REVISITING THE EFFECTIVENESS OF MONETARY AND FISCAL POLICY IN THE US, MEASURED ON THE BASIS OF STRUCTURAL VARS*

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ABSTRACT

This paper presents evidence on time-variation of the effectiveness of monetary and fiscal policies in the United States drawn from structural VARs. The results for a traditional model of fixed coefficients, estimated on the basis of rolling samples, point to very unstable output responses to policy shocks and a clear weakening over time. In the case of fiscal shocks, in particular, the multipliers have non-conventional signs during part of the period considered. When temporal variation is incorporated directly through a specification with variable coefficients, the profile of output responses becomes more stable. In this case, the results indicate a near stabilization of the impact of monetary policy in recent years, while for fiscal policy a weakening continues to take place.

1. Introduction

The length and severity of the most recent recession (2008-09) in the United States brought to the fore the discussion about the stabilizing role of fiscal and monetary policies, as it showed that at present cyclical fluctuations could be larger than those characterizing the «Great Moderation» that preceded the onset of the recession. Such developments have shaken the belief that monetary policy would be sufficient to address the imbalances (of small size) between aggregate demand and supply, reopening the debate on the stabilizing role of individual policies and their interaction. In addition, the rehabilitation of fiscal policy's importance as a stabilization tool has highlighted the uncertainty that prevails among economists concerning its effects on economic activity, as demonstrated by the controversy surrounding the impact of stimulus measures implemented during the recession by the Obama Administration. This uncertainty stems, firstly, from the predictions of different theoretical frameworks, with the neoclassic models postulating more modest impacts of fiscal policy on GDP than new-Keynesian models.

In this context, the role of empirical research on the macroeconomic effects of fiscal and monetary policies is of great importance. The SVAR models (initial contributions include Bernanke and Blinder, 1992, and Christiano, Eichenbaum and Evans, 1999, for monetary policy, and Blanchard and Perotti, 2002, for fiscal policy)[1] are one of the approaches used for this purpose, in which the derivation of shocks and mechanisms of propagation to the economy are part of the estimation process. This article revisits and updates, extending the estimation period to the present, evidence on GDP responses to both policies under an SVAR model, with special emphasis on temporal variation. Indeed, several studies have found evidence of subsample-sensitivity of the impulse-response functions estimated in these models, as well

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1 In a broad sense, considering the models identified by recursive schemes also as structural.

as in alternative approaches such as the narrative, particularly in the case of fiscal policy (e.g. Perotti, 2005, and Pereira, 2009b) but also of monetary policy (Boivin and Gianonni, 2006, and Boivin, Kiley and Mishkin, 2010). At the same time, the literature has paid increasing attention to the dependence of fiscal multipliers on «regimes», in particular stemming from the cyclical position of the economy or a possible non-reaction of monetary authorities to the impact of fiscal stimulus on activity because the federal funds rate hit the «zero lower bound» (Romer, 2011, Auerbach and Gorodnichenko, 2012, and Christiano *et al.*, 2011).

The measurement of the impact of policies on the economy is hampered by several problems, namely, bi-directional causality between the policy variables and economic activity (simultaneity) and the possibility that agents change their behavior when policy measures are announced, prior to implementation (anticipation). Simultaneity arises both for monetary and fiscal policy (particularly in the case of taxes and social transfers), while anticipation should be particularly relevant for the latter. Section 2 provides a brief discussion about the potential impact of this issue in the case of fiscal policy VARs, an issue that has been much debated.

The results presented in the course of this paper are based on a model consisting of five equations, three of which are structural: a monetary policy rule and two equations for the fiscal variables, taxes net of transfers and acquisition of goods and services, which capture the automatic responses to the economy and government's reaction function. The other two equations concern output and prices and do not have a structural interpretation, as the responses to the respective shocks are not being considered. The joint identification of the two budgetary shocks, on the one hand, and monetary shocks, on the other, has the advantage of explicitly dealing with orthogonality among them, ensuring a higher accuracy in the measurement of responses. Section 3 describes the macroeconomic system and the identification restrictions imposed.

Section 4 presents a first set of empirical results obtained through the estimation of the described system in a traditional fixed-coefficient specification. In this section, time-variation of responses is introduced informally by the estimation on the basis of a rolling sample. The results of this model with fixed coefficients indicate a significant weakening of the impact of fiscal policy shocks on output, particularly from mid-90s on. In the case of taxes net of transfers, such tendency becomes more marked when the very recent period is included in the sample. Although structural VARs are often associated with conventional multipliers of significant size, as those presented in the initial contribution of Blanchard and Perotti (2002) (see the survey presented in Ramey, 2011b), a careful analysis of time variation in the impulse-responses calls this interpretation into question. The results also point to a significant attenuation around 1980 of the impact of unanticipated monetary policy, with a sharp fluctuation in its effectiveness since then and a particularly reduced impact in recent years. This section also provides insight into how the documented weakening in output responses has affected the stabilizing role of policies during the activity contractions since mid-70s.

In section 5, temporal variation of responses is introduced in a formal way under the same model, through a specification with time-varying coefficients that are assumed to follow a random walk. This specification explicitly accounts for the possibility of time-variation in the parameters and is general enough to accommodate both gradual and sudden changes. In this case, the results are obtained by running Bayesian simulations. The specification with variable coefficients is consistent with a weakening of the role of policies over time (more markedly so in the case of fiscal policy), but to a lesser extent than implied by a traditional fixed-coefficient modeling. Still, the evidence contradicts the assumption of a greater effectiveness of fiscal policy during the recent period in which the federal funds rate has remained at the «zero lower bound» (Romer, 2011).

2. On the anticipation of fiscal policy shocks in structural VAR models

The use of VARs to estimate the effects of fiscal policy has been criticized for its lack of robustness against the problem of anticipation (Ramey, 2011a), particularly vis-a-vis the narrative approach. Recall that in the latter (represented by contributions such as Romer and Romer, 2004, for monetary policy and Romer and Romer, 2010, Pereira, 2009b, and Ramey, 2011a for fiscal policy), the characterization and quantification of shocks is made beforehand, using narrative or other sources, and the researcher has complete flexibility in their dating. The propagation mechanisms are estimated in a second stage on the basis of a reduced-form model.

Indeed, changes in the tax system and many measures on the expenditure side are often announced in advance of approval (for example, when the annual budget is presented), and there may be further delay until implementation. To the extent that agents change their behaviour when they become aware of such measures, the timing of shocks derived from structural VARs will be incorrect for the anticipated part. What is the importance of these effects, in practice? There have been micro studies (see Johnston *et al.*, 2006, and references therein) that assess the behaviour of agents when they possess information about pending fiscal shocks (the so-called «natural tax experiments»). Such studies tend to conclude that payments and refunds of taxes have a contemporary impact on consumption, even when agents could anticipate them. In this respect it is illustrative that in the abovementioned work by Romer and Romer (2010), following the narrative approach, the benchmark tax shocks are dated according to the moment when revenue is impacted. It is plausible to assume that households do not smooth consumption significantly in anticipation of small changes in disposable income. One may also note some macroeconomic literature (Mertens and Ravn, 2010) that seeks to correct anticipation effects in fiscal policy VARs, concluding that such correction does not qualitatively change the evidence drawn. Thus, anticipation does not seem likely to invalidate the results from the estimation of fiscal VARs, and more so in the present study that focuses on temporal variation of output responses.

3. Equations and identification restrictions

As mentioned, the results presented in this article are based on a macroeconomic system that includes five endogenous variables: taxes net of transfers (NT_t), acquisition of goods and services (G_t), approximately equal to government consumption and investment (see footnote 4), and GDP (Y_t), in real and *per capita* terms, the federal funds rate (FF_t) and inflation measured by GDP deflator (P_t). The data have a quarterly frequency and so the VAR is specified with four lags. The option for a small system, with the minimum number of variables allowing the joint study of the effects of the two policies, is justified by the estimation based on relatively short rolling samples and the need to limit the number of parameters in the Bayesian simulations.

The system of equations in its structural form, in the version with fixed parameters (in the version with variable parameters, these are also indexed to t), specifying only the contemporaneous part of the model, is:

$$G_t = a_0 + a_1^* P_t + coefficients/lagged\ endogenous\ variables + v_t^G,$$

$$NT_t = b_0 + b_1^* Y_t + b_2 P_t + coefficients/lagged\ endogenous\ variables + b_3 v_t^G + v_t^{NT},$$

$$P_t = c_0 + c_1 G_t + coefficients/lagged\ endogenous\ variables + v_t^p,$$

$$Y_t = d_0 + d_1 G_t + d_2 NT_t + d_3 P_t + coefficients/lagged\ endogenous\ variables + v_t^Y,$$

$$FF_t = e_0 + e_1 G_t + e_2 NT_t + e_3 Y_t + e_4 P_t + coefficients/lagged\ endogenous\ variables + v_t^{FF}.$$

The VAR methodology is characterized by the imposition of identification restrictions on the contemporaneous coefficients only, essentially exclusion restrictions, while the block of lagged endogenous variables is freely estimated. The key assumption in the identification of fiscal shocks is to assume (following Blanchard and Perotti, 2002) that implementation of measures by government as a response to macroeconomic developments occurs with at least one quarter delay. Thus, the contemporaneous GDP coefficient in the equation of taxes net of transfers captures automatic responses only, notably the effect of automatic stabilizers built in the tax and social transfer systems. By the same logic, contemporaneous GDP is not included in the equation of government consumption and investment, as in this case it is reasonable to assume the absence of an automatic response. Note that any systematic responses by government to macroeconomic developments, namely the fiscal policy rule, will be reflected in the block of lagged endogenous variables[2] (along with persistence of fiscal variables and their lagged responses to the economy). Taxes net of transfers may respond within the quarter to prices, and this channel is left open for public consumption and investment as well, as the budgetary variables enter the system in real terms.

The orthogonalization of innovations in net taxes vis-a-vis innovations in public consumption and investment is done by ordering this last variable in the first place. This is an arbitrary assumption since the reverse ordering (considering net taxes first) would be equally plausible. It should be noted, however, that changes in the order of budgetary variables have little effect on the estimate of their impacts on economic activity, the focus of this study. The equation for the federal funds rate is the monetary policy rule. The identification of innovations in this equation follows the usual assumption that monetary authorities observe the macroeconomic developments and may react to them within the quarter, while variables such as output and prices respond with a certain delay to changes in interest rates. This identification scheme is a simplified version of the one in Pereira (2009a). The version followed here does not allow a contemporaneous reaction of prices to net taxes. Furthermore, it closes the response channel of net taxes to the interest rate instead of the converse one, although there is evidence of a positive semi-elasticity of taxes to the short-term interest rate within the quarter. Such simplifications are, however, necessary as they make it possible to map this identification scheme into a recursive one, with a view to simulating the system using the Bayesian methods in Carter and Kohn (1994). It is further noted that since these simplifications do not relate to the identification of the innovations in each of the variables relative to the innovations in output, they do not significantly interfere with the analysis.

Finally, in order to satisfy the necessary condition for identification, the order condition, with exact identification, one imposes a contemporaneous non-reaction of prices to output (although, as stated, only policy shocks are given a structural interpretation). It should be noted that two of the contemporaneous coefficients in the first two equations - a_1* and b_1* - are not estimated but calibrated on the basis of institutional information about taxes and transfers[3] (in the specification with fixed parameters the average value over the sample period is taken).

2 In the fiscal policy rules it is customary to include a public debt stabilization motive. In our system the omission of debt is justified by the fact that actions to deal with accumulated past deficits are roughly exogenous to current macroeconomic developments. It is therefore acceptable that they are part of the shock that is used to evaluate the effects of fiscal policy. Note that evidence that debt significantly enters the budgetary equations of a linear model as estimated here is anyway weak (see Pereira, 2009a).

3 Following the method of Blanchard and Perotti (2002), which uses the elasticity of the income tax rate to the wage calculated by Giorno *et al*. (1995) and later updated by Girouard and André (2005).

4. Effectiveness of monetary and fiscal policies in the fixed-coefficient model

4.1. Output responses to exogenous shocks

With the identification scheme described in the previous section, the specification with fixed coefficients can be estimated by instrumental variables or a more general method, such as maximum likelihood. Recall that the model is estimated with quarterly data - ending in the 3rd quarter of 2011 - for GDP, taxes net of transfers and acquisition of goods and services, in logs of real and *per capita* figures, the federal funds rate and the change in the log GDP deflator, in annualized terms. The series, except for the interest rate, are seasonally adjusted at source.[4] The estimation is based on a rolling sample of 35 years; at the beginning, however, a sample period of 25 years only is taken, gradually increasing up to 35 years, to allow the computation of impulse-responses prior to 1980 (the first sample ends in 1973:1, as the usable observations start in 1948:2). The presentation of results for the period before 1980 is important, particularly in the case of monetary policy for which there is evidence of a structural break around this time. The shaded areas refer to the contractionary periods according to the NBER.

The output responses (in percentage) to monetary and fiscal shocks are shown in Chart 1, with confidence bands for the 16th and 84th percentiles[5], for four horizons: within the quarter and one, two and three years ahead. The dates on the axis refer to the last observation in the sample window. Fiscal shocks have the dimension of 1 percent of GDP, and thus responses to them may be interpreted as multipliers; the monetary policy shocks have the size of 1 percentage point (p.p.) of the federal funds rate.[6]

As far as fiscal shocks are concerned, the fixed-coefficient model implies a weakening of their GDP impact, both in the case of net taxes and government consumption and investment. The one-year-ahead multiplier for net taxes gradually falls (in absolute terms) starting in mid-90s, from between -1.5 and -1.0 to about 0, a decade later. In the very recent period this specification even indicates a change of sign. Regarding persistence (i.e. for longer time horizons), the profile is similar but there is no sign reversion in recent years. The one-year-ahead multiplier for purchases of goods and services stands at about 1.5 until mid-90s; there is then a drop to a level around zero where it approximately remains afterwards. The multipliers for longer horizons show a more pronounced break, assuming negative values in the last decade and a half (although 0 is within the confidence bands). When the length of the sample window is shortened, the instability of multipliers increases, namely for acquisition of goods and services. This evidence contradicts the association between the structural VAR model (with fixed parameters) and sizeable budgetary multipliers with conventional signs. The estimates appear to be quite sensitive to dropping observations from the sample and including new ones, as shown by the «peaks» in responses (in particular, for fiscal innovations in the sample ending in 2009:1).

With regard to monetary policy shocks, there is no output reaction within the quarter owing to the identification restrictions, as variables do not respond contemporaneously to the federal funds rate. The

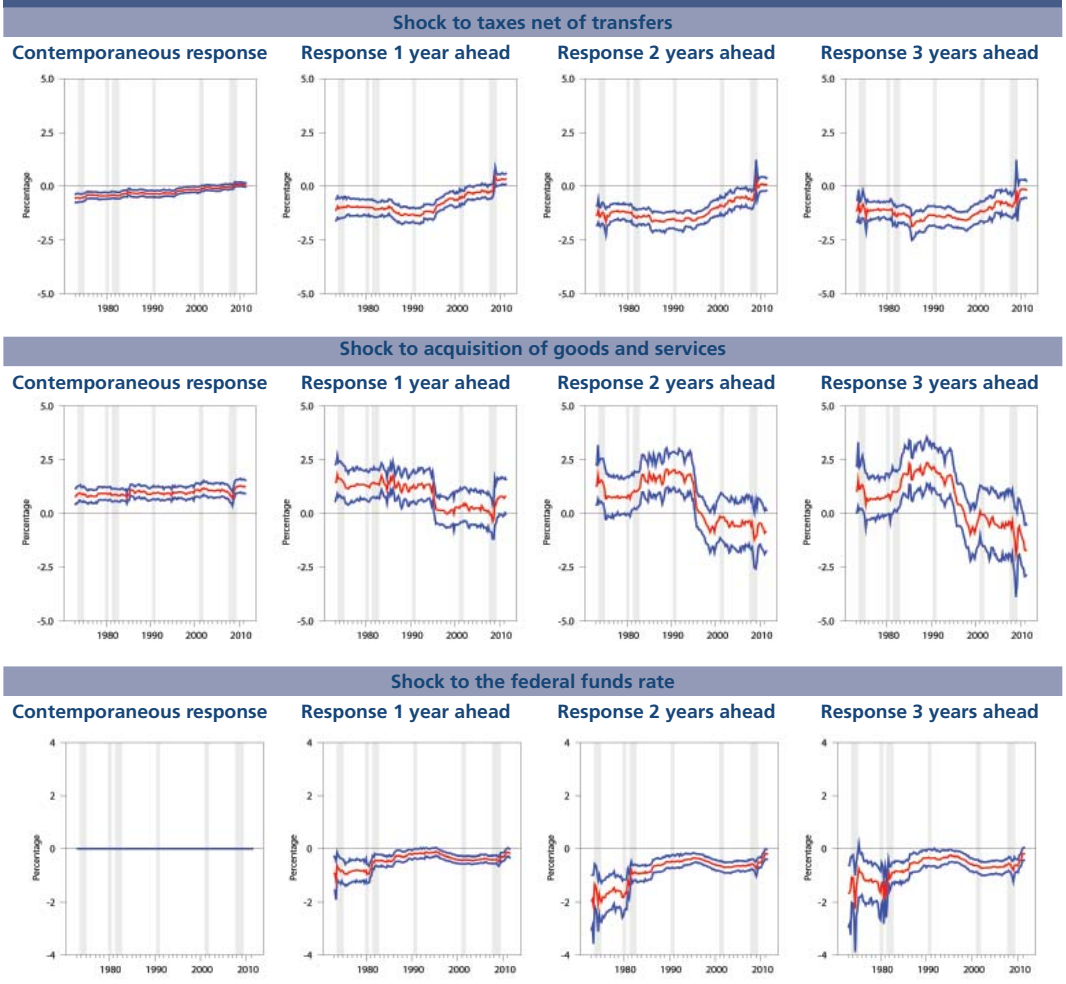
4 Budgetary data, output, output deflator and population were taken, respectively, from Tables 3.1, 1.1.5, 1.1.4 and 2.1 of the NIPA (Bureau of Economic Analysis). Note that the acquisition of goods and services is calculated as government consumption, excluding consumption of fixed capital, added to investment. The federal funds rate was taken from the FRED database (Federal Reserve Bank of St. Louis). Unlike the other series, available from 1947:1, the latter series is available only from 1954:3 on. In order not to lose the initial values in the sample, for 1947:1-1954:2 the interest rate on 3-month Treasury bills was considered. Other data used in calibrating the elasticities, for income and social transfers, are from Tables 3.12, 2.1 and 1.10 of the NIPA.

5 The confidence bands are calculated as follows. A reduced-form VAR is estimated for each of the samples. On the basis of the point estimate of the covariance matrix and assuming an inverse-Wishart distribution, extractions of that matrix are made (to which the structural decomposition is applied) and subsequently of the coefficient vector, assuming a normal distribution conditional on the covariance matrix previously extracted. The statistics underlying the confidence bands are obtained on the basis of 1000 extractions.

6 Note that the scale of the responses may differ from other studies that have estimated monetary policy VARs because in the present study real and *per capita* output is taken.

Chart 1

TIME-PROFILE OF OUTPUT RESPONSES IN A STRUCTURAL VAR WITH FIXED COEFFICIENTS



Source: Author's calculations.

Note: Impulse-response functions for policy shocks in the structural VAR model described in section 3 in a specification with fixed parameters, estimated on the basis of rolling samples ending at the date indicated on the axis (the final quarter varies between 1973:1 and 2011:3). The sample period is 35 years, however, for samples ending before 1983:1, the sample period is the maximum allowed by the available observations, with a minimum of 25 years. The shaded areas show the NBER recessions.

fixed-parameter model features a drop in effectiveness as well, in this case by early 80s (a result that is in line with other literature on this subject, quoted above). Prior to that, it is estimated that an increase in the federal funds rate by 1 percentage point triggered a reduction of about 1 percent in real *per capita* GDP for the one-year horizon. This response decreases to about -0.5 percent, and subsequently there is a fluctuation between this value and 0, with particularly low impacts around 1995 and in the very recent period. Regarding the persistence of the shock, the time-profile is similar, but the amplitude of fluctuation after 1980 somewhat larger.

4.2. Stabilizing impact of endogenous policies

This section seeks to quantify the loss of effectiveness of monetary and fiscal policy (documented in the previous section for the respective exogenous shocks) with regard to the stabilizing role. Note that this role depends on not only the effects of policies but also the extent to which they are used. Since now the objective is measuring the effect of endogenous policies, it is necessary to resort to the so-called counterfactual simulations (in the spirit of Sims and Zha, 1998, and Bernanke, Gertler and Watson, 1997). These simulations compare, during recessionary periods, the actual behaviour of policy variables and

output with their behaviour when the system is simulated under counterfactual assumptions, namely (i) absence of the exogenous component and (ii) absence of the endogenous component of policies. The simulation period begins in the quarter subsequent to the maximum in economic activity and goes on until the end of the recession; simulations are carried out for each of the six contractions since mid-70s up to the present day. The model estimates underlying the simulations are obtained on the basis of the sample window of 35 years ended in the last quarter of each recession (for the first two recessions this procedure is also followed, but the sample period available is shorter).

Let's take the equation for G_t (see section 3) as an example. In exercise (i) the system is simulated with the parameters in all equations according to their estimates, and the shocks according to their estimated trajectories, except for v_t^G that is set to 0. In exercise (ii) the system is simulated with the variable G_t determined by the respective exogenous shocks (i.e. following a random walk), equating to 0 all parameters in this equation except the coefficient of G_{t-1} which is set to 1 (the parameters in the other equations are set in accordance with the respective estimates and shocks in all equations with their estimated trajectories). The change in policy variables during recessions is broken down into their exogenous and endogenous components, which obtain as the difference between the actual level and simulated level of the variable at issue in the trough of recession, respectively, in exercises (i) and (ii) above. The effect on economic activity is measured in the same way, but taking the actual and simulated GDP levels. Implementation of such simulations, besides having a somewhat mechanical character, is subject to the caveat (stemming from the Lucas critique) that agents could have reacted differently if endogenous policy had differed from the historical trajectory. Therefore, these simulations will be more credible if the deviation from that trajectory is not too protracted (the considered recessions lasted on average about 5 quarters).

Decomposition of changes in variables into the endogenous and exogenous components

Table 1 presents the breakdown of changes in taxes net of transfers, acquisition of goods and services and the federal funds rate during recessions, into their systematic and exogenous components. Note that the actual change in policy variables is not exactly split into these two components, because structural shocks propagate through the system interacting with the respective endogenous structure. The simulation exercise will not take into account, by definition, such an interaction, and thus provides an approximate breakdown only.

Table 1

STRUCTURAL VAR WITH FIXED COEFFICIENTS: DECOMPOSITION OF MOVEMENTS IN POLICY VARIABLES DURING RECESSIONS

Recessions[a]	Net taxes (%, cumulative)			Aquisition of goods and services (%, cumulative)			Federal funds rate (p.p., cumulative)		
	Actual change	Exogenous comp.[c]	Endogenous comp.	Actual change	Exogenous comp.	Endogenous comp.	Actual change	Exogenous comp.	Endogenous comp.
1973:04-1975:01	-16.3	-3.7	-12.8	4.4	1.2	4.5	-3.7	-0.1	-4.8
1980:01-1980:03	-8.0	1.4	-9.5	-1.6	-0.4	-1.1	-5.2	-2.0	-3.7
1981:03-1982:04	-18.4	-1.5	-19.8	3.9	1.9	1.9	-8.3	-2.5	-5.7
1990:03-1991:01	-6.8	-0.4	-6.4	1.2	-0.3	1.5	-1.7	0.1	-1.9
2001:01-2001:04	-11.8	-4.5	-4.1	2.9	1.1	1.6	-3.5	-0.7	-2.5
2007:04-2009:02	-69.9[b]	-31.9	-39.8	2.4	-0.8	3.4	-4.3	1.7	-5.6

Source: Author's calculations.

Notes: (a) The dates indicate the beginning and the end of recessions. **(b)** As the fiscal variables are taken in logs in the model, the respective actual percentage change is approximated, as usual, by the difference in logs. This approximation works well, except in the case of net taxes in the 2008-2009 recession (given the magnitude of the change), where the decrease measured by the difference in logs is larger than the actual decrease, which stands at about 50 percent. **(c)** The exogenous and endogenous components are equal to the difference at the end of the simulation period (last quarter of the recession) between the actual figure and the simulated figure, shutting down, respectively, the responses/shocks associated with each component. The simulation starts in the quarter following the peak in activity and uses the sample window ending in the last quarter of the recession.

The figures in Table 1 indicate a strong endogenous counter-cyclical movement for taxes net of transfers, which should mainly reflect the performance of automatic stabilizers. As the discretionary fiscal actions in response to macroeconomic developments in the United States have been comparatively infrequent, these will be partly captured by the exogenous component (in spite of their endogenous character), overestimating it. In fact, this component had a large magnitude in the last two recessions, reflecting contemporary legislative measures taken, in whole or in part, as a reaction to these episodes, as the Economic Growth and Tax Relief Reconciliation *Act* of 2001, the Economic Stimulus Act of 2008 and the American Recovery and Reinvestment *Act* of 2009 (initial quarters).[7] It is worth noting that the observed decrease in net taxes during the 2008-09 recession has no correspondence in previous recessions (see also note (b) to Table 1).

The exercise indicates that the endogenous movements in public consumption have been much more modest by comparison, even without a consistent counter-cyclical (i.e. positive) sign. Therefore the emphasis on the spending multiplier found in the literature (which is due to the fact that spending, notably that of a military nature, is relatively less affected by simultaneity with output) is somewhat misplaced[8], as net taxes are the budgetary variable primarily used for macroeconomic stabilization (automatic and, to a lesser extent, discretionary).

The simulation shows a significant endogenous variation in the federal funds rate during recessions, in line with the monetary policy rule. Note that the reduction in this variable during the 2008-09 recession, although of the order of magnitude observed in previous recessions in absolute terms, was more important in relative terms, since the interest rate level was lower when the recession started and the «zero lower bound» was hit in the course of it. This implied that the variation in the instrument has fallen short of that implied by the monetary policy rule, which translates into a positive estimate of the exogenous component. It is worth noting that during this period, monetary policy included the implementation of non-conventional measures, which are not captured by this exercise. In the recessions in early 80s interest rate reductions went beyond what the rule prescribed, possibly signaling that considerations about economic recovery overrode inflation concerns, which tended to limit the amplitude of the decrease in interest rate.

Impact of the endogenous component on output

Table 2 shows the impact of movements in endogenous policy variables, previously determined, on real and *per capita* GDP during contractions in economic activity. The stabilizing effect is calculated as the output loss avoided at trough of recession, i.e. the difference between the actual level of this variable and the simulated level shutting down the contribution of endogenous policies. By comparing that effect and the actual contraction in activity in each downturn, it is possible to have an idea of their stabilizing role. The counterfactual multiplier provides an indication of the effectiveness of endogenous fiscal policy and is obtained as the ratio between the loss of output avoided and the change in the respective variable (at the end of recession). A similar indicator is calculated for the federal funds rate, which evaluates the decrease in output avoided by percentage point of change in interest rate.

The exercise indicates that net taxes played a very important stabilizing role in the recessions up to early 90s, reflecting the magnitude of the counter-cyclical movements in the variable (Table 1) combined with estimated multipliers between -1 and -2 (i.e. of the order of magnitudes obtained for exogenous policy in the period). In these episodes, the stabilizing role resulting from the simulation is substantial, ranging from about 1/3 for the shorter recessions to a maximum of 2/3 in the 1981-82 recession. In the last two

7 Around the 1973-75 recession, an important discretionary counter-cyclical measure was taken - the *Nixon tax rebate* - but this was already implemented in the quarter following the end of the recession.

8 On this point, see Cogan and Taylor (2011).

Table 2

STRUCTURAL VAR WITH FIXED COEFFICIENTS: IMPACT ON OUTPUT OF ENDOGENOUS MOVEMENTS IN POLICY VARIABLES

Recessions[a]	Actual change in GDP	Net taxes		Acquis. of goods and services		Federal funds rate	
		Stabilizing effect.[b]	Multiplier[c]	Stabilizing effect	Multiplier	Stabilizing effect	Effectiveness indicator
1973:04-1975:01	-4.60	3.6	-1.43	0.8	0.95	1.3	-0.27
1980:01-1980:03	-2.83	1.4	-0.84	-0.2	1.17	0.1	-0.03
1981:03-1982:04	-3.81	7.1	-2.00	0.4	1.18	1.3	-0.23
1990:03-1991:01	-2.04	1.0	-0.84	0.2	0.82	-0.1	0.04
2001:01-2001:04	-0.04	0.0	-0.06	0.3	1.37	0.2	-0.08
2007:04-2009:02	-6.56	-1.8	0.29	0.4	0.63	1.3	-0.24

Source: Author's calculations.

Notes: (a) The dates indicate the beginning and the end of recessions. **(b)** The stabilizing effect is equal to the difference at the end of the simulation period (last quarter of the recession) between the actual value and the simulated value of output, shutting down the endogenous response of policy variables. **(c)** The fiscal multipliers and the monetary policy effectiveness indicator relate the output loss avoided with the change in policy variables. The simulation starts in the quarter following the peak in activity and uses the sample window ending in the last quarter of the recession.

recessions, the methodology captures a nil or a destabilizing impact of net taxes, in line with the loss of efficiency in the recent period shown in Chart 1. It is worth noting that in spite of the underestimation of the endogenous component vis-a-vis the exogenous component in the two episodes (see the previous section), this result is due to the multipliers. Even with the caution that the interpretation of results from a mechanical exercise of this nature requires, evidence in the specification with fixed coefficients suggests that the absence of the moderating influence of net taxes, in sharp contrast with previous recessions, is a factor explaining the severity of the 2008-09 recession.

The estimated contribution of acquisition of goods and services as an instrument of stabilization is negligible, due to the small endogenous change in this variable. The multiplier, despite some fluctuation, has positive values, not indicating the break shown in Chart 1 from mid-90s on for the one-year and longer horizons. This can be explained by the fact that shocks to purchases of goods and services have maintained their effectiveness for very short horizons (see the contemporary multiplier in the same chart), which nevertheless cover an important part of recession length.

The evidence from counterfactual simulations suggests that the stabilizing effect of systematic monetary policy was similar in the three longer recessions, in absolute terms (in relative terms that effect ranges from 15 to 25 percent, respectively, in the 2008-09 and 1981-82 recessions). The indicator of relative efficiency also keeps a similar value in all three episodes. In the shorter recessions, however, the stabilizing role of the federal funds rate appears as insignificant. This might be explained by some delay in output response to monetary policy innovations (note that this can be partially induced by the identification restriction that these innovations do not impact GDP within the quarter). In short, the fixed-coefficient specification indicates such a loss of efficiency of taxes net of transfers that they would have virtually ceased to contribute to moderate recessions, this role being currently almost confined to monetary policy.

5. Output responses in the model with variable coefficients

This section presents the results of the simulation of the model under consideration in a specification with variable coefficients, using Bayesian methods. This specification is based on the key assumption that coefficients change gradually over time, according to a random walk. The parameters in the equations are grouped into three blocks containing, respectively, the coefficients of reduced form, the coefficients

of contemporaneous regressors and the variances of structural innovations.[9] Each block has the form of a linear state-space model to which the algorithm proposed by Carter and Kohn (1994) is applied. The simulation process iterates over the various blocks, using Gibbs sampling, according to a «filtered» variant, in which the full simulation process is carried out sequentially, stretching the sample one year at a time. A detailed discussion of the specification of prior distributions (for the initial states of the parameters and their volatility) and the simulation process is beyond the scope of this article.[10] The methodology is described in Primiceri (2005) and Cogley and Sargent (2005), applied to monetary policy VARs, and Pereira Lopes (2010), applied to a fiscal policy VAR. Note that the identification scheme used in the simulations is a reparameterized version of the scheme presented in section 3, giving rise to the same impulse-responses, but implying that all contemporary regressors are predetermined.

Chart 2 shows the median and confidence intervals corresponding to the 16th and 84th percentiles of impulse-response functions simulated for the period 1973:3-2011:3 (dates on the axis correspond to the time of parameter indexation).[11] The horizons are identical to those in Chart 1 and similarly responses to fiscal shocks have the interpretation of multipliers and monetary policy shocks have the dimension of 1 p.p. in the interest rate. The profile of output responses to net tax innovations is consistent with a weakening, but to a much lesser extent than shown in Chart 1. The multiplier one year ahead is about -1.5 up to mid-90s, later falling (in absolute value) to just above -0.5 until the end of the sample[12]. The shock persistence has a very similar profile. For purchases of goods and services, the one-year-ahead multiplier has a slightly rising profile in the initial period, from a little above 0.5 to close to 1.0 by 1996, followed by a reversion to the initial figures; in the last three years of the period a drop to values below 0.5 takes place. This pattern of change in effectiveness also occurs, more prominently, for longer time horizons. Thus, although the specification with variable parameters reconciles evidence from structural VARs with conventional budgetary multipliers, the magnitude of the latter is quite small, standing at the «usual» range's lower limit in the very recent period. In the case of monetary policy shocks, a weakening of the GDP impact around 1980 occurs, from about -1.25 to close to -0.75 percent, which continues, but quite attenuated, to -0.5 percent by the end of the sample. Regarding persistence there is an approximate stabilization after 1980.

One now examines the responses to fiscal shocks around recessions, to assess any increase in policy effectiveness when there is excess capacity in the economy, which finds empirical support in Auerbach and Gorodnichenko (2012). In the case of net taxes there is a very small increase (almost unnoticeable in the chart) during the longer recessions, but it is doubtful whether to attribute any meaning to such small variations. In the case of acquisition of goods and services, the mentioned hypothesis has no correspondence in the results.[13] The evidence is particularly discouraging for an enhanced effectiveness when the interest rate is at the «zero lower bound». As seen, there is no palpable upsurge in responses

9 The random walk hypothesis is jointly assumed for the parameters in each block, i.e. combining these parameters into a vector θ_t, $\theta_t = \theta_{t-1} + \varepsilon_t$ holds, where ε_t is a normal random variable with zero mean and a given covariance matrix.

10 The prior distributions of initial parameter values are normal calibrated by estimating a fixed-coefficient VAR over the training sample 1948:2-1967:4; the prior distributions of the hyperparameters are conjugate inverse--Wishart, calibrated the same way as described in Pereira Lopes (2010). The simulation period begins in 1968:1, the first end-date is 1973:3 the and last one is 2011:3 (the stability condition is not imposed). For each final date, 10 000 iterations of Gibbs sampling are run, of which 2 000 are kept for the calculation of impulse--responses; the «burn-in» period comprises 2 500 iterations. In order to reduce the number of coefficients in the block of reduced-form parameters, only two lags of the variables are considered.

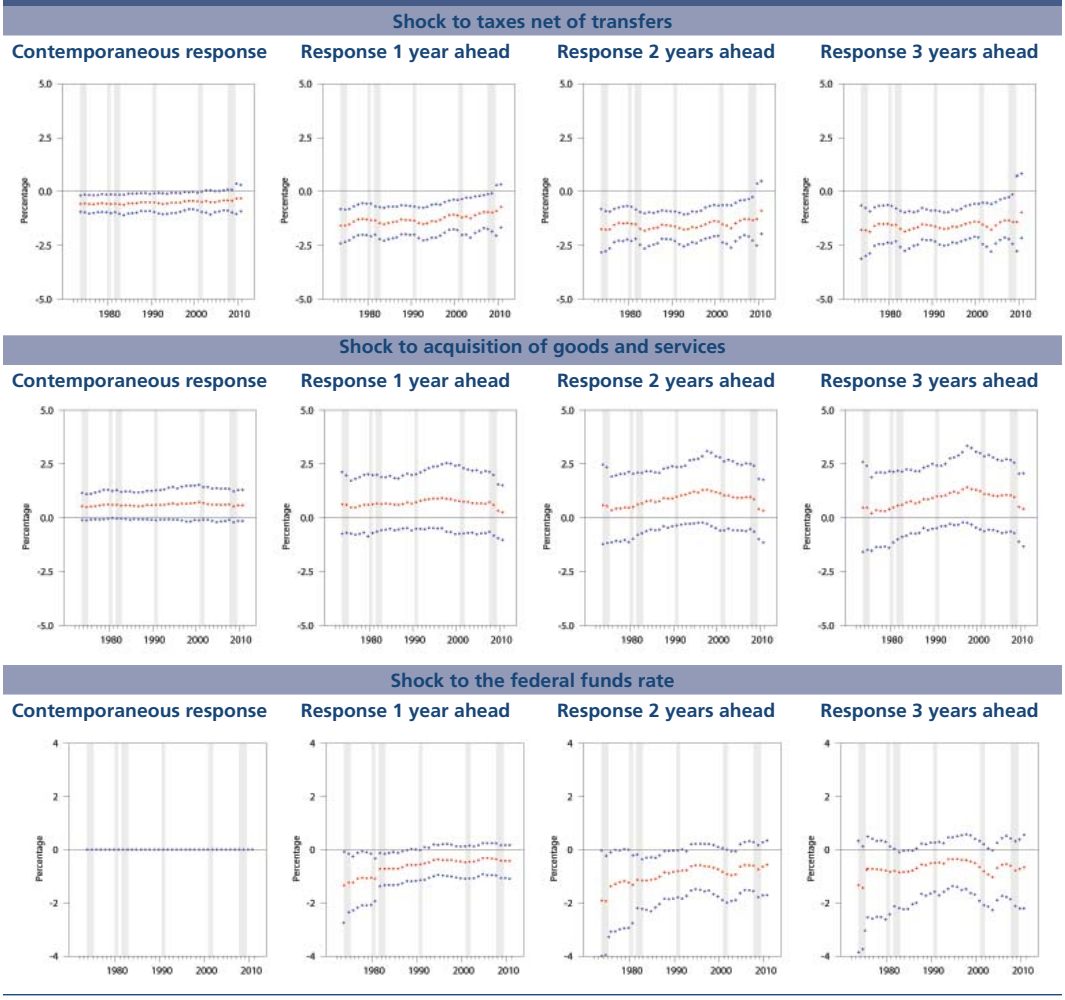
11 One follows the usual convention to present a simplified version of the impulse-response functions in which the response to shocks at time t depends only the on the parameters indexed to this date, for all horizons.

12 In Pereira and Lopes (2010) there is a strong weakening in the period following the 1973-75 recession without counterpart in Chart 2, which may reflect the fact that in that study the monetary policy variable is omitted.

13 The model estimated by Auerbach and Gorodnichenko, a non-linear VAR in which output responses may vary according to the state of the economy (recession or expansion), thus assuming a less general type of time--variation than here, is in principle better suited to address the issue.

Chart 2

TIME-PROFILE OF OUTPUT RESPONSES IN A STRUCTURAL VAR WITH VARIABLE COEFFICIENTS



Source: Author's calculations.

Nota: Impulse-response functions for policy shocks in the structural VAR model described in section 3 in a specification with time--varying coefficients (1973:3-2011:3) simulated by Bayesian methods. The shaded areas show the NBER recessions.

during the 2008-09 recession and, in fact, there is a fall in the quarters following its end (during which the Federal Reserve has kept the interest rate virtually unchanged).

Comparing with the responses shown in Chart 1 for the fixed-coefficient model, the evidence is generally consistent in that it indicates an attenuation of the effect on output over time for the three policy variables. Moreover, the two specifications point to a weakening in the responses to fiscal policy shocks since mid-90s and monetary policy shocks around 1980. However, the amount of time variation captured by the variable-coefficient specification is much more modest. In particular, budgetary multipliers maintain conventional signs throughout, and the impact of monetary innovations since 1980 fluctuates less. These results suggest that the fixed-coefficient model may exacerbate the measured temporal variability, lacking the flexibility to accommodate new observations in a «smoothed» fashion. The peaks observed in Chart 1 for responses at certain dates appear to support this conclusion. Nevertheless, the smaller variation of responses in the variable-coefficient model also raises the question of the influence on this outcome of the coefficient volatility assumed in the prior distributions. Simulations increasing that volatility produce median responses which, although less flattened, especially in the case of monetary policy, lead to the same qualitative conclusions. The main difference concerns the confidence bands which extend quite substantially. Thus, the evidence seems to be fairly robust with regard to volatility assumed a priori.

However, other specifications of temporal variation in the VAR coefficients are possible, for example, paths differing from a random walk. It is thus needed more experience with these models before firm conclusions are drawn.

6. Conclusions

This paper presents evidence on temporal variation in the effectiveness of monetary and fiscal policies on the basis of a structural VAR model with joint identification of the respective shocks. The exercise is based on the estimation of a specification with fixed coefficients, using rolling samples, and the simulation of a specification with variable coefficients. In both cases there is a weakening of the role of policies, but this tendency is more pronounced in the specification with fixed coefficients. Indeed, the latter points to the existence of fiscal multipliers with non-conventional signs since mid-90s, in the case of the acquisition of goods and services, and at the end of the sampling period in the case of net taxes. Moreover, the results indicate a virtual absence of a stabilizing role of net taxes in the 2008-09 recession, in stark contrast with the role played in previous protracted recessions. As regards monetary policy, after a weakening of its effectiveness by 1980, the results suggest a large fluctuation up to the present. However, the estimation based on rolling samples seems to exaggerate the temporal variation of responses, relative to a formal modeling with variable coefficients. In the latter case, the output response to monetary policy shocks after 1980 is smoother and features a quasi-stabilization. The fiscal multipliers maintain conventional signs, but get smaller over time and, in particular, their values contradict the assumption of a particularly effective fiscal policy in the current context.

An improved conduct of monetary policy is among the explanations that have been advanced for the waning of output responses to policy shocks, including to monetary policy shocks themselves comparing the periods before and after 1980 (see Boivin *et al.*, 2010). Similarly, the most immediate explanation for the effectiveness loss of fiscal policy would be a greater efficiency by the Federal Reserve in conducting stabilization actions. But this same argument would imply an upsurge of the effects of fiscal policy in the very recent period, which is not supported by the findings of this study. Another possible justification (which used to be put forward in the context of the «Great Moderation») refers to the fact that financial innovation should allow individuals to better smooth their income and, more generally, to hedge against fluctuations in budget aggregates and interest rates. However, this assumption clearly changed in recent years in the wake of the financial crisis, again justifying a resurgence of policy effectiveness.

In this context, it can be also mentioned the traditional Keynesian hypothesis that an increase in trade openess entails a reduction of budgetary multipliers. It should be noted, finally, the possibility that agents' perception towards public finance sustainability can change the effects of fiscal policy (and in extreme cases lead to a change in the signs of multipliers - the so-called «expansionary fiscal contraction» hypothesis). This is an area where more empirical research is needed, in order to identify the factors underlying the changes in output responses. Such an investigation is particulary difficult as it requires, in general, the specification of non-linear models, whose estimation involves non-conventional methods and relatively heavy simulation techniques.

References

Auerbach, A. and Y. Gorodnichenko (2012). "Fiscal Multipliers in Recession and Expansion", Berkeley *Working Paper.*

Bernanke, B. and A. Blinder (1992). "The federal funds rate and the channels of monetary transmission", *The American Economic Review* 82 (4): 901–921.

Bernanke, B., M. Gertler, and M.Watson (1997). "Systematic monetary policy and the effect of oil price shocks", *Economic Research Reports* 25, C.V. Starr Center for Applied Economics.

Blanchard, O. and R. Perotti (2002). "An empirical characterization of the dynamic effects of changes in government spending and taxes on output", *Quarterly Journal of Economics* 117 (4): 1329–1368.

Bovin, J. and M. Giannoni (2006). "Has monetary policy become more effective?", *Review of Economics and Statistics* 88 (3): 445–462.

Boivin J., Kiley, M., and Mishkin, F. (2010). "How has the monetary transmission mechanism evolved over time?", NBER *Working Paper* 15879.

Carter, C. and R. Kohn (1994). "On Gibbs sampling for state-space models", *Biometrika* 81 (3): 541-553.

Christiano, L., M. Eichenbaum, and C. Evans (1999). "Monetary policy shocks: What have we learned and to what end?", In J. Taylor e M. Woodford (Eds.), *Handbook of Macroeconomics*, Volume 1A: 91–157. Amsterdam: Elsevier Sccience BV.

Christiano, L., M. Eichenbaum, and S. Rebelo (2011). "When is the government spending multiplier large?", *Journal of Political Economy* 119 (1): 78-121.

Cogan, J. and J. Taylor (2011), "What the Government Purchases Multiplier Actually Multiplied in the 2009 Stimulus Package", Stanford University, *Working Paper*.

Cogley, T. and T. Sargent (2005). "Drifts and volatilities: monetary policies and outcomes in the post-WW II US", *Review of Economic dynamics* 8 (2): 262-302.

Giorno, C., P. Richardson, D. Roseveare, and P. van den Noord (1995). "Estimating potential output, output gaps and structural budget balances", *Economics Department, Working Papers* 152, OECD.

Girouard, N., and C. André (2005). "Measuring cyclically adjusted budget balances for OECD countries", *Economics Department, Working Papers* 21, OECD.

Johnston, D., J. Parker, and N. Souleles (2006). "Household expenditure and the Income Tax rebates of 2001", *American Economic Review* 96 (5): 1589–1610.

Mertens K. and M. Ravn (2010). "Measuring the Impact of Fiscal Policy in the Face of Anticipation: A Structural VAR Approach", *The Economic Journal*, 120 (544): 393-413.

Pereira, M. (2009a). "Empirical evidence on the stabilizing role of fiscal and monetary policy in the US", *MPRA Paper* 19675, University Library of Munich.

Pereira, M. (2009b). "A new measure of fiscal shocks based on budget forecasts and its implications", Banco de Portugal *Working Paper* 21.

Pereira, M. and A. Lopes (2010). "Time-Varying Fiscal Policy in the U.S.", *Working Paper* do Banco de Portugal 21.

Perotti, R.(2005). "Estimating the Effects of Fiscal Policy in OECD Countries", *Discussion Paper* 4842, CEPR.

Primiceri, G. (2005). "Time varying structural vector autoregressions and monetary policy", *Review of Economic Studies* 72 (3): 821–852.

Ramey, V. (2011a). "Identifying government spending Shocks: It's all in the timing", *Quarterly Journal of Economics* 126 (1): 1-50.

Ramey, V. (2011b). "Can Government Purchases Stimulate the Economy?", *Journal of Economic Literature* 49 (3): 673-85.

Romer, D. (2011). "What have we learned about fiscal policy from the crisis", *Conference on Macro and Growth Policies in the Wake of the Crisis,* IMF.

Romer, C. and D. Romer (2004). "A New Measure of Monetary Shocks: Derivation and Implications", *American Economic Review* 94 (4): 1055-1084.

Romer, C. and D. Romer (2010). "The Macroeconomic Effects of Tax Changes: Estimates Based on a New Measure of Fiscal Shocks", *American Economic Review* 100 (3): 763-801.

Sims, C. and T. Zha (1998). "Does monetary policy generate recessions?", *Working Paper* 12, Federal Reserve Bank of Atlanta.