OUTPUT EFFECTS OF FISCAL POLICY IN PORTUGAL: A STRUCTURAL VAR APPROACH*

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ABSTRACT

This study applies the structural VAR methodology to the identification of fiscal policy shocks in Portugal, using quarterly general government accounts from 1995 to 2011. Using a more detailed breakdown of variables than is usual, an estimate is made of the impact on economic activity of shocks to taxes, broken down into direct and indirect taxes, transfers, and government consumption, broken down into compensation of employees and expenditure on goods and services. The findings point to the existence of multiplier effects on output with a conventional sign (except for expenditure on goods and services) in the sample period, stronger for compensation of employees and direct taxes than for the remaining variables analysed. At the same time, changes in indirect taxes and, to a lesser degree, in transfers, tend to cause less of an impact on economic activity.

1. Introduction

Given the size and the scope of the 2008-2009 recession, unprecedented in recent decades, the leeway for monetary policy, with the nominal interest rates at the zero lower bound, was deemed to be insufficient to offset the severity of the fall in economic activity. Against this backdrop, there was a renewed debate on the role of discretionary budgetary policy in stabilizing the economy. More recently, as the sovereign debt crisis in the euro area erupted, the impact of discretionary budgetary policy came back to centre stage, specifically with the aim of gauging the effects on economic activity of the ambitious consolidation plans under way in some countries.

The size of budgetary multipliers, which measure the response of output to changes in a specific budgetary variable, has been heatedly debated among economists at the theoretical level. In fact, no consensus has yet been reached (see, for example, Ramey, 2011a). Lower multipliers (or those with unconventional signs) would reduce the success of fiscal stimulus policies and, at the same time, they would indicate that fiscal consolidation would have little negative impact on the economy. Larger budgetary multipliers, on the other hand, would require less budgetary effort to attain a given impact on output, but would imply a greater contractionary impact of fiscal consolidation policies.

There is, by the same token, no consensus among economists on the empirical methodology to be used to measure the repercussions of fiscal policy on economic activity (Ramey, 2011b). The main difficulty in this context stems from the bidirectional nature of the causality relationship between output and budgetary variables. In other words, these variables are themselves influenced by fluctuations in output

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through automatic stabilizers and discretionary policy measures. There are other difficulties relating to uncertainty over the time horizon that economic agents use as a reference when they react to the impact of budgetary measures and to the possibility that they change their behaviour when measures are announced (even before they are implemented). At a purely empirical level, two main approaches have been followed: the narrative (Ramey and Shapiro, 1998, and Romer and Romer, 2010), and that of the structural autoregressive (VAR) models (Blanchard and Perotti, 2002). The structural VAR approach, which is followed in this article, has been used in many recent works analysing the effects of budgetary policy in European countries. Among these are Baum and Koester (2011) with regard to Germany, Caprioli and Momigliano (2011), with regard to Italy, and de Castro and Hernández de Cos (2008) with regard to Spain. This study applies the structural VAR methodology to Portugal.

The findings reported in the literature come in with a wide variety of assessments of how big the effects of budgetary policy are on macroeconomic variables (an issue we shall come back to in the course of this article). This literature also includes evidence obtained through the use of general equilibrium models. It should be noted that findings show variation even within a given methodology. In the case of structural VAR models in particular, there is great sensitivity to the variables included in the system, the restrictions used to identify the shocks and the sampling period (on this last point, see Pereira, 2012). In the present work, robustness exercises were included (see in particular sections 4.3 and 7), with the aim of assessing the sensitivity of the results to specific hypothesis, though the extent of such exercises is limited by the size of the sample. Another important limitation in this type of analysis relates to the linear structure of the models. Indeed, symmetrical budgetary shocks may not have symmetrical effects on economic activity, and the size of the shock and its impact may not be proportional, contrary to what the linear structure imposes. Taking the above into account, the results in the literature where this study belongs should be read with caution, and furnish above all information relevant for a comparison of different budgetary instruments and their impact on macroeconomic aggregates.

The evidence in this study points to the existence of differentiated effects on economic activity according to the budgetary variable in question, though always with a conventional signal, except in the case of expenditure on goods and services. In the sample period (1995-2011), after a shock of the same size, the response of GDP was substantial in the case of compensation of employees, was average in the case of direct taxes and transfers, and was minimal in the case of indirect taxes. When the persistence of the shocks through accumulated multipliers is taken into account, the effect on output for each euro of total variation in the impulse-variable was considerably more marked for direct taxes and compensation of employees than for transfers or indirect taxes. By and large, the evidence obtained suggests that disposable income was an important transmission channel of fiscal policy during the period under analysis.

When interpreting the evidence adduced, besides the methodological limitations already mentioned, particular care is needed in placing it against the current Portuguese circumstances. The estimated effects of fiscal policy mirror the type of shocks and the macroeconomic relationships arising in the sample period. Such relationships, however, could have changed considerably in recent times, and the same applies to the nature and size of the budgetary shocks, with an impact on the transmission of fiscal policy to macroeconomic aggregates. Lastly, this article focuses only on one aspect of the conduct of budgetary policy, and that is its short- and medium-term impact on output. There are other important issues that are not tackled here, in particular the impact on potential economic growth and income distribution; nor are questions relating to the sustainability of public finances.

The article is organized in the following way. Firstly, the data used and the methodological issues are presented (sections 2 and 3). Then the effects of the shocks to budgetary variables on output are described (section 4), and some evidence is presented on the conduct of fiscal policy in Portugal (section 5). Section 6 is given over to the impact of budgetary shocks on GDP components and section 7 discusses the implications of including public debt dynamics in the models. Finally, the conclusions are presented in section 8.

2. Data

The use of quarterly data not interpolated from annual figures is one of the necessary conditions for an adequate estimate of the effects of fiscal policy through the use of structural VAR models. However, the compilation of quarterly national accounts for the general government sector as a whole is relatively recent in most European countries. Portugal is no exception, and such information for a sufficiently long period has only recently been made available. Quarterly general government accounts released by the National Statistical Office (*INE*) start in 1995. The sample used is thus 1995:Q1 to 2011:Q4, shorter than in similar studies looking at the US[1], though close, for example, to the size of the subsample used by Perotti (2002), and the samples used by Giordano *et al*., (2008) and Castro and Hernández de Cos (2008), all of which are for European countries.

In this context, it should be mentioned that the Portuguese tax system was completely revamped during the second half of the 1980s, specifically with the introduction of VAT in 1986, and the reform of direct taxation in 1989 (see Cunha and Braz, 2009). On the expenditure side, there were also major changes in the conduct of budgetary policy, with some of the reforms, such as the one of the civil servants' wage system, extending into the early 90s. Given this, it would be in any case warranted to document the effects of fiscal policy in Portugal with a sample starting after the beginning of that decade. The length of the sample period, of course, conditions the size of the system to estimate. The use of smaller samples tends, given the size of the system, to give rise to less precise estimates of the impulse-response functions.

The macroeconomic series used include, on the one hand, GDP and various components of aggregate expenditure (private consumption and its breakdown into durable and non-durable goods, and private investment and its breakdown into residential and non-residential), in real terms and in logarithms, and, on the other hand, inflation (measured by the change in the logarithm of GDP deflator). The budgetary variables include, in the first place, direct taxes (essentially the personal income tax (IRS), the corporation income tax (IRC) and actual social contributions), indirect taxes (mainly VAT and various taxes on products) and social transfers in cash. The budgetary variables also cover government consumption, including government gross fixed capital formation, as well as the breakdown of that aggregate into compensation of employees and expenditure on goods and services. This article, therefore, in line with other earlier studies (for example, Burriel *et al*., 2009), takes consumption and public investment together. In the case of Portugal, given the repeated use of public-private partnerships in the sample period, which imply the recording of investment as intermediate consumption (with a modified temporal profile), it seems all the more adequate that these variables are taken together. Appendix A gives a list of sources and the correspondence of the variables used with the national accounts aggregates, along with the statistical treatments made.

As regards the statistical treatment of budgetary variables, it is worth mentioning that these were subject to corrections aiming to take out variations that were fundamentally of an accounting nature and had no actual impact on the economy. In this context, taxes and social contributions were corrected to exclude the securitization of tax arrears (taking place at the end of 2003) that led to an anticipation of revenue, without an impact on the amounts in fact collected from economic agents. The components of government consumption (compensation of employees and expenditure on goods and services) were corrected for the impact from the transformation of hospitals into public corporations, with effects from

1 As an example, Blanchard and Perotti (2002) use the period from 1960:Q1 to 1997:Q4 to obtain their central results.

2002 on[2]. The budget series were also taken in logarithms and deflated with the GDP deflator.[3] As a final point, all the series not corrected for seasonality at source, and this includes most of the budgetary variables, were corrected by the authors.

3. Methodology

Initial studies applying the structural VAR methodology to fiscal policy adopted a very aggregate definition of budgetary variables, considering only taxes net of transfers, on the one hand, and public expenditure (fundamentally consumption and public investment), on the other. These definitions were used in a great deal of the subsequent work in this field. It is, however, plausible that the various headings that make up these aggregates have distinctive influences on economic activity. Moreover, studies such as de Castro and Hernández de Cos (2008) and Unal (2011) find evidence of differentiated effects of revenue and expenditure categories, reinforcing the standpoint that a more detailed breakdown of budgetary variables is appropriate. The evidence stemming from this study provides ample confirmation of this statement.

Each of the structural VAR models estimated in this article is made up of two blocks, the fiscal and the macroeconomic blocks. A first group of models is considered, in which budgetary variables disaggregate in different ways, with the macroeconomic block made up of GDP and inflation.[4] The base model in this group includes budgetary variables at a more aggregate level, specifically taxes, social transfers in cash and government consumption. Two variants are then estimated, one breaking down taxes into direct and indirect (controlling for the two mentioned public expenditure variables), and another breaking down government consumption into compensation of employees and expenditure on goods and services (controlling for taxes and transfers). It was considered preferable, given the size of the sample, to estimate these two smaller systems than to include all the disaggregated budgetary variables in the same model. Furthermore, regardless of the particular component of revenue and expenditure whose effects are being measured, it is always necessary to include the remaining budgetary variables in the system, even in aggregate form, since there is a big probability that the respective shocks will be correlated.

Concerning the sources of exogenous fiscal shocks in Portugal, one of the main long-term determinants of public finances after 1995 has been the increase in social expenditure, mainly associated to pension and health systems. This trend, however, is captured by the endogenous dynamics of the system (specifically through own lags of variables), giving rise only partially to structural shocks. As for shocks on the revenue side, a considerable part of discretionary movements in taxes occurred as a response to the above mentioned dynamics of social expenditure. Such movements generally took place with a greater lag than the one usually incorporated in VAR models, being another source of innovations. Lastly, the fluctuations in some of the items in acquisition of goods and services are also a relevant source of exogenous shocks to the system.

In order to study the responses to fiscal shocks of other macroeconomic variables besides GDP, specifically consumption and private investment and some of their components, systems including these variables were also estimated. The strategy followed in this case consisted in adding a component of

2 Another important methodological change relates to the treatment of the State contribution to the *Caixa Geral de Aposentações* in 2005. In this case, no correction was possible because of the dearth of information on the quarterly profile of this contribution for the period before 2005.

3 Although some budgetary series have their own deflators, the use of these is not appropriate for estimating shocks. In fact, many budgetary shocks result from price effects (changes in tax rates, increases or cuts in salaries and so on) and these are annulled, by the very way that the deflators are constructed, by the application of the latter to nominal series.

4 If a longer sample were available, the inclusion of an instrument of monetary policy or an external demand variable could be considered. It should be mentioned, however, that a large direct response from the budgetary variables in Portugal to those variables is not likely, nor it is a substantial correlation between the structural fiscal shocks and the euro area monetary policy shocks, or external demand shocks, which tends to minimize the impact on the findings from non-inclusion of mentioned variables.

aggregate demand to the relevant models at a time (a strategy similar to that adopted by Blanchard and Perotti, 2002, and Romer and Romer, 2010). Section 7 presents the results from a system which takes into account public debt dynamics; a discussion of the specific methodological features that such an approach requires is made there.

The identification methodology in this article is closely welded to the applications of structural VAR models to fiscal policy mentioned before. The identification scheme used is of the type $Aut=Bet$, where A and B are the matrices that contain the restrictions on contemporaneous coefficients, ut represents the vector of reduced-form innovations and et represents the vector of structural innovations. Matrices A and B in the case of the base model are given by:

$$\begin{bmatrix} 1 & 0 & 0 & ely_I & elp_I \\ 0 & 1 & 0 & ely_T & elp_T \\ 0 & 0 & 1 & ely_G & elp_G \\ r_{41} & r_{42} & r_{42} & 1 & 0 \\ r_{51} & r_{52} & r_{53} & a_{54} & 1 \end{bmatrix} \begin{bmatrix} u_t^I \\ u_t^T \\ u_t^G \\ u_t^y \\ u_t^p \end{bmatrix} = \begin{bmatrix} 1 & b_{12} & b_{12} & 0 & 0 \\ 0 & 1 & b_{23} & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} e_t^I \\ e_t^T \\ e_t^G \\ e_t^y \\ e_t^p \end{bmatrix},$$

where the variables in the system are taxes (I), social transfers (T), government consumption (G), output (y) and inflation (p). The coefficients ely and elp are the budgetary elasticities (note that the model is estimated in logarithms) within the quarter, the first relative to output and the second to prices. In fact, under the assumption that implementation by government of measures in response to macroeconomic developments occurs with at least one quarter's lag, the contemporaneous coefficients of output and prices in the equations of budgetary variables capture automatic responses only. The elasticities in question are calibrated outside the model, using institutional information on taxes (relevant features of the tax system), transfers and other public expenditure categories in Portugal. In section 3.1 there is a description of the hypotheses and information used for this calibration. The macroeconomic variables are allowed to respond contemporaneously to all fiscal variables (this reaction is captured by the coefficients r).

The identification of each of the innovations in the block of budgetary variables relative to the remaining innovations in that block requires an ordering of these variables. There is, however, no strong reason for assuming that expenditure shocks come before tax shocks or vice-versa, being necessary to experiment with alternative orderings. Looking at the contemporaneous correlations between the reduced-form residuals from the equations of fiscal variables,[5] there is above all an important negative correlation between the residuals from taxes, on the one hand, and the residuals from expenditure variables, on the other. These findings contrast with the low correlation that is usually reported in studies for other countries (which, however, often consider taxes net of transfers, and this, by definition, partially cancels out the type of correlation visible in the sample for Portugal). This negative correlation found in the Portuguese data, given the sampling period, suggests that it is likely to stem mainly from a simultaneous implementation of tightening or loosening measures on the revenue and expenditure sides. It should also be noted that such an effect seems to offset another one that should generate contemporaneous positive correlation between tax and expenditure reduced-form residuals, and that is the automatic reaction of direct taxation to shocks in wage and pension outlays.

Section 4 presents the main findings, both placing expenditure before taxes, as illustrated in matrix B above (where, in addition, government consumption comes before transfers), and placing taxes first. By and large, this change in the ordering does not lead to a significant change in the size of the estimated budgetary multipliers. Although this study focuses on the response of output to fiscal shocks, one also

5 In general the inversion of the order of two variables in the system has a bigger influence on the results, the more contemporaneously correlated the respective reduced-form residuals happen to be.

comments on the response of the primary balance to these shocks. This last response, as might be expected, shows greater sensitivity to the way budgetary variables are ordered (though this is practically confined to the quarter of impact). The identification between the innovations within the macroeconomic block is made through the ordering of prices after output (coefficient a).[6] The order condition is exactly satisfied in this identification scheme.

In models that take budgetary variables in a more disaggregated way, the corresponding disaggregated elasticities are considered but the identification of the innovations is made in the same way. In the models which look at the effects of budgetary variables on the GDP components, the latter are ordered after output. As a final point, the systems are specified with 4 lags, given the quarterly frequency of the data (on this point, see footnote 7).

3.1. Budgetary elasticities

Table 1 shows the output and price elasticities of fiscal variables that were assumed in the estimates presented throughout the article. The methodology used for these calculations will be found in detail in appendix B. In section 4.3 there is a discussion of the impact on the main results from consideration of alternative figures for the elasticities of taxes relative to GDP. The elasticities for the aggregated budgetary variables are obtained for each quarter as the weighted average of the figures calculated for the components. The weight of these components will, of course, vary over time and the same happens with the weighted elasticities; the values included in matrix A of the previous section are averages over the sampling period.

In the case of direct taxes, for the personal income tax and social contributions, the OECD methodology (Girouard and André, 2005, and previous studies) was adapted for quarterly observations. Specifically, output elasticities are calculated on the basis of the elasticities of these taxes relative to their macroeconomic base and of the macroeconomic bases relative to GDP (the latter estimated through econometric regressions with quarterly data). In the case of the corporation income tax, a contemporaneous elasticity equal to zero is assumed, since the relevant macroeconomic base is fundamentally previous years' profit.[7] The resulting elasticity of direct taxes in relation to output is less than one. This figure derives from the evidence of a quite low elasticity of employment (and consequently of the income tax base) relative to GDP within the quarter, and from the assumption of no response of the corporation income tax. For

Table 1

QUARTERLY ELASTICITIES OF FISCAL VARIABLES

	GDP	Prices
Taxes[a]	0.6	-0.1
Direct taxes[a]	0.4	-0.1
Personal income tax	0.4	0.2
Corporation income tax	0.0	-1.0
Social contributions	0.4	0.0
Indirect taxes	1.0	0.0
Social transfers[a]	-0.1	-1.0
Government consumption	0.0	-0.8
Compensation of employees	0.0	-1.0
Goods and services	0.0	-0.5

Source: Authors' calculations.
Note: (a) Sample averages.

6 The correlation of residuals in the reduced-form equations for the two variables in question is very small, and so this hypothesis will be approximately neutral for the findings.

7 It should be noted that the elasticity of corporation income tax relative to GDP will be captured by the lags of this last variable. Such an effect would probably be better incorporated in a model with more than four lags, but this is not feasible, given the insufficient degrees of freedom.

indirect taxes, a unitary elasticity is considered and, for social transfers, only outlays on unemployment benefits are assumed to respond to output. Finally, it is supposed that government consumption is not influenced contemporaneously by economic activity.

The elasticities of the personal income tax and social contributions relative to prices are obtained in a analogous way as elasticities to GDP. Further, it is assumed that receipts from the corporation income tax do not react to prices within the quarter, meaning that real revenue has a negative unitary elasticity. Receipts from indirect taxes are supposed to be proportional to inflation, coming in with zero elasticity in real terms. Salaries and social transfers, in turn, do not accompany movements in prices within the quarter (negative unitary elasticity in real terms). With regard to expenditure on goods and services, it is assumed that part of this aggregate will be determined by the amount actually stipulated in the budget and this will therefore not react to prices, while the remainder, including for example, expenditure on health sector co-payments, will move in line with inflation.

4. The impact of fiscal shocks on output

The shocks in this section were transformed to reflect the relationship between the fiscal variable in question and the aggregate that is impacted.[8] More specifically, shocks have always the size of 1 euro, with the response also measured in euros.

4.1. Shocks to taxes and social transfers

As already mentioned, the breakdown of the budgetary variables considered in the analysis of the effects of fiscal shocks on GDP is relatively detailed. Chart 1 illustrates the impulse-response functions of output to shocks to taxes and social transfers, along with the respective confidence bands.[9] Besides the temporal profile of responses, some of the literature in this field (for example, Perotti, 2002, and Mountford and Uhlig, 2009) highlights its accumulation over time. Tables 2 and 3 show the responses of the impulse-variable and output to fiscal shocks (this last coincides with what is shown in Chart 1) along with average cumulative responses, in the quarter of impact and one, two and three years ahead. The cumulative responses indicate the persistence of the impact on output and of the shock itself. The cumulative multiplier one year ahead is also shown (Table 2), obtained by dividing the cumulative responses of output and of the impulse-variable.

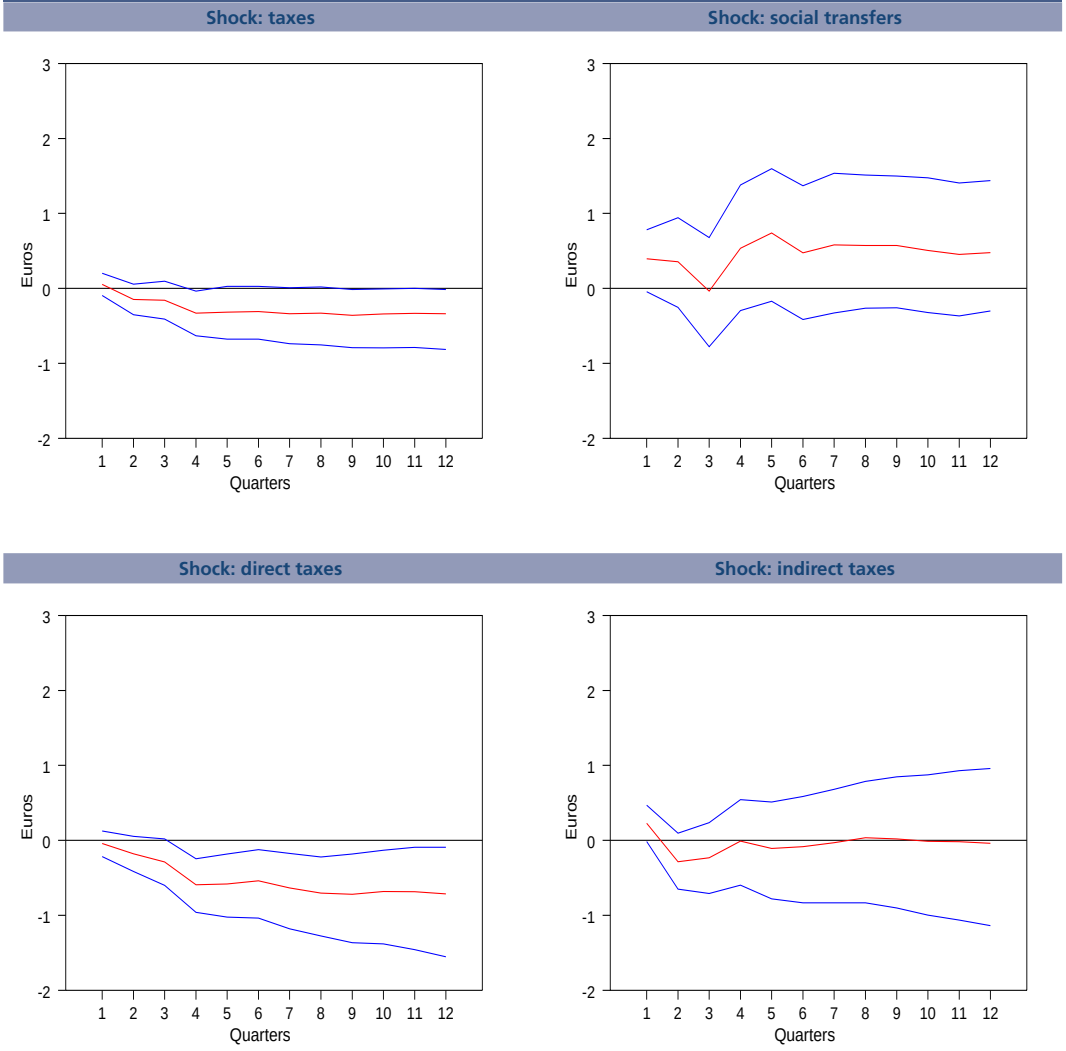
As for tax shocks, their composition in terms of direct and indirect taxes has a substantial influence on the response of economic activity. Indeed, innovations in direct taxes have a greater impact on output: the estimated responses indicate that a shock of 1 euro has a maximum impact of -70 cents around two years after the shock. In other words, this would be the reduction (increase) in GDP for each euro of initial increase (reduction) in the fiscal variable (Table 3). The point estimate in the case of indirect tax shocks has also a conventional sign although it is clearly not significant in statistical terms over the whole horizon. Other authors who have analysed disaggregated taxes, such as de Castro and Hernández de Cos (2008), for Spain, have also found evidence of a greater repercussion on GDP in the case of shocks to direct taxes. The response of economic activity after a shock to taxes as a whole is negative (Chart 1) and builds up for a year, with the response from one to three years oscillating between -30 and -40

8 Without this procedure, the responses would show the effect of a one-percent variation of the impulse-variable as a percentage of the response-variable.

9 The confidence bands are calculated in the following way. The reduced-form VAR is estimated and, on the basis of the point estimate of the covariance matrix and assuming an inverse-Wishart distribution, an extraction of that matrix is made. An extraction of the vector of the coefficients follows, assuming a normal distribution conditional to the previously extracted covariance matrix. Applying the structural decomposition, the impulse--response functions of the system are calculated. The confidence bands are obtained as the percentiles 16 and 84 in a sequence of impulse-response functions resulting from 2500 extractions.

Chart 1

OUTPUT RESPONSE TO SHOCKS TO TAXES AND SOCIAL TRANSFERS



Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. Expenditure variables are ordered before taxes. Responses to shocks to taxes and social transfers are taken from a model that also includes government consumption and prices. Responses to direct and indirect tax shocks are taken from a model that also includes social transfers, government consumption and prices (indirect taxes are ordered before direct taxes).

Table 2

SHOCKS TO TAXES AND SOCIAL TRANSFERS: VARIABLE'S RESPONSE | IN EUROS, POINT ESTIMATES

	Response			Average cumulative response		
	Direct taxes	Indirect taxes	Social transfers	Direct taxes	Indirect taxes	Social transfers
contemp.	1.0	1.0	1.0	1.0	1.0	1.0
1 year	-0.1	0.4	0.4	0.2	0.5	0.5
2 years	-0.1	0.1	0.3	0.1	0.3	0.4
3 years	-0.1	0.0	0.3	0.1	0.2	0.4

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to chart 1 for the models used. The average cumulative response is calculated dividing the cumulative response by the number of quarters since impact.

Table 3

SHOCKS TO TAXES AND SOCIAL TRANSFERS: OUTPUT RESPONSE | IN EUROS, POINT ESTIMATES AND CONFIDENCE BANDS

	Response			Average cumulative response		
	Direct taxes	Indirect taxes	Social transfers	Direct taxes	Indirect taxes	Social transfers
contemp.	0.0	0.2	0.4	0.0	0.2	0.4
	(-0,2; 0,1)	(-0,1; 0,5)	(0,0; 0,8)	(-0,2; 0,1)	(-0,1; 0,5)	(0,0; 0,8)
1 year	-0.6	0.0	0.5	-0.3	-0.1	0.3
	(-1,0; -0,2)	(-0,6; 0,6)	(-0,3; 1,4)	(-0,5; 0,0)	(-0,5; 0,3)	(-0,2; 0,9)
2 years	-0.7	0.0	0.6	-0.4	-0.1	0.5
	(-1,3; -0,2)	(-0,7; 0,8)	(-0,3; 1,6)	(-0,8; -0,1)	(-0,6; 0,4)	(-0,2; 1,2)
3 years	-0.7	0.0	0.5	-0.5	0.0	0.5
	(-1,6; -0,1)	(-1.2; 1,1)	(-0,3; 1,4)	(-1,0; -0,2)	(-0,7; 0,6)	(-0,2; 1,2)
	Maximum (quarter)			Cumulative multiplier (1 year)		
	-0,7 (9º)	-0,3 (2º)	0.7 (5º)	-1.2	-0.2	0.6
	(-1.4; -0.2)	(-0.7; 0.1)	(-0.1; 1.7)	(-2.9; -0.1)	(-1.3; 0.6)	(-0.5; 2.0)

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to chart 1 for the models used. The average cumulative response is calculated dividing the cumulative response by the number of quarters since impact; the cumulative multiplier is obtained dividing output and impulse-variable cumulative responses.

cents. As regards social transfers, the findings point to a positive impact on GDP (70 cents, maximum, for each euro initially spent), though this is on the brink of statistical non-significance.[10]

When taxes are ordered before expenditure variables (Tables C1 to C3 in Appendix C), the direct tax multiplier increases, with a maximum impact on output of -1 euro for each euro of initial variation (Table C2). In contrast, the peak of the positive GDP response to innovations in social transfers is now only around 60 cents.

The persistence of the direct tax shock is very low (Tables 2 and C1), and this could, on the one hand, be related to the greater recourse to temporary budgetary measures for these taxes, notably changes in the withholding tables of the personal income tax out of step with changes in the tax brackets, leading to variations in revenue that are later offset. On the other hand, the low persistence of these shocks comes from their recessive effect on GDP, given the positive response of the fiscal variable to output (section 5 details some evidence on the responses of budgetary variables to GDP shocks).[11] In the case of indirect taxes, the persistence of the shocks is more moderate, reflecting above all the relatively soft response of output to them (note that, as expected, there is also a strong positive reaction of indirect taxes to GDP). The low persistence of innovations in taxes has been frequently mentioned in recent articles looking at the effects of fiscal policy, and the results here are close to those, for example, in studies focusing on the Italian economy (Giordano *et al.*, 2008 and Caprioli and Momigliano, 2011). Social transfer shocks show a higher persistence than tax shocks, but a smaller one than shocks to compensation of employees (see section 4.2). Both expenditure on social transfers, fundamentally relating to pensions, and on salaries are aggregates more stable than taxes, and this could justify in part the greater persistence of their shocks.

10 As mentioned in section 3, the small dimension of the sample contributes to the imprecision of the estimates in a general way. In any case, the impulse-response functions from VAR models often show considerable imprecision, which arises as the consequence of imposing a minimum of restrictions (only those needed to identify the structural shocks).

11 The extrapolation from the evidence presented in section 5 to this context implicitly assumes that responses to endogenous GDP movements, referred to in the present section, are similar to the response to unanticipated shocks, analysed in that section.

The results point to a greater stimulus capacity, and similarly a more recessive impact, of changes in direct taxation than of changes in social transfers (and of both compared with indirect taxation). The cumulative one-year multiplier indicates that for each euro of fall in receipts from direct taxes, output would have expanded between 0.9 and 1.2 euros (depending on the relative ordering of revenue and expenditure variables); an identical increase in social transfers would have caused an expansion of around 60 cents (Tables 3 and C3). Looking at longer horizons, the discrepancy between the multiplier effects of the two variables widens, given that the direct tax shock decays, in comparative terms, much more quickly. These conclusions, however, are surrounded by additional uncertainty, for the confidence bands increase as the horizon extends. The cumulative one-year multiplier for indirect taxes indicates a contraction in economic activity of between 20 to 30 cents (depending on the relative ordering of revenue and expenditure variables) for each euro of total additional revenue.

The higher persistence of shocks to social transfers suggests that a stimulus to economic activity in the sample period would entail higher budgetary costs if put in place through them than through direct taxes. To evaluate this point, one calculated the impact on the primary balance of shocks to budgetary variables (not presented here), taking the combined responses of all these variables. The average cumulative impact on the primary balance from a shock to transfers remains close to the respective magnitude after one year; within a two to three year horizon there is a comparatively milder fall. Contrary to this, the equivalent impact on the primary balance of a direct tax shock shows a substantial waning after the first year, and this intensifies for longer horizons.[12] The smaller effect of changes in direct taxation on the budget balance is due not only to the lower persistence of the shock itself, but also a reversion of the initial effect on the balance brought about by the response of indirect taxes following the response of output. In the absence of a substantial effect on output, the impact profile of changes to indirect taxation on the primary balance is (for longer horizons) similar to that for transfers.

There is a vast literature on the effect of tax shocks on GDP and studies usually point to negative values over one year, though with a smaller magnitude than the size of the shock (see, for example, Spilimbergo *et al*., 2009, for a summary of the findings in the literature). Differ from these magnitudes, for instance, the results in Romer and Romer (2010), who found a negative effect similar to the magnitude of the shock one year ahead, but reaching three times that magnitude over time; and also the results in Perotti (2002), who reported positive (thus non-conventional) responses for some of the countries analysed in the initial quarters after the shock. In Portugal, there is very little literature on the effects of fiscal policy on economic activity using VAR models. Afonso and Sousa (2011) used quarterly data on a cash basis (1978:Q1-2007:Q4) for part of the general government sector, considering two alternative identification schemes, one recursive and the other close to the one used here. For the second of these identification schemes, the response of GDP is negative, reaching a maximum in the eighth quarter after the shock.[13] It is also worth noting the results obtained for Portugal by Almeida *et al*. (2011), for the impact of temporary budgetary measures based on a general equilibrium model (the PESSOA model), and therefore in a very different framework from the one used here. These results (converting the size of the shocks to 1 euro) point to annual shocks of 1 euro triggering in the first year responses of -40 cents for direct and indirect taxes, 20 cents for transfers to households in general, and 60 cents for transfers targeting families with liquidity constraints.

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12 The speed at which the impact of the shock to direct taxes on the primary balance wanes may be exacerbated by the predominance in the sample of shocks with temporary effects on receipts, in the case of the personal income tax. On the other hand, if permanent shocks tend to have a greater impact on output, there may be as well some underestimation of the response of this last variable to shocks in direct taxes.

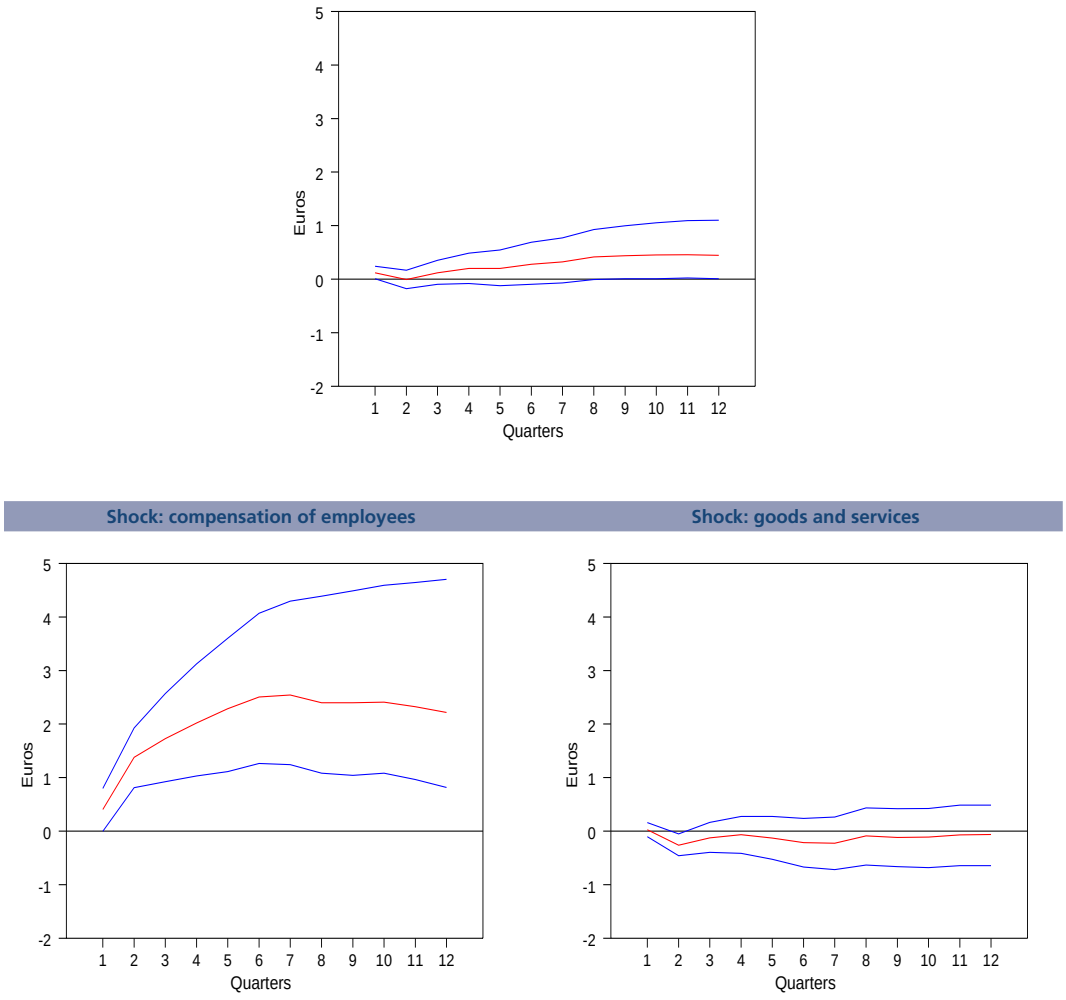
13 Marvão Pereira and Roca-Sagalés (2011) also analyse the effects of budgetary policy on economic activity in Portugal using a structural VAR model, but one with a recursive identification scheme and annual data (1980-2005).

4.2 Shocks to government consumption and components

The response of output to shocks to government consumption (Chart 2 and Tables 4, 5 and C1 to C3 in Appendix C) is positive, reaching a maximum of 30 to 50 cents at the end of around three years, but this is on the brink of statistical non-significance (Tables 5 and C2). The breakdown of government consumption into compensation of employees and expenditure on goods and services shows that this response is essentially determined by the combination of an expressive positive effect associated with expenditure on salaries with a negative response for the remaining expenditure.[14] Indeed, innovations in salaries have a large (and statistically significant) impact on economic activity: an initial change of 1 euro

Chart 2

OUTPUT RESPONSE TO SHOCKS TO GOVERNMENT CONSUMPTION AND COMPONENTS



Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. Expenditure variables are ordered before taxes. The response to shocks to government consumption is taken from a model that also includes taxes, social transfers and prices. Responses to shocks to compensation of employees and acquisition of goods and services are taken from a model that also includes taxes and social transfers (acquisition of goods and services is ordered before compensation of employees).

14 The response to innovations in government consumption as a whole seems to be more determined by this last component, despite its smaller weight (around 40 per cent), than by salaries. This may be due to the fact that expenditure on goods and services has unusually marked variations in some quarters, and these may operate as «influential observations» in the estimation process.

Table 4

SHOCKS TO GOVERNMENT CONSUMPTION AND COMPONENTS: VARIABLE'S RESPONSE | IN EUROS, POINT ESTIMATES

	Response			Average cumulative response		
	Government consumption	Compensation of employees	Goods and services	Government consumption	Compensation of employees	Goods and services
contemp.	1.0	1.0	1.0	1.0	1.0	1.0
1 year	0.3	0.8	0.1	0.5	0.8	0.3
2 years	0.1	0.5	0.0	0.3	0.7	0.2
3 years	0.1	0.6	0.0	0.2	0.6	0.1

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to chart 2 for the models used. The average cumulative response is calculated dividing the cumulative response by the number of quarters since impact.

Table 5

SHOCKS TO GOVERNMENT CONSUMPTION AND COMPONENTS: OUTPUT RESPONSE | IN EUROS, POINT ESTIMATES AND CONFIDENCE BANDS

	Response			Average cumulative response		
	Government consumption	Compensation of employees	Goods and services	Government consumption	Compensation of employees	Goods and services
contemp.	0.1	0.4	0.0	0.1	0.4	0.0
	(0,0; 0,2)	(0,0; 0,8)	(-0,1; 0,1)	(0,0; 0,2)	(0,0; 0,8)	(-0,1; 0,1)
1 year	0.2	2.0	-0.1	0.1	1.4	-0.1
	(-0,1; 0,5)	(1,0; 3,2)	(-0,4; 0,3)	(-0,1; 0,3)	(0,8; 2,0)	(-0,3; 0,1)
2 years	0.4	2.4	-0.1	0.2	1.9	-0.1
	(0,0; 0,9)	(1,0; 4,4)	(-0,6; 0,4)	(0,0; 0,5)	(1,1; 3,0)	(-0,5; 0,2)
3 years	0.4	2.2	-0.1	0.3	2.1	-0.1
	(0,0; 1,0)	(0,8; 4,6)	(-0,7; 0,5)	(0,0; 0,6)	(1,1; 3,5)	(-0,5; 0,2)
	Maximum (quarter)			Cumulative multiplier (1 year)		
	0,5 (11º)	2,5 (7º)	-0,3 (2º)	0.2	1.7	-0.3
	(0.0; 1.0)	(1.2; 4.2)	(-0.5; -0.1)	(-0.2; 0,6)	(1.0; 2.5)	(-1.1; 0.3)

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to chart 2 for the models used. The average cumulative response is calculated dividing the cumulative response by the number of quarters since impact; the cumulative multiplier is obtained dividing output and impulse-variable cumulative responses.

in this item results in a maximum increase of around 2.5 euros in GDP, after approximately half a year. A shock to expenditure on goods and services triggers a negative GDP impact, but the point estimate ceases to be statistically significant after the initial quarters.

The sign of output response to shocks in expenditure on goods and services is difficult to justify theoretically[15], and may stem from the way some of this expenditure is recorded in national accounts, which tends to hamper the estimation of the effect of such shocks on economic activity. For example, in the case of public-private partnerships the recorded expenditure has, by definition, a temporal profile that is completely distinct from the expenditure actually made, and only this later matters from the point of view of the impact on output. The same type of discrepancy can be seen in the transfers in kind that result from contractual payments from the State to corporate hospitals. Such contractual payments may not correspond, in terms of intra-annual profile and/or overall amount, to the actual disbursements made by the hospitals. This also goes for the acquisition of military equipment (that implies large one-off variations in intermediate consumption), recorded in national accounts only at the point of delivery. Moreover, where Portugal is concerned, such acquisition of military equipment has often an offsetting impact on imports, and thus a residual repercussion on economic activity.

15 A positive repercussion on output would indeed be expected in both a traditional Keynesian model and in a neo-classical model (Cavallo, 2005).

The persistence of shocks to compensation of employees (Tables 4 and C1) is greater than that of shocks to taxes and, to a lesser extent, to transfers (the persistence of innovations in government consumption as a whole is moderate, similar to what is observed for transfers). This evidence of slow decay of expenditure shocks is found in other studies, for example Blanchard and Perotti (2002), though this study finds levels of persistence globally higher than here. Burriel *et al*., (2009) provide evidence of lesser persistence of expenditure shocks in the euro area as a whole than in the US.

The response of output to shocks in compensation of employees decays slowly in line with the persistence of the shock itself. The cumulative one-year multiplier indicates an expansion of economic activity of 1.7 euros for each euro of total additional expenditure (Tables 5 and C3). This figure is in marked contrast to an expansion of only 10 to 20 cents (depending on the ordering of revenue and expenditure variables) at the end of one year for government consumption as a whole. Part of the impact of salaries on GDP stems, in a mechanical way, from the contribution to GDP of gross value added of general government sector that is fundamentally made up of salaries paid. Some of the studies in this area (for example, Caprioli and Momigliano, 2011) consider the effects of fiscal policy on private GDP. To assess the importance of this mechanical effect, the system used to gauge the effects of innovations in salaries was re-estimated, considering private GDP (that is, excluding from GDP the general government gross value added).[16] The multiplier effect of salary expenditure after one year, when calculated relative to private GDP, goes down to around 1.2 euros for each additional euro disbursed.[17]

In general terms, salaries are clearly more effective in stimulating economic activity in the short-term than transfers and slightly more effective than direct taxes. Over longer time horizons, direct taxes (a variable for which the persistence of output response clearly outdoes the persistence of the shock) tend to have a larger stimulus capacity than compensation of employees. The evidence set out in this section, together with the responses of private consumption presented in section 6, are compatible with an important role of disposable income in the transmission of the effects of fiscal policy to the economy. The relevance of this transmission channel is consistent with the extensive literature focusing on the behaviour of economic agents faced with tax shocks under natural tax experiments (see Johnson *et al*., 2006, and the references cited there). Such an evidence should be read bearing in mind that in short- to medium-term horizons as focused on in this article, the effects of budgetary policy operating through aggregate demand will tend, by their nature, to predominate over the effects on incentives and productivity, on the supply side.

The profile of the impact of shocks to compensation of employees on the primary balance for longer horizons deviates from what is suggested by their slow decay. Up to one year, the average cumulative variation of the primary balance stays close to the magnitude of the shock. Subsequently, however, there is a quicker decay than for transfers. This profile stems from the strong response of GDP (note that this takes nearly four quarters to build up) that brings about a positive response of taxes and contributes to revert the initial change in the balance. This evidence reinforces the conclusion that budgetary consolidation through transfers would lead, in the sample period under consideration, to less of an impact on economic activity than through salaries.

Generally speaking, the literature points to output responses to changes in government consumption larger than those triggered by changes in revenue, and of a rather differentiated magnitude (from slightly positive up to nearly 1.5 times the size of the shock after one year – see again Spilimbergo *et al*., 2009).

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16 There is no consensus in the literature on the definition of private GDP. There are studies that calculate this aggregate by subtracting total government consumption from GDP, and not just gross value added of general government. Such an approach is not fully adequate, given that only shocks to compensation of employees (not to expenditure on goods and services) have an automatic repercussion on GDP.

17 To get an idea of the relationship between the multipliers of compensation of employees relative to GDP and private GDP, the first multiplier would be equal, in a Keynesian model with a closed economy and constant interest rate, to the reciprocal of the marginal propensity to save, while the second multiplier would be equal to the first multiplier multiplied by the marginal propensity to consume.

In addition, a number of articles find a weakening of the effects of fiscal policy from the 80s onwards, in terms of both revenue and expenditure (Perotti, 2002 or Pereira, 2012). For Portugal, Afonso and Sousa (2011) obtain non-conventional responses up to two years after the shock (for the identification scheme similar to the one used in this article). These authors, as already mentioned, make use of cash data covering only part of the general government sector, which may cause problems especially in the estimation of expenditure shocks, and may be one of the factors giving rise to significant differences from this study. The simulations carried out using the PESSOA model - Almeida *et al.*, (2011) - point to annual shocks in government consumption having a one-to-one effect on output in the first year.

4.3 Different output elasticities of taxes

Bearing in mind that there is a high degree of uncertainty in the calibration of contemporaneous quarterly elasticities of taxes and that some of the literature has highlighted the sensitivity of results for other countries to this calibration (Caldara and Kamps, 2008), this section provides a robustness analysis to using different elasticities. As mentioned in section 3.1, the values included in the model are significantly lower than the elasticities based on annual data for Portugal, mainly due to the hypothesis of non-reaction of the corporation income tax to output and the slight reaction of employment to GDP within the quarter. Therefore, the elasticities calculated with annual data can be seen as an upper ceiling for quarterly elasticities. The robustness exercise is carried out in this context (no information is available on alternative quarterly output elasticities of taxes for Portugal that could be used instead). The robustness analysis takes into account the figures used for the calculation of cyclically adjusted balances in the European System of Central Banks (ESCB), Braz (2006), and in the OECD, Girouard and André (2005) – see table 6.

Chart 3 compares the results presented in section 4 with those obtained from estimations with the alternative elasticities. The profile of the impulse-response functions following shocks to total taxes and to direct taxes remains virtually unchanged. With the OECD elasticities, and even more so with the ESCB ones, there is an overall downward shift in the impulse-response functions that amplifies the multiplier effect of the shocks. In fact, assuming higher positive contemporaneous output elasticities of taxes, given the contemporaneous correlation between the residuals of the reduced-form equations of taxes and output, leads to a more negative contemporaneous impact of taxes on GDP. The output response over time remains anchored to this more negative figure in the quarter of impact.

However, it is important to highlight the fact that, despite the consideration of very distinct elasticities, the maximum response to shocks on direct and indirect taxes moves from -30 and -70 cents, respectively, in the specification in table 3, to -50 and -90 cents, respectively, in the model that includes the ESCB elasticities. Given that annual tax elasticities should be viewed as an upper limit for the quarterly ones, the main results in the article are particularly robust to the variation in the size of elasticities.

Table 6

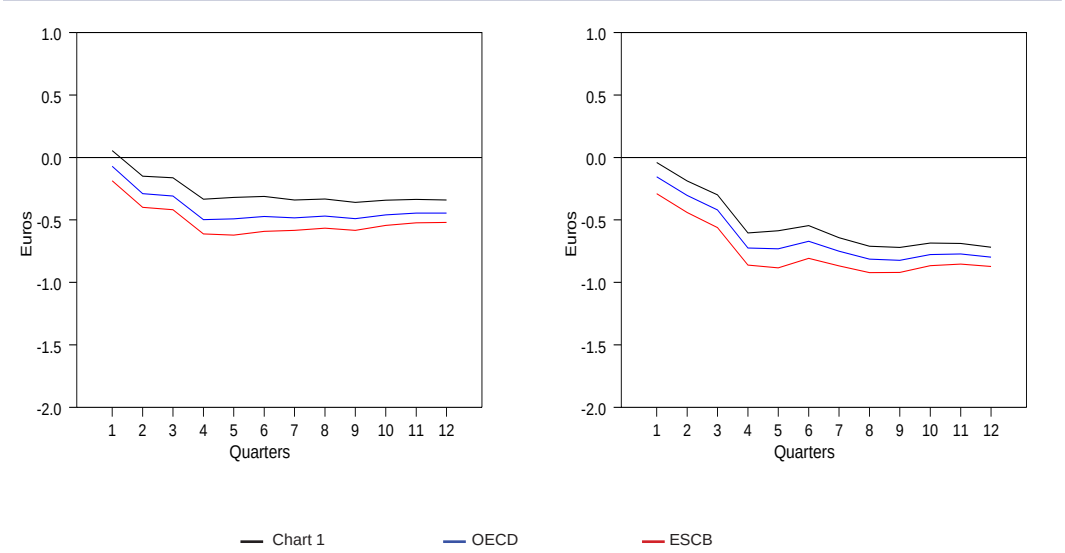
ELASTICITIES OF TAXES TO GDP – ALTERNATIVE APPROACHES

	OECD (annual)	ESCB (annual)	*Memo: Table 1*
Taxes[a]	1.1	1.5	*0.6*
Direct taxes[a]	1.2	1.6	*0.4*
Indirect taxes	1.0	1.5	*1.0*

Source: Authors' calculations and references quoted in the text.
Nota: (a) Sample averages.

Chart 3

OUTPUT RESPONSES TO TAX SHOCKS - DIFFERENT CONTEMPORANEOUS ELASTICITIES | POINT ESTIMATES



Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to chart 1 for the models used.

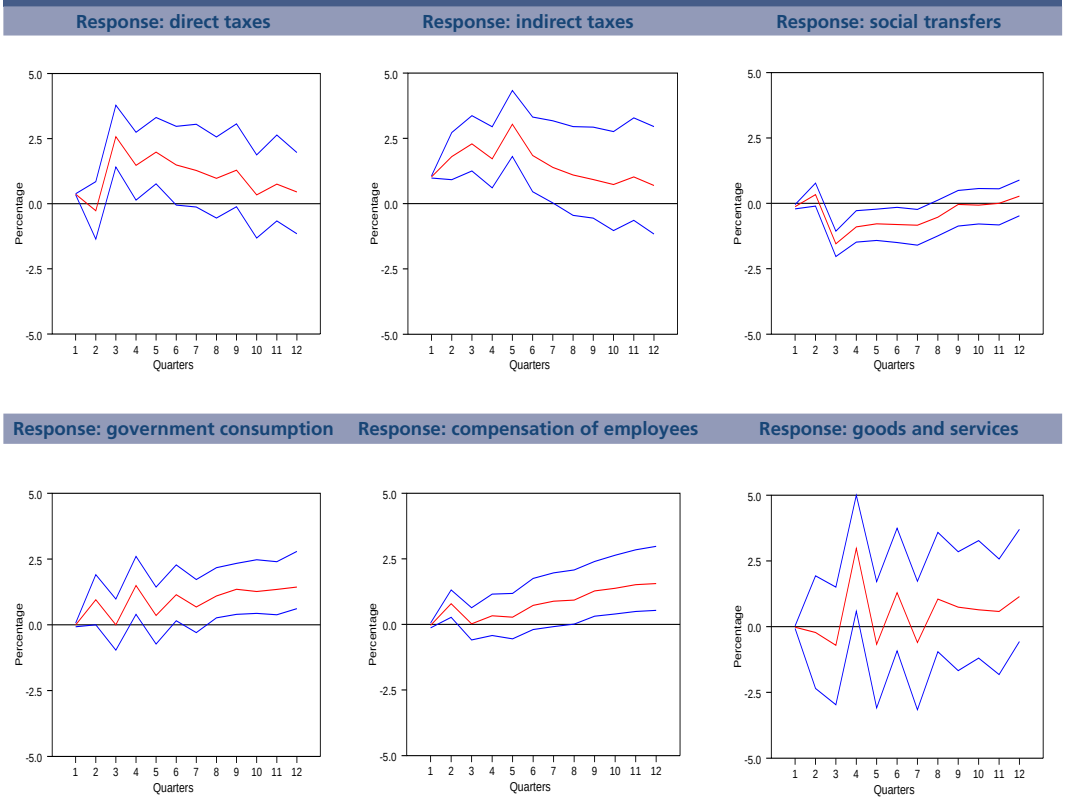
5. Evidence concerning automatic and discretionary stabilization

This section presents evidence on the fiscal policy role in the automatic and discretionary stabilization of the economy that can be inferred from the models used earlier. More specifically, the focus is on the responses of fiscal variables to exogenous shocks in output and on the variance decomposition of forecasting errors for those variables. These results complement those presented before to the extent that they can be extrapolated for the reaction of public finance aggregates to endogenous movements in output, which has a considerable influence on the value of cumulative multipliers. It is important to mention that the contemporaneous reaction to GDP shocks is largely determined by the calibrated elasticities: positive for shocks in taxes, negative but close to zero for shocks in social transfers and nil for shocks in government consumption or in its components. More informative is the response to GDP shocks of these variables in the medium term, which will stem from the combination of the automatic and discretionary reactions of budgetary policy to fluctuations in output.

As might be expected, taxes show a positive reaction to shocks in GDP (Chart 4), and social transfers have a negative reaction, both of them holding their statistical significance up to around two years after the shock. In the case of direct taxes and transfers, the responses only begin to form after the second quarter, a fact that seems to confirm the low contemporaneous elasticities chosen in the calibration. In addition, the growth of these responses up to the fourth quarter corroborates the assumption put forward that the annual budgetary elasticities would be higher than quarterly ones. The response of taxes is likely to reflect first and foremost its automatic stabilization role. One measure of the importance of this function is given by the weight, in the medium term, of GDP shocks in the variance decomposition of the respective forecasting errors (not presented here): around 50 per cent for direct taxes and 70 per cent for indirect taxes. The stabilization role played by indirect taxes is greater than that of direct taxes: the average cumulative response of these variables to a shock of 1 percent in GDP comes in, respectively, at 1.7 and 1.0 percent after one year (1.8 and 1.2 percent, respectively, after two years). For transfers, the weight of output in the variance decomposition is lower, though also relevant (over 30 per cent). Note that, not only unemployment-related benefits, but also other components of transfers, such as means-tested benefits (for example, Rendimento Social de Inserção), may be counter-cyclical. In addition, shocks in prices have a major role in the variance decomposition for direct taxes and transfers, more

Chart 4

RESPONSES OF FISCAL VARIABLES TO OUTPUT SHOCKS



Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. See notes to charts 1 and 2 for the models used.

than 40 and 50 per cent, respectively, signalling dependence on past inflation (note that the variables are deflated by a contemporaneous deflator).

The positive, and therefore pro-cyclical, response of government consumption to GDP shocks fundamentally reflects the response of compensation of employees. This evidence that discretionary budgetary policy has not had a stabilizing effect on economic cycles is in line with a number of studies that have analysed the cyclical stance of budgetary policy in Portugal (for example, Pina, 2004 and Cunha and Braz, 2009). More surprising is the degree of endogeneity of salaries to fluctuations in output, whose weight in the variance decomposition stands at around 50 per cent, being higher than the weight of inflation (approximately 30 per cent). The importance of the macroeconomic shocks to the variance decomposition of government consumption has a similar size. By way of comparison, Pereira (2009) obtains for the US a joint weight for innovations in output and in prices in the variance decomposition for government consumption which, in the sampling period when it is higher, stood at around 25 per cent.

The positive response of compensation of employees to shocks in GDP begins to form, at a slow pace, from the third quarter, this being aligned with a centralized process of pay scale updating in the public sector that reacts with a significant lag, not least due to its annual nature, to movements in economic activity.[18] In the sample two distinct periods can be identified in the way the relationship between movements in GDP and compensation of employees has materialized. The first period relates fundamentally to the second half of the 1990s, characterized by an expansion in the number of public servants, with a

18 For a description of the public sector labour market in Portugal, see *"The Portuguese Economy in the Context of Economic, Financial and Monetary Integration"* chap.6, 2009, Economics and Research Department, Banco de Portugal.

significant impact on salaries, against a buoyant GDP growth. The following period is marked by changes in human resources management in general government with the introduction – at different stages and with occasional exceptions – of restrictions to employees' hiring and freezes of salaries and promotions. These policies were put in place in circumstances marked by low growth or even output contraction, thus also giving a pro-cyclical slant to public sector expenditure on salaries.

6. The impact of fiscal shocks on GDP components

An analysis was undertaken in order to come to a better understanding of the impact of fiscal shocks on private sector activity. One looked at the responses of total private consumption and durable and non-durable goods consumption, on the one hand, and total private investment and non-residential and residential investment, on the other.[19] Only the impulse-response functions more meaningful in terms of economic interpretation are shown. The responses of private consumption and investment are measured in euros. In contrast, the effects of budgetary policy on the different components of these aggregates (which have very different magnitudes) are given as a percentage of the response-variable since this makes it possible to get a more accurate comparison of their sensitivity to fiscal shocks.

Private consumption tracks GDP in terms of its reaction to budgetary innovations (Chart 5): negative to shocks in taxes and positive to shocks in social transfers and compensation of employees. This is consistent with an important role of disposable income in the transmission of budgetary policy shocks, as mentioned above. However, only the response of compensation of employees has clear statistical significance. The trajectory of private consumption following shocks to government consumption is fundamentally nil, differing very little from the GDP response. One should recall the points made in section 4.2 about the recording of expenditure on goods and services in national accounts, which make it difficult to measure the impact of changes in this item, and consequently in government consumption, on macroeconomic aggregates.

For the purpose of comparing the effects of budgetary innovations on private consumption of durable and non-durable goods, chart 6 illustrates the responses of these variables, in percentage terms, to a shock of 1 percent in the impulse-variable. The evidence points to shocks in taxes, social transfers and compensation of employees having a bigger impact on the consumption of durable than of non-durable goods. This result is in line with a relatively more elastic demand for durables or, in other words, a demand more sensitive to changes in households' disposable income.

As for the effects of fiscal shocks on private investment (not presented here), the results point to an absence of response to innovations in taxes and social transfers. In turn, salaries have a positive but not statistically significant effect during the sample period on this component of aggregate demand. One feature to be borne in mind in the analysis is the limited importance, during this period, of the traditional channel of response of private investment to fiscal shocks (positive to shocks on the revenue side and negative to shocks on the expenditure side), through the interest rate. Indeed, given the readiness of non-residents to finance the Portuguese economy, the variation of public indebtedness may well have had a comparatively low repercussion on the private sector financing costs. It should be noted that there has been a considerable change in the financing conditions of the economy, and this could lead to an upsurge in the importance of the interest rate channel in the transmission of fiscal policy to private investment.[20]

A distinct analysis of residential and non-residential investment could be of greater interest, since their determinants are partly distinct. The first is mainly composed of household investment in homes, so that

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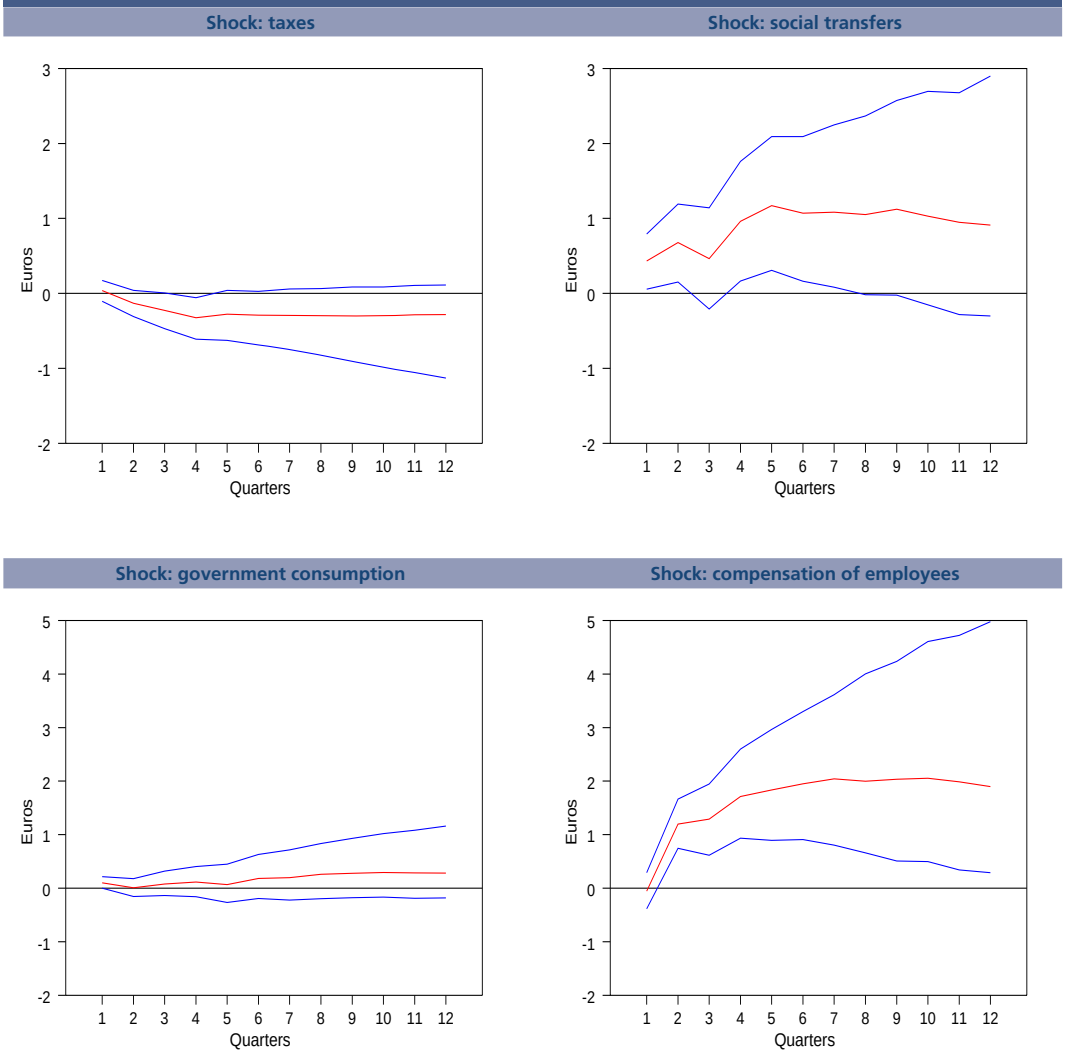
19 This breakdown of consumption and investment is similar to that used in other studies, such as Ramey and Shapiro (1998) and, more recently, in Mountford and Uhlig (2009) and in Romer and Romer (2010).

20 An upsurge of the interest rate channel, if it would happen, would lead to a reduction in the size of the fiscal multipliers in comparison with the previous period.

Chart 5

RESPONSES OF PRIVATE CONSUMPTION TO FISCAL SHOCKS



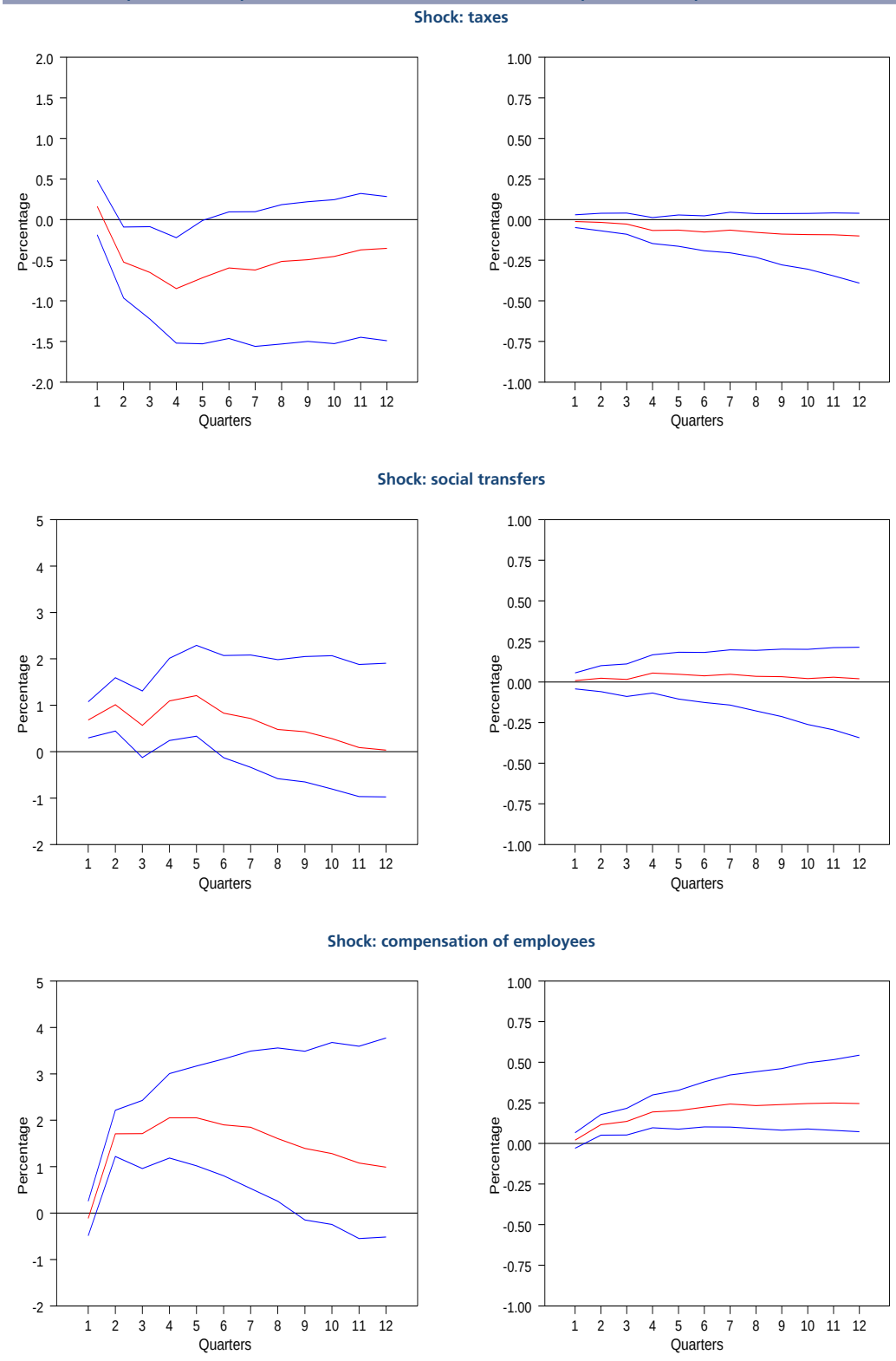
Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. The models used are identical to those underlying charts 1 and 2 but including private consumption, except in the case of shocks to compensation of employees for whose model taxes are taken net of transfers, in order to limit the number of variables in the system.

a response to fiscal shocks close to the one for private consumption of durable goods would be expected. The results, in fact, point to effects of the same sign in the case of shocks in taxes and in salaries although now not statistically significant, except for a brief period of one or two quarters roughly one year after the shock (Chart 7). The innovations in transfers, which had a significant effect on the consumption of durable goods, do not have a relevant impact on residential investment (not presented here), and this can be explained by the fact that these transfers are to a significant amount channelled to pensioners, who are likely to be less prone to opt for investment in homes.

Concerning non-residential investment, there is literature (see Romer and Romer, 2010, and references cited there) that singles out macroeconomic conditions as an important factor influencing investment decisions of firms. Along these lines, the budgetary shocks which were previously noted to have had expansionary effects would tend, through these effects, to lead to an increase in non-residential invest-

Chart 6

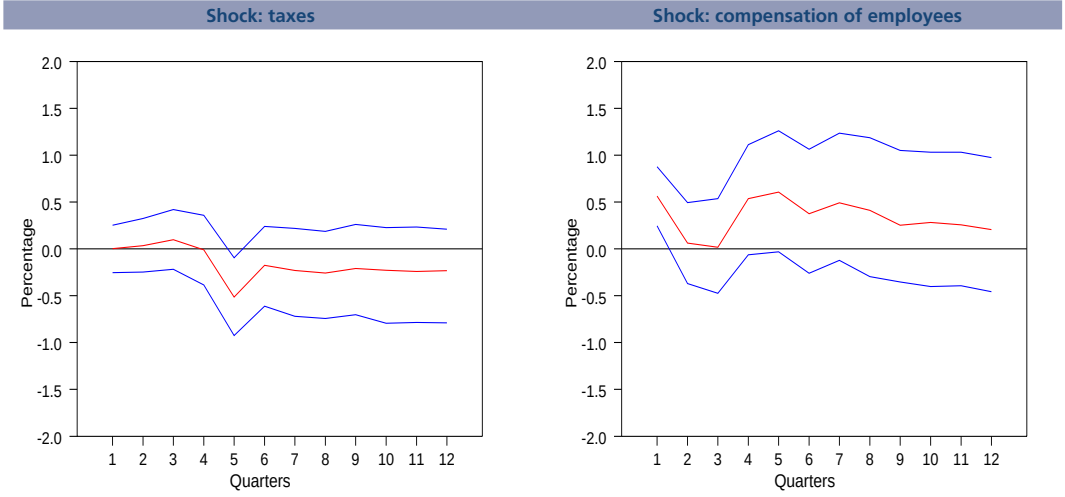
RESPONSES OF PRIVATE CONSUMPTION OF DURABLE AND NON-DURABLE GOODS TO FISCAL SHOCKS



Source: Authors' calculations.
Notes: Shocks have the size of 1 percent of impulse-variable; note the difference in the scales for consumption of durables and non-durables. The models used are identical to those underlying chart 5, but considering private consumption of durable and non-durable goods.

Chart 7

RESPONSES OF RESIDENTIAL INVESTMENT TO FISCAL SHOCKS



Source: Authors' calculations.
Notes: Shocks have the size of 1 percent of impulse-variable. The models used are identical to those underlying chart 5, but considering residential investment.

ment.[21] Moreover, there are studies which find a negative relationship between this variable and changes in the direct taxes paid by corporations (Djankov *et al.*, 2010). The sample period includes measures of this type (Cunha and Braz, 2009). Note that the two mentioned transmission channels imply an identical sign for the effects of shocks in direct taxes on non-residential investment. The response of this variable is indeed negative to shocks in direct taxes, starting to build up only towards the end of one year and not reaching statistical significance. The response to shocks in compensation of employees is positive and not significant (Chart 8). It is important to note that the estimated impact of shocks in indirect taxes (not presented here) is positive. This result - difficult to justify - offsets the response to shocks in direct taxes, leading to a fundamentally nil path of non-residential investment following shocks in taxes as a whole.

7. Inclusion of public debt dynamics

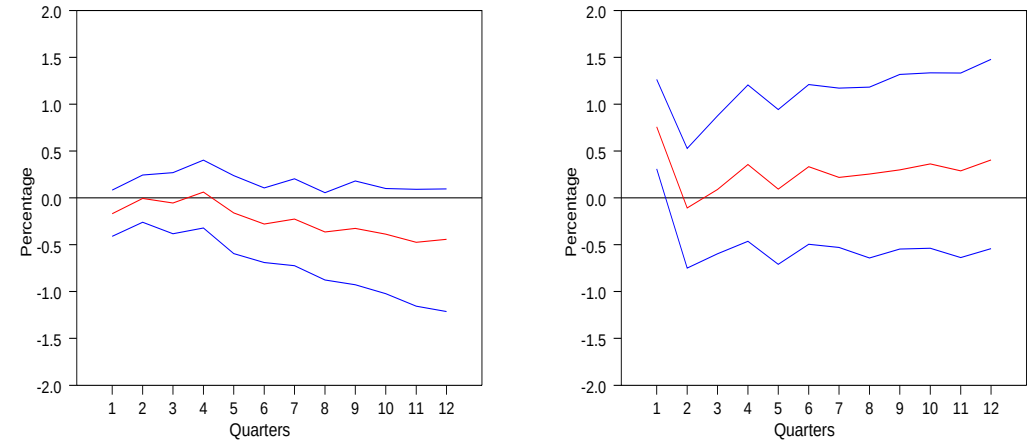
One of the criticisms that can be levelled against the models estimated in earlier sections relates to the fact that they do not incorporate the possibility that the effects of fiscal policy depend on the initial budgetary situation, *i.e.* that government and economic agents react in different ways to situations characterized by dissimilar levels of pressure on the sustainability of public finances. Favero and Giavazzi (2007) sustain that the inclusion of public debt dynamics has an impact on the estimation of multipliers. Some articles, such as Burriel *et al.*, (2009) report that such inclusion bolsters the size and persistence of the estimated effects.

With the aim of incorporating debt dynamics, one included in the earlier models the short-term interest rate on public debt, as an endogenous variable, and the lagged debt-to-GDP ratio, as an exogenous variable (the definition of these variables is set out in Appendix A). The variation in the debt ratio is linked to the endogenous variables in the system through the usual identity with the deficit. In the simulation of the impulse-responses, the path of the debt ratio is calculated on the basis of this identity and, at the

21 Under the assumption of a reduced importance of the traditional interest rate channel in the transmission of fiscal policy to investment during the sample period, a channel which, it should be noted, would imply an opposite effect of fiscal shocks.

Chart 8

RESPONSES OF NON-RESIDENTIAL INVESTMENT TO FISCAL SHOCKS



Source: Authors' calculations.
Notes: Shocks have the size of 1 percent of impulse-variable. The models used are identical to those underlying chart 5, but considering non-residential investment.

same time, feedback effects of debt on the remaining variables are considered (for more details, see the mentioned bibliography).

The responses of GDP to shocks in total taxes and salaries (Table 7) indicate a smaller impact comparing to the values reported in section 4 (Chart 1 and Tables 3 and 5), which is the opposite to the evidence presented by Burriel *et al*., (2009) for the euro area. In turn, the impulse-response functions to shocks in social transfers and in government consumption have rather different profiles from the ones presented earlier, and there is a complete loss of statistical significance. Despite the differences mentioned, the estimated responses with the inclusion of debt dynamics are situated within the confidence bands estimated without its inclusion, with the exception of those relating to shocks in government consumption and in taxes from the sixth quarter after the shock.

In short, the models that allow for the conduct of budgetary policy to react to public debt may have a sounder theoretical foundation but, in the case of Portugal, this approach tends to reduce the magnitude and blur the precision of the estimates. It was examined whether the data did in fact favour the inclusion of the debt ratio in the model, and one concluded that there was only flimsy evidence to support this. Indeed, the coefficient of the lagged debt ratio in the reduced-form equations for the fiscal variables is only significant (at 5 per cent) in the case of salaries. It may be that the linear modelling of government's response to public debt, which has been used in the literature, is less than suitable, as that response could be strongly asymmetric (nil for a low debt to GDP ratio and very high for values above a certain threshold considered unsustainable).

Table 7

OUTPUT RESPONSE TO FISCAL SHOCKS - MODEL WITH DEBT FEEDBACK | IN EUROS, POINT ESTIMATES

	Taxes	Social transfers	Government consumption	Compensation of employees
contemp.	0.0	0.2	0.0	0.4
1 year	-0.3	0.0	0.0	1.5
2 years	0.0	0.3	-0.1	1.3
3 years	0.3	0.5	-0.4	1.2

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. The models used are identical to those underlying charts 1 and 2, but including the short-term interest rate on public debt and the lagged debt-to-GDP ratio (as an exogenous variable).

8. Conclusions

In this study, the structural VAR approach has been used to study the effects of fiscal shocks on economic activity in Portugal, based on quarterly data for the period 1995:Q1-2011:Q4. The output responses reveal quite distinct effects depending on the budgetary items, although almost all responses showed conventional signs, and have magnitudes that fit in the intervals arising from the results of a very large number of studies in this area. The persistence of fiscal shocks also varies substantially, with a lower persistence of innovations relating to taxes, particularly to direct taxes, compared to innovations on the expenditure side.

In the sampling period, salaries and direct taxes stand out for a larger multiplier impact on economic activity than the other variables analysed. It follows that a fiscal stimulus through salaries and direct taxes would involve a relatively smaller budgetary cost, a result reinforced over time by the waning of the initial repercussion on the primary balance of shocks, stemming from the response of other budgetary variables to output expansion. Conversely, changes in indirect taxation and (to a lesser extent) in transfers would tend to minimize the impact of a fiscal consolidation on economic activity.

It is important to mention again that an extrapolation of the evidence in this study to current circumstances demands additional caution, over and beyond that required from methodological limitations inherent to structural VAR modelling. Current circumstances can, in fact, be characterized by structural breaks in the macroeconomic relationships comparing to the sample period, which may be particularly acute in the case of Portugal, and that will tend to affect the transmission of fiscal policy to the economy. The grounds for this supposition can, for example, be found in the literature that posits an intensification of the effects of fiscal policy in periods characterized by a deep economic recession,[22] by a reduction in the effectiveness of monetary policy when reaching the lower zero bound[23], and by a high degree of synchronisation of fiscal policy in different countries. In this context, there may be a lower probability that beneficial effects of fiscal consolidation on growth are felt in short-term, which some literature associates to consolidation programmes aiming to correct large imbalances and ensure a sustainable path of public finances.[24] These beneficial effects are more likely to be seen in the medium to long term. Given this, it is crucial to highlight the considerable dependency of the fiscal multipliers on the specific context where a particular budgetary policy is implemented, and the added uncertainty as to the size of the multipliers at the present time.

Apart from this, it must be taken into account that the choice of the fiscal instruments to be used as part of a stimulus or consolidation package has much broader implications than what is subject of analysis in this article. In fact, one does not consider issues such as those relating to long-term incentives and productivity, the provision of public goods and income distribution, among others that have repercussions on the potential growth of the economy and on the level of society's well-being. In this context, the multipliers must be understood fundamentally as useful tools to anticipate the effects of budgetary policies on GDP, a task which will always be surrounded by a great deal of uncertainty.

Concerning future research applied to Portugal along this strand, it could be pertinent to apply the methodology in this article to a set of comparable data relating to a range of European countries, and the comparison of the results with what has been presented. Indeed, there is evidence that the multipliers can differ greatly from country to country. Another possible extension could be to follow the narrative

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22 For example, Auerbach and Gorodnichenko (2012) find evidence of higher budgetary multipliers in periods of recession.

23 When approaching the zero lower bound, the interest rate tends to respond less to fiscal policy shocks and the fiscal multipliers will therefore be higher (see Christiano *et al*., 2011 for a discussion using the results from a dynamic general equilibrium model).

24 In particular, through the effects on confidence and expectations of economic agents and the stability of financial systems (Alesina *et al*., 2012, Corsetti *et al*., 2012 and Iltzezki *et al*., 2011).

approach, such as in Romer and Romer (2010), to analyse the output effects of changes in taxation in Portugal. Such work is all the more important given the uncertainty surrounding the results presented here and the dearth of studies on fiscal multipliers for Portugal.

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Appendix A: Data

MACROECONOMIC VARIABLES			
Series	**Source**	**Definition**	**Seasonal adjustment**
GDP	INE	GDP at market prices	INE
GDP deflator	INE		INE
Private consumption	INE	Final consumption expenditure of houlseholds and NPISH[a]	INE
Private consumption of non-durables	INE	Final consumption expenditure of resident houlseholds in non-durable goods and services plus final consumption expenditure of NPISH.	INE
Private consumption of durables	INE	Final consumption expenditure of resident houlseholds in durable goods.	INE
Private investment	INE	Gross fixed capital formation by institutional sector - sectors S11, S12 and S1M (S14+ NPISH)	X12 Arima SEATS
Non-residential investment	INE	Gross fixed capital formation by institutional sector - sectors S11 and S12	X12 Arima SEATS
Residential investment	INE	Gross fixed capital formation by institutional sector - sector S1M (S14+ NPISH)	X12 Arima SEATS
Short-term interest rate on general government debt[b]	BP, authors	*Taxa de Base Anual* until December 2009; from January 2010 onwards calculated by the authors from interest rates on *Bilhetes de Tesouro*.	-

Source: Authors' calculations.
Nota: (a) NPISH - Non-profit institutions serving households. **(b)** Variable used only in models in section 7.

FISCAL VARIABLES [a]				
Series	**Source**	**Adicional corrections**	**Seasonal adjustment**	**ESA95 operation code**
Current taxes on income and wealth (IRP)	INE	securitization	X12 Arima SEATS	REC_D5
Actual social contributions	INE	securitization	X12 Arima SEATS	REC_D611
Taxes on production and imports (IPI)	INE	securitization	X12 Arima SEATS	REC_D2
Social benefits other than social transfers in kind (PS)	INE	-	X12 Arima SEATS	PAY_TRD62
Final Consumption Expenditure (CP)	INE	-	X12 Arima SEATS	PAY_P3
Gross fixed capital formation (IP)	INE	-	X12 Arima SEATS	PAY_TRP51
Compensation of employees (Rem)	INE	transformation of hospitals into public corporations	X12 Arima SEATS	PAY_TRD1
General government debt[b]	BP, authors	calculated from State debt before December 1999	-	-

Source: Authors' calculations.
Note: (a) Fiscal variables were calculated from the above mentioned series: Direct taxes (ID) = IRP + CS; Indirect taxes (II) = IPI; Taxes(I) = ID + II; Social Transfers (T) = PS; Government Consumption (G) = CP + IP; Compensation of Employees = Rem; Aquisition of goods and services = G– Rem. **(b)** Variable used only in models in section 7.

Appendix B: Details on the calculation of elasticities

Elasticity of direct taxes

Based on the OECD methodology, the elasticity of direct taxes to output and prices are obtained, in each quarter, as a weighted average of elasticities for the personal income tax (IRS), the corporation income tax (IRC) and social contributions. The elasticity of each of those components is separately calculated using the following equation:

$$ely_{VO_i} = elBM_{VO_i} ely_{BM_i}$$

where VO_i is the fiscal variable i and BM_i its macroeconomic base. The elasticity of each tax to the respective macroeconomic base ($elBM_{VOi}$) follows mainly from the characteristics of the tax system.

As regards the personal income tax and social security contributions, the macroeconomic base considered is the wage bill (derived from employment and wage series). The values reported for Portugal in Girouard and André (2005), respectively, 1.7[25] and 1.0, were used for the elasticity of these taxes to the wage. The elasticity of the wage bill to GDP (ely_{BMi}) is estimated with quarterly data through regressions of wages on employment and of employment on GDP, in first differences of logarithms, including 4 lags and a constant (following Blanchard and Perotti, 2002)[26]. The results indicate contemporaneous elasticities of wages to employment and of employment to GDP of, respectively, 0.7 and 0.3. The calculation of the elasticity of the personal income tax assumes that the fraction of revenue coming from the public sector wage bill has zero output elasticity. The elasticity of the personal income tax and social security contributions to prices is calculated by subtracting 1 to the elasticity of these taxes to the wage given above (Perotti, 2002). It is further assumed that the fraction of personal income tax revenue coming from the public sector wage bill has (in real terms) an elasticity of -1 relative to prices.

The most frequently used macroeconomic base for the corporation income tax is the gross operating surplus (GOP), to which a unitary elasticity of the tax (in annual terms) is usually assumed. However, given that the revenue from this tax in Portugal is primarily related to previous years' profits[27], one posits a zero elasticity of the tax to quarterly GOP. By the same token, a zero elasticity (unitary negative, for real revenue) is assumed in relation to prices.

Elasticity of indirect taxes

Regarding the elasticity of indirect taxes to output, a unitary elasticity to GDP is considered, as in Girouard and André (2005), taking into account the proportionality of most taxes that compose this aggregate, and the lack of information on the impact of changes in indirect taxation occurred in the sample period. As VAT, the most important tax in this group, is *ad valorem*, one posits a zero elasticity of real revenue to prices.

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25 The source of this figure is Neves and Sarmento (2001), and this was later maintained in Braz (2006).

26 Only private wages and employment are considered.

27 In Portugal, firms make pre-payments in year *t* on the basis of the tax liability for *t-1* and make balance payments in *t+1* for the difference between the tax liability for *t* and the pre-payments made.

Elasticity of social transfers

Regarding social transfers, it is considered that only the expenditure related to unemployment responds to cyclical developments, which is an assumption commonly used in the procedures of cyclical adjustment of budgetary series. In fact, although social transfers not related to unemployment, but which involve means testing, may bear a relationship with economic activity, such a relationship within the quarter is difficult to sustain.

Assuming that the ratio of subsidized unemployment in total unemployment remains constant and not considering the cyclical behavior of the participation rate in the labor market, the elasticity of social transfers to GDP (*elyT*) can be obtained through the relationship:

$$ely_{Tt} = (\frac{D_{des}}{D_T})_t \, ely_{txdes} \, \frac{1}{txdes_t}$$

where (D_{des}) is that the share of expenditure on social transfers related to unemployment, *txdes* is the unemployment rate and ely_{txdes} the semi-elasticity of the unemployment rate to GDP (see Pereira, 2009). This semi-elasticity was estimated by a regression of the unemployment rate on the logarithm of GDP, in first differences, including 4 lags and a constant (yielding a value of -0.13).

Regarding the elasticity of social transfers to prices (elp_T), one posits the value of -1 for real spending as such transfers are in general not contemporaneously indexed to inflation.

Elasticity of public consumption and components

It is assumed that the elasticity of public consumption to output (ely_G) is zero, since one does not expect a response of any of its components to economic activity within the quarter.

Regarding the elasticity of public consumption to prices (ely_G), a methodology similar to that used for direct taxes is followed, this elasticity being obtained, in each quarter, as a weighted average of elasticities for expenditure on salaries and on goods and services. It is considered that salaries in the public sector are not contemporaneously indexed to inflation, which leads to a value of -1 for its elasticity in real terms. Regarding spending on goods and services, while the price of goods and services purchased may evolve with inflation, a portion of the aggregate will be determined by the amount actually budgeted, thus not reacting to prices (elasticity equal to - 1), while the remainder, including for example health co-payments, will accompany movements in inflation (elasticity equal to 0). As an approximation, the elasticity of expenditure on goods and services to prices is set to -0.5.

Appendix C: Responses to fiscal shocks with taxes ordered before expenditure variables

Table C1

AVERAGE CUMULATIVE VARIABLE'S RESPONSE, ALTERNATIVE ORDERING | IN EUROS, POINT ESTIMATES

	Direct taxes	Indirect taxes	Social transfers	Government consumption	Compensation of employees	Goods and services
contemp.	1.0	1.0	1.0	1.0	1.0	1.0
1 year	0.3	0.4	0.5	0.4	0.8	0.3
2 years	0.2	0.2	0.4	0.2	0.7	0.1
3 years	0.1	0.1	0.4	0.2	0.6	0.1

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. The models used are identical to those underlying charts 1 and 2, but with taxes ordered before expenditure variables.

Table C2

GDP RESPONSE, ALTERNATIVE ORDERING | IN EUROS, POINT ESTIMATES

	Direct taxes	Indirect taxes	Social transfers	Government consumption	Compensation of employees	Goods and services
contemp.	-0.1	0.1	0.4	0.1	0.5	0.0
1 year	-0.6	-0.1	0.4	0.0	1.8	-0.3
2 years	-0.9	-0.2	0.4	0.2	2.5	-0.3
3 years	-1.0	-0.4	0.3	0.3	2.3	-0.2
Max. (quarter)	-1,0 (13º)	-0,4 (18º)	0,6 (5º)	0,3 (13º)	2,5 (7º)	-0,4 (7º)

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. The models used are identical to those underlying charts 1 and 2, but with taxes ordered before expenditure variables.

Table C3

AVERAGE CUMULATIVE GDP RESPONSE AND CUMULATIVE MULTIPLIER, ALTERNATIVE ORDERING | IN EUROS, POINT ESTIMATES

	Average cumulative GDP response					
	Direct taxes	Indirect taxes	Social transfers	Government consumption	Compensation of employees	Goods and services
contemp.	-0.1	0.1	0.4	0.1	0.5	0.0
1 year	-0.3	-0.1	0.2	0.0	1.4	-0.2
2 years	-0.5	-0.2	0.3	0.1	1.9	-0.3
3 years	-0.7	-0.2	0.3	0.1	2.1	-0.3
	Cumulative multiplier (1 year)					
	-0.9	-0.3	0.5	0.1	1.7	-0.9

Source: Authors' calculations.
Notes: Shocks have the size of 1 euro. The models used are identical to those underlying charts 1 and 2, but with taxes ordered before expenditure variables.