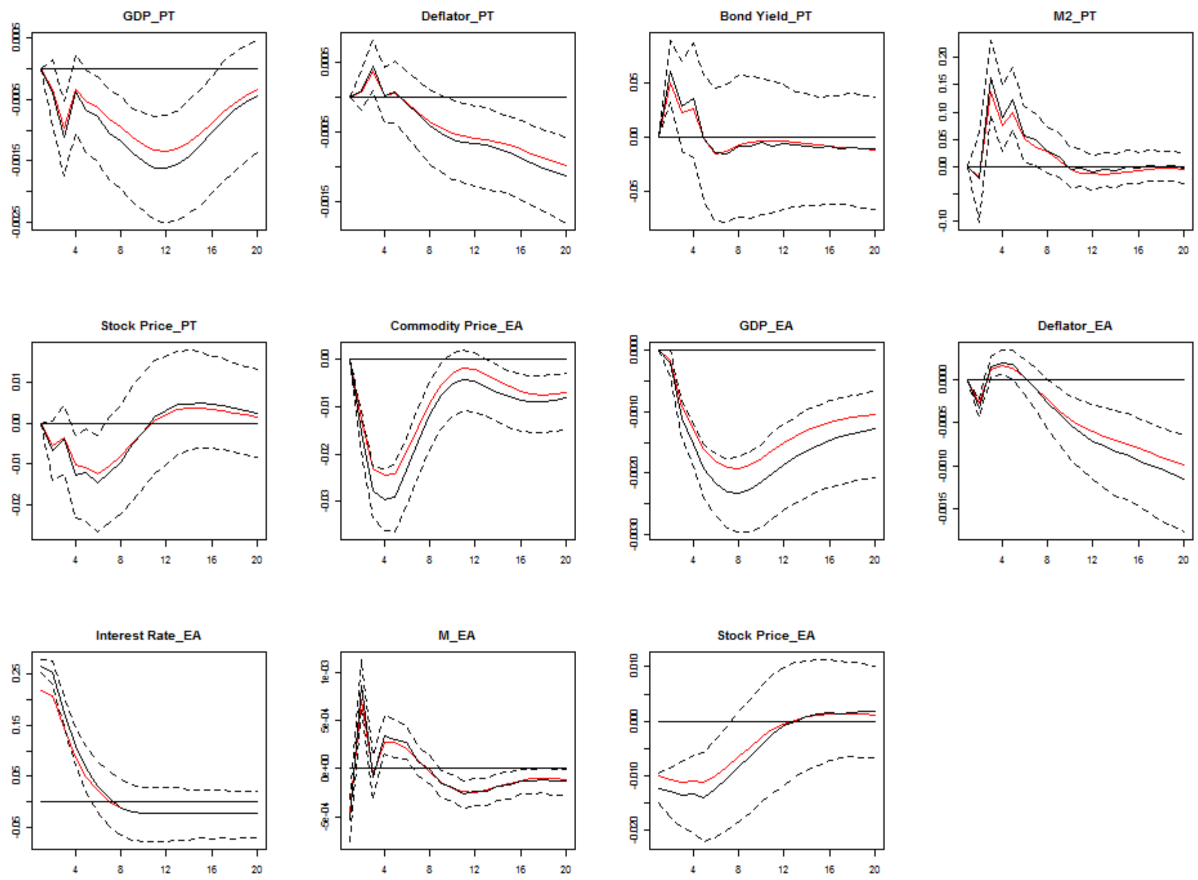

Figure 4: Impulse-response functions to a monetary policy contraction using the Cushman and Zha (1997) and Zha (1999) identification.

Table 3 reports variance decompositions and displays the percentage of variance of the k-step-ahead forecast error in the elements of X_t due to an interest rate shock, for $k = 1$, 4, 8 and 20. Interest rate shocks account for 3.1% (Portugal) and 3.4% (euro area) of the variation in the stock price index 20 quarters ahead. They are also responsible for 3.5% (Portugal) and 8.1% (euro area) of the variation of real GDP 20 quarters ahead and represent a large fraction of the variation in the commodity price (7.0%).

Table 3: Percentage variance due to a monetary policy shock.

Variable:	1 Quarter Ahead	4 Quarters Ahead	8 Quarters Ahead	20 Quarters Ahead
GDP (PT)	0.0 [0.0; 0.0]	1.4 [0.8; 2.4]	2.4 [1.4; 4.0]	3.5 [2.0; 5.8]
Deflator (PT)	0.0 [0.0; 0.0]	1.0 [0.6; 1.7]	1.7 [1.0; 2.9]	3.4 [1.9; 5.6]
Bond yield (PT)	0.0 [0.0; 0.0]	1.0 [0.5; 1.7]	1.8 [1.1; 3.0]	2.9 [1.8; 4.5]
M_2 growth (PT)	0.0 [0.0; 0.0]	2.2 [1.4; 3.3]	3.1 [2.1; 4.3]	3.5 [2.5; 4.7]
Stock price (PT)	0.0 [0.0; 0.0]	1.1 [0.6; 1.8]	1.9 [1.0; 3.4]	3.1 [1.9; 4.9]
Commodity price	0.0 [0.0; 0.0]	7.7 [5.3; 10.6]	8.6 [5.8; 12.2]	7.0 [4.7; 10.1]
GDP (EA)	0.0 [0.0; 0.0]	4.0 [2.5; 6.1]	9.1 [5.9; 13.0]	8.1 [5.1; 12.1]
Deflator (EA)	0.0 [0.0; 0.0]	2.0 [1.4; 2.9]	1.6 [1.0; 2.5]	3.5 [1.8; 6.1]
Interest rate (EA)	62.7 [57.6; 67.7]	19.2 [31.9; 23.4]	9.5 [7.4; 12.3]	7.1 [5.1; 9.6]
M_2 growth (EA)	1.6 [0.7; 3.0]	4.6 [3.3; 6.2]	5.0 [3.6; 6.6]	5.3 [3.9; 7.0]
Stock price (EA)	3.4 [2.1; 5.1]	2.5 [1.5; 4.1]	2.6 [1.5; 4.5]	3.4 [2.0; 5.4]

Note: Median and 68% probability intervals computed using a Monte Carlo Markov-chain (MCMC) algorithm.

4 A VAR Counter-Factual Exercise

I now build a VAR counter-factual exercise aimed at describing the effects of shutting down the shocks in interest rate. In practice, after estimating the B-SVAR summarized by (1), I construct the counter-factual (CFT) series as follows:

$$\underbrace{\Gamma(L)}_{n\times n}\underbrace{X_t^{CFT}}_{n\times 1} = \Gamma_0 X_t^{CFT} + \Gamma_1 X_{t-1}^{CFT} + ... = c + \varepsilon_t^{CFT} \tag{5}$$

$$\upsilon_t = \Gamma_0^{-1}\varepsilon_t^{CFT} \tag{6}$$

This is equivalent to considering the following vector of structural shocks that come from the estimation of the corresponding B-SVAR and the identification a la Christiano et al. (1996):

$$\varepsilon_t^{CFT} = [\varepsilon_t^{Pcm}, \varepsilon_t^{GDP}, \varepsilon_t^{P}, \varepsilon_t^{i}, \varepsilon_t^{M_2}, \varepsilon_t^{SP}]' \qquad \varepsilon_t^i = 0 \quad \forall t.$$

Similarly, in the framework based on the Cushman and Zha (1997) and Zha (1999), I look at the vector of structural shocks:

$$\varepsilon_t^{CFT} = [\varepsilon_t^{GDP,PT}, \varepsilon_t^{P,PT}, \varepsilon_t^{B,PT}, \varepsilon_t^{M_2,PT}, \varepsilon_t^{SP,PT}, \varepsilon_t^{Pcm,EA}, \varepsilon_t^{GDP,EA}, \varepsilon_t^{P,EA}, \varepsilon_t^{i,EA}, \varepsilon_t^{M_3,EA}, \varepsilon_t^{SP,EA}]'$$

$$\varepsilon_t^{i,EA} = 0 \quad \forall t.$$

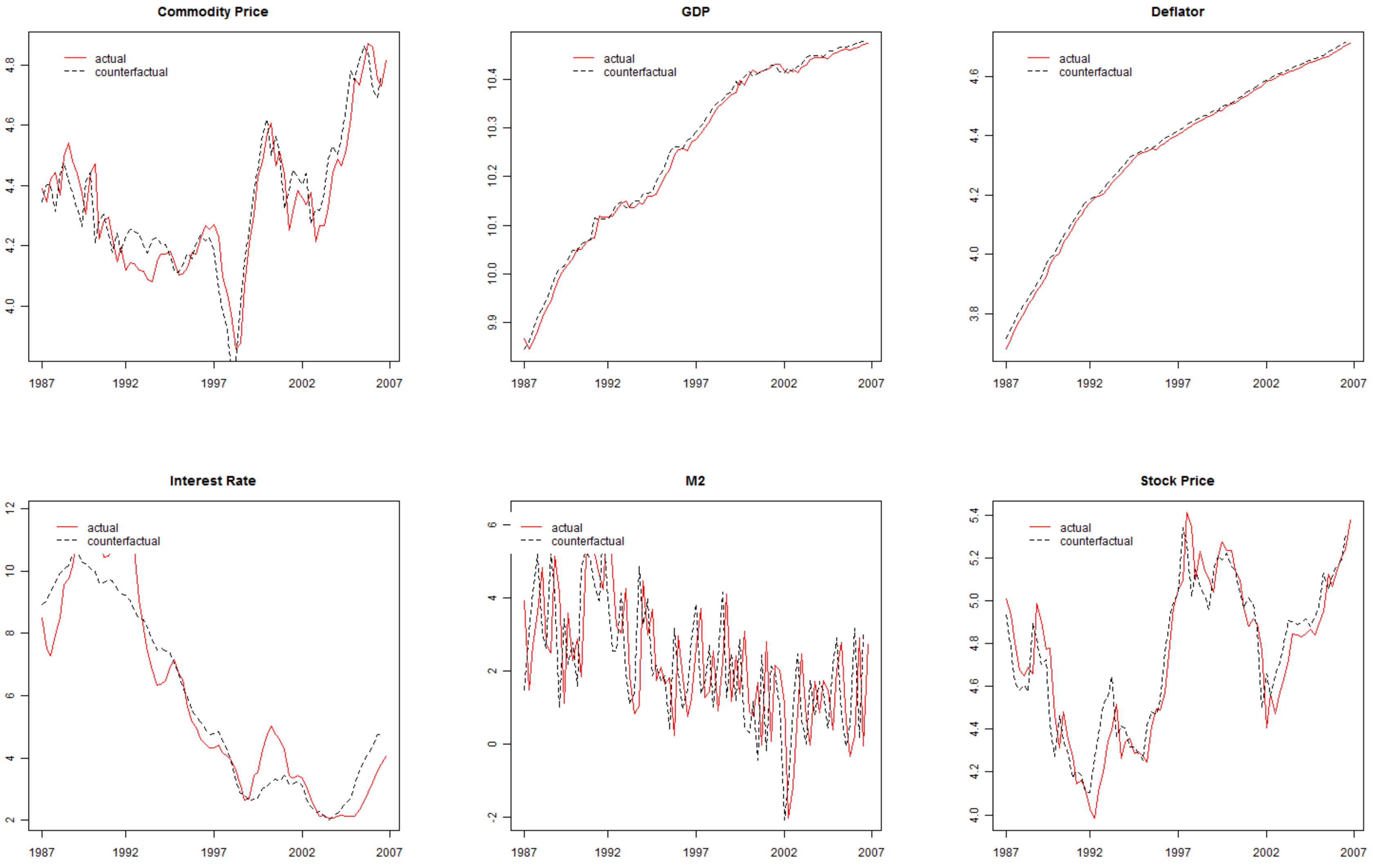

Figure 5: Actual and counter-factual series for Portugal obtained from the Christiano et al. (1996) identification.

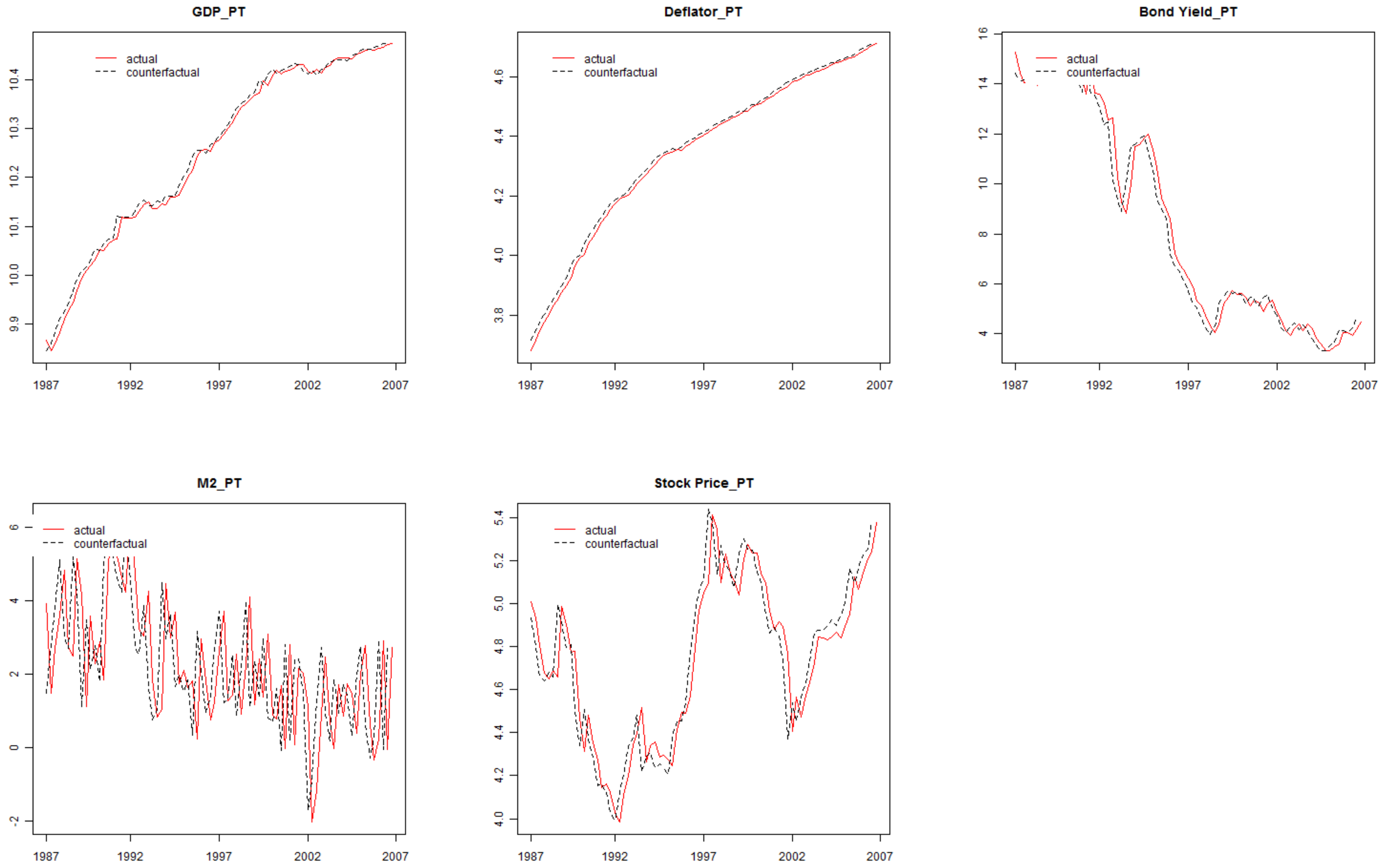

Figure 6: Actual and counter-factual series for Portugal obtained from the Cushman and Zha (1997) and Zha (1999) identification.

Figures 5 and 6 plot the actual and the counter-factual series for Portugal for, respectively, the Christiano et al. (1996) and Cushman and Zha (1997) and Zha (1999) specifications. The results suggest a considerable difference between the actual and the counter-factual series for the interest rate and, therefore, the importance of unexpected variation in monetary policy. In particular, the actual interest rate has been higher than the counter-factual interest rate over the periods 1987-1993 and 1998-2003. Moreover, it can be seen that both the real GDP and the price level in Portugal would have been higher for almost the entire sample if there were no monetary policy shocks. Similarly, there are also significant effects on the stock price index of Portugal: the actual and counter-factual series substantially depart from each other in the period 1992-1994 and 2002-2006. This evidence shows that monetary policy had an important asset price effect.

5 Conclusion

In this paper, I analyze the macroeconomic effects of monetary policy on the Portuguese economy. I show that a positive interest rate shock has a negative impact on real GDP, while leading to a substantial increase of the unemployment rate. The monetary policy contraction also generates a quick fall in the commodity price, although the reduction of the price level is more gradual. In addition, it impacts negatively on the stock price index, produces a "short-lived liquidity effect" and delivers an important rebalancing of asset portfolios, namely, via the "flight to quality". In accordance with the negative comovement between bonds and stocks, the Portuguese government bond yield increases after the policy shock, which reflects the deterioration of the conditions for refinancing public debt.

The empirical findings also provide evidence of a money demand function characterized by small output and interest rate elasticities. By its turn, the monetary policy rule reveals a particular attention to the developments in the money markets.

Finally, a VAR counter-factual exercise highlights the divergence between the actual and the counter-factual series for the interest rate and, therefore, the importance of unexpected variation in monetary policy. Moreover, it shows that both the real GDP and the price level in Portugal would have been higher during almost the entire sample period if there were no monetary policy shocks.

References

[1] Afonso, A., and R. M. Sousa, 2012. The macroeconomic effects of fiscal policy. *Applied Economics*, 44(34), 4439-4454.

[2] Butkiewicz, J., and M. McConnell, 1995 The stability of the demand for money and M1 velocity: evidence from the sectoral data. *Quarterly Review of Economics and Finance*, 35(3), 233-243.

[3] Cagan, P., 1972 The channels of monetary effects on interest rates. *Journal of Business*, 47, 94-96.

[4] Castro, V , 2010. The duration of economic expansions and recessions: More than duration dependence. *Journal of Macroeconomics*, 32, 347-365.

[5] Castro, V , 2011. Can central banks' monetary policy be described by a linear (augmented) Taylor rule or by a nonlinear rule? *Journal of Financial Stability*, 7(4), 228-246.

[6] Castro V., 2012. The duration of business cycle expansions and contractions: Are there change-points in duration dependence? *Empirical Economics*, forthcoming.

[7] Christiano, L., Eichenbaum, M., and C. L. Evans, 1996 The effects of monetary policy shocks: evidence from the Flow of Funds. *Review of Economics and Statistics*, 78, 16-34.

[8] Cushman, D. O., and T. Zha, 1997. Identifying monetary policy in a small open economy under flexible exchange rates. *Journal of Monetary Economics*, 39, 433-448.

[9] Friedman, M., 1968. The role of monetary policy. *American Economic Review*, 58, 1-17.

[10] Goldfeld, S. M., 1973. The demand for money revisited. *Brookings Papers on Economic Activity*, 3, 577-646.

[11] Granville, B., and S. K. Mallick, 2009. Monetary and financial stability in the euro area: Pro-cyclicality versus trade-off. *Journal of International Financial Markets, Institutions and Money*, 19, 662-674.

[12] Jawadi, F., 2009. Essay in dividend modelling and forecasting: Does nonlinearity help? *Applied Financial Economics*, 19(16), 1329-1343.

[13] Jawadi, F., 2010. Financial crises, bank losses, risk management and audit: What happened? *Applied Economics Letters*, 17(10), 1019-1022.

[14] Jawadi, F., 2012. Introduction to time-varying modeling with macroeconomic and financial data. *Macroeconomic Dynamics*, forthcoming.

[15] Leeper, E. M., and T. Zha, 2003. Modest policy interventions. *Journal of Monetary Economics*, 50(8), 1673-1700.

[16] Mallick, S. K., and M. Mohsin, 2010 On the real effects of inflation in open economies: theory and empirics. *Empirical Economics*, 39(3), 643-673.

[17] Rafiq, M. S., and S. K. Mallick, 2008 The effect of monetary policy on output in EMU3: a sign restriction approach. *Journal of Macroeconomics*, 30, 1756-1791.

[18] Ramaswamy, R., and T. Slok, 1998. The real effects of monetary policy in the European Union: What are the differences? *IMF Staff Papers*, 45(2), 374-399.

[19] Sims, C., and T. Zha, 2006a. Were there regime switches in U.S. monetary policy? *American Economic Review*, 96, 54-81.

[20] Sims, C., and T. Zha, 2006b. Does monetary policy generate recessions? *Macroeconomic Dynamics*, 10(2), 231-272.

[21] Sousa, R. M., 2010a Consumption, (dis)aggregate wealth, and asset returns. *Journal of Empirical Finance*, 17, 606-622

[22] Sousa, R. M., 2010b. The consumption-wealth ratio and asset returns: The euro area, the UK and the US. *Journal of Money, Investment and Banking*, 16, 12-29.

[23] Sousa, R. M., 2010c. Housing wealth, financial wealth, money demand and policy rule: evidence from the euro area. *North American Journal of Economics and Finance*, 21, 88-105.

[24] Sousa, R. M., 2012a. Linking wealth and labour income with stock returns and government bond yields. *European Journal of Finance*, forthcoming.

[25] Sousa, R. M., 2012b. Wealth-to-income ratio and stock returns: Evidence from the Euro Area. *Applied Economics Letters*, 19(7), 619-622.

[26] Sousa, R. M., 2012c. Wealth-to-income ratio, government bond yields and financial stress in the Euro Area. *Applied Economics Letters*, 19(11), 1085-1088.

[27] Sousa, R. M., 2012d. Wealth, asset portfolio, money demand and policy rule. *Bulletin of Economic Research*, forthcoming.

[28] Sousa, R. M., 2012e. What is the impact of wealth shocks on asset allocation? *Quantitative Finance*, forthcoming.

[29] Taylor, J. B., 1993. Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, 39, 195–214.

[30] Tremosa-Balcells, R., and J. Pans-Novell, 2001. Measuring monetary policy shocks in the European Monetary Union. *Applied Economics Letters*, 8, 299-303.

[31] Zha, T., 1999. Block recursion and structural vector autoregressions. *Journal of Econometrics*, 90, 291-316.

Appendix

A The Posterior Distribution of the Impulse-Response Function

The impulse-response function to a one standard-deviation shock is:

$$B(L)^{-1}\Gamma_0^{-1}. \tag{A.1}$$

To assess uncertainty regarding the impulse-response functions, I construct probability bands by drawing from the Normal-Inverse-Wishart posterior distribution of $B(L)$ and Σ

$$\begin{aligned} \beta|_{\Sigma} &\sim N\left(\hat{\beta}, \Sigma \otimes \left(X'X\right)^{-1}\right) \\ \Sigma^{-1} &\sim \text{Wishart}\left(\left(T\hat{\Sigma}\right)^{-1}, T-m\right) \end{aligned} \tag{A.2}$$

where β is the vector of regression coefficients in the VAR system, Σ is the covariance matrix of the residuals, the variables with a hat denote the corresponding maximum-likelihood estimates, X is the matrix of regressors, T is the sample size and m is the number of estimated parameters per equation.

B A Mixed Monte Carlo Importance Sampling Algorithm for Drawing from the Posterior Distribution of the Impulse-Response Function

To be able to identify the structural monetary shocks, one needs at least $(n-1)n/2$ linearly independent restrictions. With enough restrictions in the Γ_0 matrix and no restrictions in the matrix of coefficients on the lagged variables, the estimation of the model is numerically simple since the log-likelihood will be

$$\begin{aligned} l(B, a, \Gamma_0) &= -\frac{T}{2} + \log|\Gamma_0| - \frac{1}{2} trace\left[S(B,a)\Gamma_0'\Gamma_0\right] \\ \text{where } S(B,a) &= \sum_{t=1}^{T}\left(B(L)X_t - a\right)\left(B(L)X_t - a\right)' \end{aligned} \tag{B.1}$$

and the maximum-likelihood estimator of B and a can be found simply doing OLS equation-by-equation regardless of the value of Γ_0. Integrating $l(B, a, \Gamma_0)$ (or the posterior with conjugate priors) with respect to (B, a) the marginal log probability density function of Γ_0 is proportional to

$$-\frac{T-k}{2}\log(2\pi) + (T-k)\log|\Gamma_0| - \frac{1}{2}trace\left[S\left(\hat{B}_{OLS}, \hat{a}_{OLS}\right)\Gamma_0'\Gamma_0\right]. \tag{B.2}$$

In the S-VAR setting considered, the impulse-response functions are given by

$$B(L)^{-1}\Gamma_0^{-1}. \tag{B.3}$$

This implies that to assess posterior uncertainty regarding the impulse-response function one needs joint draws for both $B(L)$ and Γ_0.

Since equation (B.2) is not in the form of any standard probability density function one cannot draw directly from Γ_0 to make inference. Nevertheless, if one takes a second order expansion of equation (B.2) around its peak one gets the usual Gaussian approximation to the asymptotic distribution of the elements in Γ_0. Since this is not the true form of the posterior probability density function, one cannot use it directly to produce a Monte Carlo sample. A possible approach is importance sampling, in which one draws from the Gaussian approximation, but weigh the draws by the ratio of (B.2) to the probability density function from which one draws. The weighted sample cumulative density function then approximates the cumulative density function corresponding to (B.2).

Note also that the distribution of $B(L)$, given Γ_0, is the usual normal distribution

$$vec(B(L))|\Gamma_0 \sim N\left(vec\left(\hat{B}_{OLS}\right), \Gamma_0^{-1}\left(\Gamma_0^{-1}\right)' \otimes \left(X'X\right)^{-1}\right). \tag{B.4}$$

So one can take joint draws using the following simple algorithm: (i) draw Γ_0 using (B.2); and (ii) draw $vec(B(L))$ using equation (B.4). Confidence bands for the impulse-response function are then constructed from the weighted percentiles of the Monte Carlo sample where the weights are computed by importance sampling.

Denote with $\hat{H}$ the numerical Hessian from the minimization routine at the point estimate and $\hat{\Gamma}_0$ the maximum-likelihood estimator. The algorithm used to draw the confidence bands from the posterior distribution is the following:

1. Check that all the coefficients on the main diagonal of $\hat{\Gamma}_0$ are positive. If they are not, flip the sign of the rows that have a negative coefficient on the main diagonal [that is, our point estimates are normalized to have positive elements on the main diagonal).

2. Set $i = 0$.

3. Drawn $vech\left(\tilde{\Gamma}_0\right)$ from a normal $N\left(vech\left(\hat{\Gamma}_0\right), \hat{V}\right)$, where $\hat{V} = \hat{H}^{-1}$ and $vech(.)$ vectorizes

the unconstrained elements of a matrix. That is, this step draws from the asymptotic distribution of Γ_0. When some of the diagonal elements of $\tilde{\Gamma}_0$ are not positive, the draw is rejected and one goes back to 2.

4. Compute and store the importance sampling weight

$$m_i = \exp\left[\begin{array}{c} T\log\left|\det\left(\tilde{\Gamma}_0\right)\right| - \frac{1}{2}trace\left(S\left(\hat{B}_{OLS}, \hat{a}_{OLS}\right)\tilde{\Gamma}_0'\tilde{\Gamma}_0\right) \\ -\log\left|\hat{V}\right|^{-\frac{1}{2}} + .5\left(vech\left(\tilde{\Gamma}_0\right) - vech\left(\hat{\Gamma}_0\right)\right)'\hat{V}^{-1}\left(vech\left(\tilde{\Gamma}_0\right) - vech\left(\hat{\Gamma}_0\right)\right) \\ -SCFT \end{array}\right] \quad \text{(B.5)}$$

where $SCFT$ is a scale factor that prevents overflow/underflow (a good choice for it is normally the value of the likelihood at its peak).

5. Draw $vec\left(\tilde{B}(L)\right)$ from a normal $N\left(vec\left(\hat{B}_{OLS}\right), \tilde{\Gamma}_0^{-1}\left(\tilde{\Gamma}_0^{-1}\right)' \otimes (X'X)^{-1}\right)$ to get a draw for $\tilde{B}(L)$.

6. Compute the impulse-response function and store it in a multidimensional array.

7. If $i < \#draws$, set $i = i + 1$ and go back to 3.

The stored draws of the impulse-response function, jointly with the importance sampling weights, are used to construct confidence bands from their percentiles. Moreover, the draws of $\tilde{\Gamma}_0$ are stored to construct posterior confidence interval for these parameters from the posterior (weighted) quantiles.

Normalized weights that sum up to 1 are simply constructed as:

$$w_i = \frac{m_i}{\sum_i^{\#draws} m_i}. \quad \text{(B.6)}$$

C Data Description

C.1 Portugal

GDP

Data for GDP are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4. The source is the Bank of Portugal.

Price Deflator

All variables were deflated by the GDP deflator (2000=100). Data are quarterly, seasonally adjusted, and comprise the period 1978:1-2007:4. The source is the Bank of Portugal.

Monetary Aggregate

Monetary Aggregate corresponds to the adjusted notional M2 stock. Data are quarterly, seasonally adjusted, and comprise the period 1980:1-2007:4. The source is the European Central Bank.

Unemployment Rate

Unemployment rate is defined as the survey-based unemployment rate (all persons) (series "MEI.Q.PRT.UNRTSUTT.STSA"). Data are quarterly, seasonally adjusted and comprise the period 1984:1-2007:4. The source is the Main Economic Indicators of the Organization for Economic Co-Operation and Development (OECD).

Stock Market Index

Stock Market Index corresponds to the MSCI-US Total Return Index, which measures the market performance, including price performance and income from dividend payments. I use the index which includes gross dividends, this is, approximating the maximum possible dividend reinvestment. The amount reinvested is the dividend distributed to individuals resident in the country of the company, but does not include tax credits. Series comprises the period 1987:4–2007:2. The source of information is Morgan Stanley Capital International (MSCI).

Long-Term Interest Rate

Long-Term Interest Rate corresponds to the yield to maturity of 10-year government securities. Data are quarterly, and comprise the period 1957:1-2007:4. Data for the period 1974:2-1975:4 is not available. Therefore, I linearly interpolate the data for that period using the observations at 1974:1 and 1976:1. The source is the International Financial Statistics (IFS) of the International Monetary Fund (IMF) (series " IFS.Q.182.6.61.$$$.Z.F.$$$").

C.2 Euro area

Euro area aggregates are calculated as weighted average of euro-11 before 1999 and, thereafter, as break-corrected series covering the real-time composition of the euro area.

GDP

Seasonally adjusted nominal GDP ('stocks') at market prices. From 1999:1 onwards, this series covers nominal GDP of the real-time composition of the euro area, correcting for the breaks caused by the several enlargements, i.e. currently the observations from 2007:4 backwards are extrapolations based on growth rates calculated from the levels series compiled for the euro area 15 in 2008. For period before 1999, the nominal GDP series for the euro area is constructed by aggregating national GDP data for euro 11 using the irrevocable fixed exchange rates of 31 December 1998 for the period 1980:1-1998:4. Again, growth rates from this series are used to backward extend the euro area GDP series.

The euro area seasonally adjusted real GDP series (at 2000 constant prices) has been constructed before 1999 by aggregating national real GDP data using the irrevocable fixed exchange rates. As for the euro area nominal GDP, an artificial euro area real GDP series has also been constructed using the procedure illustrated above. Data are quarterly, seasonally adjusted, expressed in million of Euro, and comprise the period 1980:1-2007:4.

Price Deflator

All variables are expressed in real terms by using the GDP deflator. The GDP deflator is calculated as a simple ratio between nominal and real GDP. The year base is 2000 (2000 = 100). Data are quarterly, seasonally adjusted, and comprise the period 1980:1-2007:4.

Monetary Aggregate

All the data used are denominated in euro. The seasonally adjusted M_3 series for the euro area has been constructed using the index of adjusted stocks for the corresponding real time composition of the currency area. This index corrects for breaks due to enlargement, but as well for reclassifications, exchange rate revaluations and other revaluations. In order to translate the index into outstanding amounts, the M_3 seasonally adjusted index of adjusted stocks for the euro area has been re-based to be equal to the value of the seasonally adjusted stock for the euro area M_3 in January 2008. Before 1999, stocks and flows of the estimated "euro area M_3" are derived by by aggregating national stocks and flows at irrevocable fixed exchange rates. Data are seasonally adjusted quarterly averages covering the period 1980:2 to 2007:4.

Short-Run Interest Rate

For short-term interest rates from January 1999 onwards, the euro area three-month Euribor is used. Before 1999, the artificial euro area nominal interest rates used are estimated as weighted averages of national interest rates calculated with fixed weights based on 1999 GDP at PPP exchange rates. National short-term rates are three-month market rates. Data are quarterly averages, and comprise the period 1980:1-2007:4.

Commodity Index

World market prices of raw materials. Total index. USD basis, converted into euro. Weighted according to commodity imports of OECD countries, 1989-1991, excluding EU- internal trade. Share in total index: 100%. Data are quarterly, seasonally adjusted, and comprise the period 1980:1-2007:4.

Stock Market Index

The source is the International Financial Statistics (IFS) of the International Monetary Fund (IMF).

- For Belgium: series "12462...ZF Share price index (Share prices: INDUSTRIAL)";
- For Finland: series "17262...ZF Share price index (Share prices: Industrial)";
- For France: series "13262...ZF Share price index (Share prices)";
- For Germany: series "13462...ZF Share price index (Share prices)";
- For Ireland: series "17862...ZF Share price index (Share prices)";
- For Italy: series "13662...ZF Share price index (Share prices)";
- For Netherlands: series "13862...ZF Share price index (Share prices:General)"; and
- For Spain: series "18462...ZF Share price index (Share prices)".

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