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# ISSUE FOR DISCUSSION

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

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

Manuel Coutinho Pereira\*\* | Lara Wemans\*\*

## 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<sup>1</sup>, 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

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

2002 on<sup>2</sup>. The budget series were also taken in logarithms and deflated with the GDP deflator.<sup>3</sup> 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.<sup>4</sup> 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

<sup>2</sup> 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.

**<sup>3</sup>** 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.

**<sup>4</sup>** 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:

$\begin{bmatrix} 1 \\ 0 \\ 0 \\ r_{41} \\ r \end{bmatrix}$	0 1 0 r <sub>42</sub>	0 0 1 r <sub>42</sub>	ely <sub>I</sub> ely <sub>T</sub> ely <sub>G</sub> 1	elp <sub>I</sub> elp <sub>T</sub> elp <sub>G</sub> 0	$\begin{bmatrix} u_t^I \\ u_t^T \\ u_t^G \\ u_t^G \\ u_t^y \\ u_t^y \end{bmatrix}$	$=\begin{bmatrix} 1\\0\\0\\0\\0\end{bmatrix}$	b <sub>12</sub> 1 0 0	b <sub>12</sub> b <sub>23</sub> 1 0	0 0 0 1	0 0 0 0	$\begin{bmatrix} e_t^T \\ e_t^T \\ e_t^G \\ e_t^G \\ e_t^Y \\ e_t^T \end{bmatrix}$	,
$r_{51}$	$r_{52}$	$r_{53}$	$a_{54}$	1 ]	$u_t^p$	L <sub>0</sub>	0	0	0	1 <sup>]</sup>	$e_t^p$	

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,<sup>5</sup> 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

<sup>5</sup> 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*).<sup>6</sup> 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.<sup>7</sup> 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

QUARTERLY ELASTICITIES OF FISCAL VARIABLES						
	GDP	Prices				
Taxes <sup>(a)</sup>	0.6	-0.1				
Direct taxes <sup>(a)</sup>	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 <sup>(a)</sup>	-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.

Table 1

**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.<sup>8</sup> 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.<sup>9</sup> 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 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

<sup>8</sup> 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.

**<sup>9</sup>** 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.



### Source: Authors' calculations.

Quarters

1 2 3 4 5 6 7 8 9

**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).

10 11 12

Euros

0

-1

-2

2 3 4 5 6 7 8 9

Quarters

1

10 11 12

## Table 2

Euros

0

-1

-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 AN BANDS	ND SOCIAL TR	ANSFERS: OU	TPUT RESPONS	E   IN EUROS, PO	DINT ESTIMATES A	ND CONFIDENCE
		Response		Averag	ge cumulative re	sponse
	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)
	IV	laximum (quart	er)	Cumul	ative multiplier	(1 year)
	-0,7 (9°)	-0,3 (2°)	0.7 (5°)	-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.<sup>10</sup>

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).<sup>11</sup> 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.

**<sup>10</sup>** 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).

**<sup>11</sup>** 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.<sup>12</sup> 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 guarter after the shock.<sup>13</sup> 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.

**<sup>12</sup>** 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.

**<sup>13</sup>** 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.<sup>14</sup> Indeed, innovations in salaries have a large (and statistically significant) impact on economic activity: an initial change of 1 euro



#### **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

ESTIMATES				J. VANADLE J		EURUS, PUINT
		Response		Averag	ge cumulative res	ponse
	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		Averag	ge cumulative res	ponse	
	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)	
	IV	Aaximum (quarte	r)	Cumul	ative multiplier (1	1 year)	
	0,5 (11°)	2,5 (7°)	-0,3 (2°)	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<sup>15</sup>, 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.

**<sup>15</sup>** 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).<sup>16</sup> 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.<sup>17</sup>

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).

**<sup>16</sup>** 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.

**<sup>17</sup>** 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 <sup>(a)</sup>	1.1	1.5	0.6				
Direct taxes <sup>(a)</sup>	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.





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 guarter 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



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.<sup>18</sup> 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

**<sup>18</sup>** 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.<sup>19</sup> 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.<sup>20</sup>

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

**<sup>19</sup>** 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).

**<sup>20</sup>** 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.



#### Source: Authors' calculations.

2 3 4 5 6 7 8 9

Quarters

-1

-2

**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.

10 11 12

-1

-2

2 3 4 5 6 7 8 9 10 11 12

Quarters

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-



2

3 4 5

1

6 7

Quarters

8

9 10 11 12

Notes: Shocks have the size of 1 percent of impulse-variable; note the difference in the scales for consumption of durables and -durables on the scales of the percent of impuse variable, note the american and scales of 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.

-1.00

4

2 3

1

5 6 7

Quarters

8

9 10 11 12

-2

Source: Authors' calculations.



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.<sup>21</sup> 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 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

**<sup>21</sup>** 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



**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,<sup>22</sup> by a reduction in the effectiveness of monetary policy when reaching the lower zero bound<sup>23</sup>, 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.<sup>24</sup> 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

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

**<sup>23</sup>** 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).

<sup>24</sup> 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 VARIA	BLES		
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 <sup>(a)</sup>	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 <sup>(b)</sup>	BP, authors	<i>Taxa de Base Anual</i> until December 2009; from January 2010 onwards calculated by the authors from interest rates on <i>Bilhetes de Tesouro</i> .	-

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 <sup>(b)</sup>	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 ( $elBM_{VO}$ ) 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*<sub>BMI</sub>) 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)<sup>26</sup>. 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<sup>27</sup>, 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.

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

<sup>26</sup> Only private wages and employment are considered.

**<sup>27</sup>** 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.

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:

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

where  $(D_{des})$  is that the share of expenditure on social transfers related to unemployment, *txdes* is the unemployment rate and *ely*<sub>txdes</sub> 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  $(elp_{\tau})$ , 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 (13°)	-0,4 (18°)	0,6 (5°)	0,3 (13°)	2,5 (7°)	-0,4 (7°)			

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	17	-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.
# ECONOMIC AND POLICY DEVELOPMENTS

OUTLOOK FOR THE PORTUGUESE ECONOMY: 2013-2014

BOX: A SCENARIO WITH ALTERNATIVE FISCAL ASSUMPTIONS

SPECIAL ISSUE ASSESSMENT OF BANCO DE PORTUGAL'S PROJECTION ERRORS FOR ECONOMIC ACTIVITY IN THE PERIOD 2009-12

# OUTLOOK FOR THE PORTUGUESE ECONOMY: 2013-2014

Current projections for the Portuguese economy point to a contraction of economic activity of 2.3 per cent in 2013 (-3.2 per cent in 2012). This contraction reflects a sharp decline in domestic demand (Table 1), against a background of lower permanent income prospects. Exports are expected to decelerate in 2013, although maintaining a positive growth, despite the deteriorating outlook for external demand. The year will be marked by very low inflationary pressures, both internal and external, which will translate into a consumer price growth slightly below 1 per cent.

These projections take only into account the fiscal consolidation measures included in the State Budget for 2013, due to the absence of additional measures specified in sufficient detail, especially for 2014. In this context, domestic demand is projected to stabilise in 2014, after the strong decline in previous years. This evolution is underpinned by an acceleration of exports, as economic activity is assumed to recover in Portuguese exports' main destination markets. Economic activity is thus projected to grow by 1.1 per cent in 2014. Similarly to 2013, inflationary pressures are expected to remain low and the inflation rate to stand at low levels.

The Portuguese economy is conditioned by a process involving the correction of macroeconomic imbalances, which implies a recessive impact with negative consequences on the labour market. In the public sector, the correction of imbalances involves the need to maintain the fiscal consolidation process. In the private sector, the current projection is consistent with a reduction in debt levels and with maintaining the process of a gradual and orderly deleveraging of the banking sector. In the current projections, the Portuguese economy reinforces its financing capacity against the rest of the world over the next two years, after having put, in 2012, an end to a series of high external deficits recorded over a long period of time.

The risks associated with the projection are globally on the downside for economic activity and are especially marked in 2014. These risks are mainly contingent on the external demand recovery, which may be less significant than assumed, as well as on the adoption of fiscal policy measures in order to

PROJECTIONS OF BANCO DE PORTUGAL: 2013-2014   ANNUAL RATE OF CHANGE, PER CENT							
	Weights	EB Spring 2013			EB Winter 2012		
	2011		2013 <sup>(p)</sup>	2014 <sup>(p)</sup>	2012 <sup>(p)</sup>	2013 <sup>(p)</sup>	2014 <sup>(p)</sup>
Gross domestic product	100.0	-3.2	-2.3	1.1	-3.0	-1.9	1.3
Private consumption	66.5	-5.6	-3.8	-0.4	-5.5	-3.6	0.1
Public consumption	20.0	-4.4	-2.4	1.5	-4.5	-2.4	1.5
Gross fixed capital formation	17.9	-14.5	-7.1	1.9	-14.4	-8.5	2.8
Domestic demand	104.4	-6.8	-4.2	0.4	-6.9	-4.0	0.8
Exports	35.8	3.3	2.2	4.3	4.1	2.0	4.8
Imports	40.1	-6.9	-2.9	2.7	-6.9	-3.4	3.5
Contribution to GDP growth (in p.p.)							
Net exports		3.9	1.9	0.7	4.2	2.1	0.6
Domestic demand		-7.0	-4.2	0.4	-7.2	-4.0	0.8
of which: change in inventories		0.2	-0.1	0.1	0.0	0.2	0.0
Current plus capital account (% of GDP)		0.8	3.6	4.8	-0.1	3.1	4.4
Trade balance (% GDP)		0.1	2.8	3.8	0.3	3.1	4.1
Harmonized index of consumer prices		2.8	0.7	1.0	2.8	0.9	1.0

### Table 1

Source: Banco de Portugal.

**Notes:** (p) – projected. For each aggregate, this table shows the projection corresponding to the most likely value, conditional on the set of assumptions considered, which are based on the information available up to mid December 2012.

meet the budgetary goals itemised in the Economic and Financial Assistance Programme. In turn, additional gains in export market shares may be achieved, in line with the evolution in recent years. "Box *A scenario with alternative fiscal assumptions*", in this Bulletin, presents a scenario with additional fiscal policy measures, taking into account the intention of the Portuguese government to adopt a comprehensive programme of public spending cuts. This box also presents a sensitivity analysis of this scenario to alternative export developments.

The current projection presents a deeper GDP fall in 2013 than published in the Winter 2012 *Economic Bulletin*. This revision reflects more updated information, pointing to a less favourable external environment, and depicts in general a more recessive environment for the fourth quarter of 2012, with implications for 2013. There is nevertheless an unanticipated build-up in inventories. An assessment of recent projection errors of Banco de Portugal is presented in this Bulletin in the "Special Issue Assessment of Banco de Portugal's Projection Errors For Economic Activity In The Period 2009-12".

### Persistent decline in external demand in 2013, followed by recovery in 2014

The projections consider a wide range of information on future developments of the Portuguese economy conditioning variables (Table 2). Assumptions point to a decline in external demand in 2013, similarly to 2012, and to a recovery in 2014. This profile largely reflects expected developments in the euro area's economic activity, in a context of continued buoyancy of non-euro area economies. Current assumptions include a downwards revision of external demand for the Portuguese economy relative to the Winter 2012 *Economic Bulletin*.

Assumptions for the financing costs of the Portuguese State in 2013 and 2014 are based on estimates for the average rate of external financing costs under the Economic and Financial Assistance Programme and on the interest rates underlying the emission of government bonds. The gradual return to medium and to long-term market financing during 2013 will probably imply an increase in the financing costs of the Portuguese State.

The 3-month EURIBOR rate assumed in the projection exercise is endowed with a slightly upward trend over the projection horizon. Bank lending rate spreads *vis-à-vis* the money-market benchmark rate are likely to narrow over the projection horizon, particularly in 2014. The technical assumption for exchange

PROJECTION ASSUMPTIONS									
		E	EB Spring 2013			EB Winter 2012			
		2012	2013 <sup>(p)</sup>	2014 <sup>(p)</sup>	2012 <sup>(p)</sup>	2013 <sup>(p)</sup>	2014 <sup>(p)</sup>		
External demand	aar	-0.2	-0.5	4.2	0.2	0.3	4.7		
Interest rate									
3-month EURIBOR	%	0.6	0.2	0.4	0.6	0.1	0.3		
State financing cost <sup>(a)</sup>	%	2.6	2.3	3.8	2.6	2.6	4.1		
Euro exchange rate									
Euro effective exchange rate	aar	-5.4	2.8	-0.1	-5.4	0.2	0.0		
Euro-dollar	aav	1.28	1.31	1.31	1.28	1.30	1.30		
Oil price									
in dollars	aav	111.9	109.4	102.5	111.9	106.8	102.1		
in euros	aav	87.1	83.4	78.3	87.2	82.2	78.6		

### Table 2

Sources: Bloomberg, ECB, Thomson Reuters and Banco de Portugal calculations.

**Notes:** aar - annual average rate of change, % - per cent, aav - annual average value. External demand assumptions are based on projections for the euro area, published in the March's Issue of the European Central Bank's Bulletin. The 3-month EURIBOR is based on the evolution of futures contracts. The financing costs of the Portuguese State consider the relevant financing sources, including the estimated financing costs implied by the Economic and Financial Assistance Programme; for a detailed description see http://www.bportugal.pt/pt-PT/OBancoeoEurosistema/ProgramaApoioEconomicoFinanceiro/Paginas/default.aspx. Regarding exchange rates, it was assumed that the average values observed in the two weeks preceding the information's closing date are kept until the end of 2014. An increase in the exchange rate corresponds to an appreciation. Assumptions for the oil price are based on the available information on futures markets.

rates implies an appreciation of the euro in 2013, both against the US dollar and in effective terms. Oil prices per barrel in euro are assumed to decline by 4.2 per cent in 2013 and 6.1 per cent in 2014.

As for public finance variables, current projections take into consideration the procedures used in the Eurosystem's projection exercises, reflecting only the measures already approved, especially within the scope of the State Budget for 2013, or those that are highly likely to be approved and specified in sufficient detail. This assumption affects in particular the projections for 2014. As mentioned in the previous Economic Bulletin, the State Budget for 2013 has established a consolidation strategy based mainly on the revenue side and, in particular, on taxes on households. On the expenditure side, the State Budget for 2013 envisages a continued reduction in the number of civil servants, which naturally imply a further reduction in public consumption, and a fall in public investment. These declines are however lower than the ones registered in 2012.<sup>1</sup>

# Contraction in economic activity and deterioration in labour market conditions in 2012, in a context of a sharp adjustment in the balance of payments

In 2012 the Portuguese economy presented a positive external financing capacity, with the current plus capital account balance going from a deficit of 5.8 per cent of GDP in 2011 to a surplus of 0.8 per cent. This recovery represents a very important feature of the external imbalance correction process, after the very high deficits recorded over a long period of time.

The Portuguese economy contracted by 3.2 per cent in 2012, as a result from the sharp decline in all domestic demand components. A special focus should be placed in private consumption and Gross Fixed Capital Formation (GFCF), which strengthened, in 2012, the contraction observed in the previous year. The negative impact of domestic demand on economic activity, followed by a strong decline in imports, was partly offset by an increase in exports, which continued to show rather significant gains in market share in the year as a whole. Nevertheless, nominal exports of goods registered a sharp deceleration in 2012, similarly to other euro area countries (Chart 1). The volume of exports of goods and services even declined in Portugal in the fourth quarter of 2012, but this fall is expected to be temporary, reflecting *inter alia* specific factors, such as strikes in the ports sector. In fact, international trade data published by Statistics Portugal show that the nominal exports of goods increased by 5.6 per cent on year-on-year terms in January 2013. The end of 2012 was also characterized by a very expressive build-up in inventories, which is largely deemed to be temporary.

Labour market conditions deteriorated sharply in 2012, leading to a rise in the unemployment rate to 15.7 per cent of the labour force and originating a 4.2 per cent decline in employment in annual average terms. This deterioration was particularly sharp in the last quarter, as the unemployment rate increased to 16.9 per cent. Unemployment developments must be put into perspective against the upward trend recorded over the last decade, which is partially of structural nature (Chart 2). Current projections do not consider, however, any effect associated with the structural measures adopted in the meantime, given the difficulties in estimating their magnitude and time profile.

### Smaller contraction in economic activity and domestic demand in 2013

Current projections point to a decline of 2.3 per cent in GDP in 2013 (-3.2 per cent in 2012). This projection is explained by a very significant and widespread decline in domestic demand (albeit to a lesser extent than in 2012), which is partially offset by positive exports growth (Chart 3). The projection for domestic demand is underpinned by a fall in households' and government's consumption spending, as well as a further decline in GFCF.

<sup>1</sup> For more detailed information, see "Box 3.2 *Fiscal outlook for 2013*" in the Autumn 2012 *Economic Bulletin* of Banco de Portugal.



**Notes:** The methodology associated with the computations of the structural unemployment rate is described in "Unemployment: Supply, Demand, and Institutions", The Portuguese Economy in the Context of Economic, Financial and Monetary Integration, Chapter 4, Economics and Research Department, Banco de Portugal.

In a context where no additional fiscal consolidation measures were considered besides those included in the State Budget for 2013, due to the absence of additional measures specified in detail, current projections envisage a 1.1 per cent recovery of economic activity in 2014. Public finance assumptions imply a slight increase in public consumption and some recovery of households' real disposable income, which contributes to somewhat sustained private consumption levels. These developments are followed by an acceleration in exports, as a recovery in external demand is deemed likely. The gradual recovery in demand prospects in both internal and external markets translates into a favourable impact on business investment.

Private consumption is projected to decline by 3.8 per cent in 2013 (-5.6 per cent in 2012) and around 0.4 per cent in 2014. Durable goods consumption is likely to decline further in 2013, although less markedly than in the previous year. The current year's developments stems from the deterioration of permanent income prospects, in a content of high uncertainty and sharp deterioration of labour market conditions. The latter should imply also a reduction in the consumption of non-durable goods as well as services. The materialisation of the current projection would imply that total private consumption in 2014 would stand at levels close to those registered in 2000.

The absence of smoothing in households' consumption expenditure represents an important feature of the adjustment process of the Portuguese economy. The relative stability of the households' savings rate in 2013 occurred against the background of a strong decline in real disposable income, which is to some extent explained by a substantial increase in direct taxation, a decline in employment, and wage moderation, in a context where the unemployment rate is likely to remain at historically high levels. Current saving developments, which are taking place against the backdrop of the adjustments of the Portuguese economy, contrast with those observed in previous recessions (Chart 4). This reflects the more permanent nature of the adjustment that is perceived by economic agents and the maintenance of restrictive financing conditions. Moreover, uncertainty as to the length of the adjustment period contributes to the rise in precautionary savings.



Sources: INE and Banco de Portugal. Note: (p) - projected.

Sources: INE and Banco de Portugal. Notes: (p) - projected. The savings rate is expressed as a percentage of disposable income. Period t corresponds to 1993, 2003 and 2009, respectively.

t+3

t+4

t+5

Current projections point to a 7.1 per cent contraction in GFCF in 2013 (-14.5 per cent in 2012), followed by a 1.9 per cent increase in 2014. The contraction in 2013 is widespread across all institutional sectors. The reduction in this year's business component continues to signal a strong deterioration in demand prospects, being affected also by the high indebtedness levels of non-financial corporations and by the maintenance of tight financing conditions. For 2014, projections point to a recovery in business GFCF, underpinned by some improvements in financing conditions, the recovery in external demand, and a gradual increase in domestic demand. This latter fact is however conditioned by the assumed absence of additional fiscal consolidation measures.

The 2013's decline in residential investment reflects the prospects for households' permanent income, especially affected by the deterioration of labour market conditions. The decline in this component should be inserted within a medium-term trend, following the stabilisation of the housing stock, after the hikes recorded during the 1990s. Projections for 2014 point to some stabilisation of residential investment, underpinned by a somewhat sustained households' disposable income. Finally, public investment is likely to decrease by more than 10 per cent in 2013 and to stabilise in 2014.

## Export deceleration in 2013 and recovery in 2014

Exports are projected to grow by 2.2 per cent in 2013 and 4.3 per cent in 2014 (3.3 per cent in 2012). The projection for 2013 is affected by a decline in the external demand for Portuguese goods and services, in line with the assumptions for the economic activity in euro area economies, even though emerging market economies continue to evince some buoyancy.

Recent and prospective export developments contrast with those observed in previous recessions, chiefly reflecting a more unfavourable external framework (Chart 5 and Chart 6). Nonetheless, export projections for 2013 imply additional gains in market share of 2.7 percentage points, followed by stabilisation in 2014 (7.0 percentage points in the period 2011-12). The materialisation of current projections boosts the recovery in the export market share registered over the past two years (Chart 7).



Notes: (p) - projected. Period t corresponds to 1993, 2003 and 2009, respectively.

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Turning to imports, projections point to a 2.9 per cent decline in 2013 and a 2.7 per cent increase in 2014 (-6.9 per cent in 2012). Imports in 2013 are determined by a contraction in domestic demand, particularly the consumption of highly import-intensive durable goods and business investment, as well as a slowdown in exports growth. The increase in imports projected for 2014 reflects a recovery in aggregate demand.

### Continued external imbalance adjustment process

The current plus capital account balance is projected to increase from a surplus of 0.8 per cent of GDP in 2012 to 3.6 per cent in 2013 and 4.8 per cent in 2014 (Chart 8). This path chiefly reflects projections for the trade balance, which should show a surplus of 2.8 per cent of GDP in 2013 and 3.8 per cent in



Sources: INE and Banco de Portugal. Note: (p) - projected.

Sources: INE and Banco de Portugal. Note: (p) - projected.

2014 (which compares to a balanced position in 2012). The improvement in the external balance will have a favourable impact on the international investment position (IIP) of the Portuguese economy and represents a striking feature of current projections.

The income account deficit is anticipated to decline to 3.8 per cent of GDP in 2014 (3.9 per cent in 2012), reflecting a lower return on investments held by non-resident agents, particularly due to the gradual deleveraging of private agents. Current and capital transfers are likely to stabilise at around 5 per cent of GDP over the projection horizon.

### Stabilisation of inflation at slightly below 1 per cent in 2013 and 2014

The growth rate of the Harmonised Index of Consumer Prices is projected to stand, on average, slightly below 1 per cent in 2013 and 2014. Current projections incorporate a deceleration of the energy component in 2013 and a decline in 2014, chiefly reflecting the decline in oil prices in euro that is assumed in the projection exercise. The non-energy component is projected to slow down in 2013 and to grow very moderately in 2014, in line with very low inflationary pressures. In 2012, inflation was highly influenced by temporary factors, especially the rise in indirect taxation, which ceased to produce effects in 2013. Projections for inflation were revised marginally downwards when compared with the Winter 2012 *Economic Bulletin.*<sup>2</sup>

As mentioned earlier, inflationary pressures, both internal and external, should be very low over the projection horizon. Developments in domestic demand and the sharp deterioration of labour market conditions may contribute decisively to keep on wage moderation. According to current projections, unit labour costs in the private sector are likely to decline by 1.1 per cent in 2013 and 0.5 per cent in 2014 (-1.2 per cent in 2012). The annual average growth of import prices of non-energy goods will probably stand at around 1 per cent over the 2013-14 period, in line with a deceleration of the world economic activity in 2013 and a gradual recovery in 2014.

### Employment continues to fall in 2013

Employment is projected to decline by 3.3 per cent in 2013 and to become relatively stable in 2014 (-4.2 per cent in 2012). The contraction in employment in 2013 extends to both private and public sectors, in line with economic activity developments and the assumptions on public finance variables. In 2014 employment is projected to recover gradually in the private sector, following the projected recovery in economic activity. The decline in the public sector employment is likely to be less marked in 2014.

# Globally downside risks for economic activity, especially in 2014, and balanced risks for inflation

Current projections for economic activity face downside risks, especially in 2014. For inflation, the risks are balanced ("Box *A scenario with alternative fiscal assumptions*" presents a complementary scenario with additional fiscal policy measures and an analysis of sensitivity to export developments). At the domestic level, the main risk factor stems from the implementation of additional fiscal adjustment measures to ensure compliance with the objectives agreed within the scope of the Economic and Financial Assistance

**<sup>2</sup>** The change in inflation over 2013 should be interpreted by taking into account that the price index base has changed to 2012 =100. Thus, the calculation of year-on-year rates of change is based on different price index bases. According to Statistics Portugal, the impact of the update in the weights of the different goods and services on the year-on-year rate of change of the CPI stood between -0.5 and -0.7 percentage points in January and between -0.7 and -0.9 in February. This impact will tend to unwind over 2013, and therefore the expected effect on the annual average rate of change in 2013 should be fairly marginal. For further information, please refer to www.ine.pt.

Programme. The materialisation of this risk may yield lower-than-expected public consumption levels, as well as households' lower disposable income. It may also generate lower inflation levels, as corporations may have to adjust their profit margins to demand conditions. An additional increase in the prices of goods and services subject to regulation cannot be ruled out, however.

As regards the external environment, the main risk factor stems from the possibility that the buoyancy of external demand may be smaller than envisaged in current projections. This has naturally a negative effect on Portuguese exports, economic activity, and employment. The materialisation of this risk is conditional on several supranational factors, as it depends on the magnitude and synchronisation level of fiscal consolidation processes in Europe and on European-level decisions aimed at solving the sovereign debt crisis in the euro area. These facts have implications for the regular and stable financing conditions of the different economic agents, and especially of States. In turn, the possibility of obtaining additional gains in export market shares cannot be ruled out, in line with developments in recent years.

# The reduction of structural imbalances, indispensible to ensure sustainable growth, may continue to shape the Portuguese economy in coming years

The Portuguese economic recession worsened by the end of 2012. Current projections suggest that this recession will only unwind gradually in the course of 2013, against the backdrop of significant surpluses in the current plus capital account. It is therefore crucial to combine a medium-term fiscal consolidation with incentives for sustainable economic growth. This implies, *inter alia*, a reallocation of resources to the tradable sector. Reducing structural unemployment requires consistent efforts to promote greater efficiency in the functioning of the labour and output markets, contributing to an allocation of resources that stimulate an increase in potential output and permanent income. Improving the quality of business investment is also essential for incorporating technical progress that promotes a sustained increase in total factor productivity and of firms' competitiveness, and therefore a successful correction of the Portuguese economy imbalances.

# BOX | A SCENARIO WITH ALTERNATIVE FISCAL ASSUMPTIONS

The macroeconomic projections published by Banco de Portugal rely on a set of assumptions, in particular fiscal policy assumptions and assumptions regarding the external environment of the Portuguese economy. As analysed in the Special Issue entitled "Assessment of Banco de Portugal's projection errors for economic activity in the period 2009-12", published in this Economic Bulletin, projection errors in the most recent period were largely the result of deviations from the assumptions on these variables.

This box presents a scenario with additional fiscal consolidation measures, particularly for 2014, as the Portuguese government intends to adopt a comprehensive programme to reduce public expenditure. Given the high uncertainty surrounding developments in external demand and the export market share, this box also shows a sensitivity analysis of this scenario to export growth arising from deviations in external demand and/or unanticipated changes in the market share.

### A scenario with additional fiscal consolidation measures

As usual, the projection shown in the article entitled "Outlook for the Portuguese Economy: 2013-2014" only includes fiscal policy measures that have already been approved or are very likely to be approved and that have been specified in detail. However, the measures to be adopted under the expenditure-reducing programme and the time profile of their implementation have yet to be specified in sufficient detail. Given the magnitude of the expenditure reduction that has been announced, the projection for 2014 will probably be significantly affected. It is therefore important to present a scenario with alternative fiscal assumptions.

Building this scenario involves adopting a set of technical assumptions, *i.e.*, a set of assumptions needed to simulate the measures' impact. This exercise was therefore prepared considering a gross public expenditure reduction of 1.5 per cent of GDP in 2014.<sup>1</sup> In terms of the breakdown considered, around 50 per cent of the expenditure reduction was applied to compensation of employees and the remainder to expenditure on social benefits (including pension expenditure). It is worth stressing that the expenditure breakdown considered significantly affects the results presented for 2014 (Table 1).

According to the results, the materialization of the scenario with alternative fiscal assumptions would have an adverse impact of 0.8 per cent on GDP. This would imply GDP growth of 0.3 per cent in 2014 (compared with 1.1 per cent in the current projection). In this scenario, domestic demand is projected to contract by 1 per cent (compared with 0.4 per cent growth). The measures to reduce public expenditure include the assumption that the volume of public consumption<sup>2</sup> will virtually stabilise in 2014 (rather than grow by 1.5 per cent). As regards the private domestic demand components, the measures exert their largest impact on household consumption expenditure. This takes place against the background of a stronger reduction in disposable income, which also implies a slower recovery in private investment, particularly in the residential component. The impact of the measures to reduce public expenditure results in a slight gain in competitiveness with a limited impact on the export volume. In the context of a lower growth in global demand, imports are expected to increase 1.4 per cent (compared with 2.7 per cent), contributing to an increase of 0.7 per cent of GDP in the trade balance surplus.

<sup>1</sup> The net direct impact on the budget balance also includes the direct effect on revenue of both personal income taxes and social contributions arising from the reduction in public expenditure.

**<sup>2</sup>** Part of the additional measures considered affects the public consumption deflator rather than the volume of public consumption.

### Table 1

#### SCENARIO WITH ALTERNATIVE FISCAL ASSUMPTIONS AND SENSITIVITY ANALYSIS TO EXPORT GROWTH – 2014 LANNUAL RATE OF CHANGE IN PERCENTAGE

GROWTH - 2014 ANNOAL RATE OF CHANGE, IN FERCENTAGE									
	Weights 2011	Baseline	Scenario with alternative fiscal assumptions	Impact of alternative fiscal assumptions	Sensitivity analysis to export growth (+1pp/-1pp)				
Gross domestic product	100.0	1.1	0.3	-0.8	0.2/-0.2				
Private consumption	66.5	-0.4	-2.0	-1.7	0.0/0.0				
Public consumption	20.0	1.5	0.2	-1.3	0.0/0.0				
Gross fixed capital formation	17.9	1.9	1.4	-0.5	0.2/-0.2				
Domestic demand	104.4	0.4	-1.0	-1.4	0.1/-0.1				
Exports	35.8	4.3	4.5	0.2	1.0/-1.0				
Imports	40.1	2.7	1.4	-1.3	0.6/-0.6				
Contribution to GDP growth (in p.p.)									
Net exports		0.7	1.2	0.6	0.2/-0.2				
Domestic demand		0.4	-1.0	-1.4	0.1/-0.1				
of which: change in inventories		0.1	0.1	0.0	0.0/0.0				
Current plus capital account (% of GDP)		4.8	5.5	0.7	0.2/-0.2				
Trade balance (% of GDP)		3.8	4.5	0.7	0.2/-0.2				

Source: Banco de Portugal.

### Sensitivity of the scenario with alternative fiscal assumptions to developments in exports

As previously mentioned, projections for the Portuguese economy also rely on a set of assumptions for the external environment, which has been subject to considerable uncertainty. In addition, the adjustment of the Portuguese economy in the more recent period was characterised by unanticipated gains in its export market share, as non-price competitiveness factors materialised. Against this background, it is useful to assess the sensitivity of the projection for economic activity to deviations of external demand and/or unanticipated changes in the market share of Portuguese exports. In order to assess this sensitivity, the impact of a deviation of external demand and/or unanticipated developments in the market share of Portuguese exports of  $\pm 1$  per cent was simulated.

Chart 1 shows the current projection for 2014, the scenario with alternative fiscal assumptions and the sensitivity of this scenario to deviations of external demand and/or unanticipated changes in the market share of Portuguese exports. According to the results, a deviation of  $\pm 1$  per cent of export growth has an impact of  $\pm 0.2$  per cent on GDP growth.



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Outlook for the Portuguese Economy: 2013-2014

# ASSESSMENT OF BANCO DE PORTUGAL'S PROJECTION ERRORS FOR ECONOMIC ACTIVITY IN THE PERIOD 2009-12

As of December 2000 Banco de Portugal has released projections for the Portuguese economy. This falls within the central bank's mandate, given that the development of prospective and credible macroeconomic scenarios helps to reduce uncertainty, anchor agents' expectations and, ultimately, improve the quality of their decisions.

The projections are conditional on a set of assumptions that help characterise the performance of the Portuguese economy on the basis of a macroeconometric model, around which information on past and more recent developments is organised. The importance of these assumptions is discussed in the section below. Section 2 assesses Banco de Portugal's performance when projecting GDP growth in the period 2009-12, to the extent that this variable plays a crucial role in the agents' decisions. Subsection 2.1 compares this performance to that of a number of international institutions; Subsection 2.2 breaks-down Banco de Portugal's projection errors, on the basis of the model used to produce the projections.

Notwithstanding the continuous improvement of projection instruments used, results suggest that the uncertainty surrounding fiscal and external environment assumptions is particularly important to explain the projection errors from the recent past. As such, both the risk and uncertainty analysis included in articles on projections and the identification of associated risk factors are of the utmost importance.

## 1. The Importance of Defining Assumptions

As regards the international environment, projections for the Portuguese economy are based on a set of assumptions on (i) world economic growth, particularly in the main trading partners; (ii) commodity prices and other imported goods prices; (iii) developments in the nominal effective exchange rate; (iv) the monetary policy implemented by the European Central Bank and its impact on money market rates; and (v) government debt interest rates. This approach ensures consistency, given that Portugal is a small open economy integrated in the euro area, which means that international developments are not likely to be affected by domestic economic developments.

Due to its participation in the Eurosystem's multilateral projection exercises, Banco de Portugal has been granted access to a common set of assumptions on the international environment. As such, prospective scenarios published are based on a given international environment drawn upon by national central banks, which is produced by a large group of experts and previously scrutinised at Eurosystem level.

Turning to prospective fiscal policy developments, projections published by Banco de Portugal only include fiscal policy measures that have already been approved and those that, albeit still not approved, have been specified in sufficient detail and are likely to pass the legislative process. This option aims, on the one hand, to ensure maximum transparency and intertemporal consistency of projections and, on the other hand, make it immune to the debate on measures that would probably be incorrectly assessed due to their insufficient specification detail. The inclusion of measures that do not comply with these criteria could be interpreted as the central bank assessing the policy measures under discussion, something that does not fall within its tasks. The same assumption applies when national central banks produce projections within the scope of the Eurosystem's multilateral projection exercises, which is crucial for ensuring the credibility and independence of projections.

When analysing the Portuguese economy framed by the Economic and Financial Assistance Programme (EFAP), the consolidation process unfolds on a multi-annual basis. However the available information is limited regarding the time profile as well as the detailed composition of the consolidation measures.

Against a background where policy measures needed to ensure compliance with the fiscal targets are frequently discussed and their definition is a continuous process, the methodology described in the above paragraph is crucial for ensuring the credibility and independence of projections. However, this assumption has led to an overvaluation of GDP growth since the beginning of the EFAP, namely when taking into account projection horizons exceeding that of the approved State Budget. In this context, the assessment of risks associated with the specification of additional fiscal measures is key when interpreting projections and cannot be separated from the projection itself.

Therefore, given the assumptions made, the prospective scenarios published by Banco de Portugal should be interpreted as conditional projections, *i.e.*, representing the most likely developments in the economy, conditional on the materialization of these assumptions. In the current juncture of high uncertainty surrounding the international environment, persistent international financial market tensions and the need to adopt significant policy measures that ensure compliance with the fiscal targets, the non-materialisation of these assumptions has resulted in a sizeable increase in projection errors on the part of institutions publishing projections for the Portuguese economy.

### 2. An Assessment of the Recent Performance of Banco de Portugal Projections

As part of its mission, Banco de Portugal regularly publishes macroeconomic projections for the Portuguese economy in this *Economic Bulletin*. Developments in the Portuguese economy are also monitored by a number of international institutions that also produce macroeconomic projections on a regular basis. The quality of published projections is regularly monitored, given that information incorporated in projection errors is key for analysing and improving projection exercises.

This section begins by presenting a comparison between the performance of Banco de Portugal projections for economic activity growth and those produced by a number of international institutions that regularly produce projections for the Portuguese economy (more specifically, the European Commission, the IMF and the OECD). Subsequently, the projection model is used to breakdown Banco de Portugal's projection errors, particularly as regards deviations from the assumptions for the international environment and developments in fiscal policy variables.

# 2.1. A comparison of the performance of projections published by Banco de Portugal, the European Commission, the IMF and the OECD

The assessment of the relative performance of projections published by Banco de Portugal and a number of international organisations falls within the performance monitoring process, making it possible to assess *ex post* the reliability of these projections. In this context, the relative performance of projections developed by Banco de Portugal should be compared with those produced by the European Commission, the IMF and the OECD. Similarly to Banco de Portugal, these institutions publish projections at least twice a year and cover a time horizon exceeding one year.

This comparison regards projections for GDP growth in the period 2009-12, which was marked at an early stage by the onset of a global financial crisis and, subsequently, its transmission to the sovereign debt markets of a number of euro area countries, including Portugal. This analysis includes projections published in the first and second halves of the year in the period 2008-12. To calculate the projection error, the actual value for the GDP growth rate was considered to be the value published by Statistics Portugal (*INE*) in the second half of the year following that covered by projections, so as to take into account retrospective revisions that are likely to occur in the course of the following year. The exception to this rule regards the calculation of errors for 2012, where the value released in the beginning of March 2013 by Statistics Portugal within the scope of the Quarterly National Accounts was taken as the actual value.

It should be noted that this comparison with the performance of other institutions is not without limi-

tations, owing to the nature of the exercise itself. The main shortfall is the inability to ensure that the projections produced by the different institutions are based on the same set of information. Indeed, institutions release their projections on different dates and have different cut-off dates for information and, at times, release dates vary within a sole institution. However, the strong correlation of projection errors seems to indicate that these information lags are not substantially relevant.

Developments illustrated in Chart 1 suggest that projections produced by Banco de Portugal tend to converge more rapidly to the actual value than those produced by the remaining institutions, although differences are relatively limited. Moreover, the sign of the projection errors tends to be common to all institutions.

A quantified analysis of the relative performance of institutions is possible with recourse to two indicators that are traditionally used in literature: the root mean square error of projection and the mean absolute deviation. These indicators measure the mean error with recourse to two metrics that diverge given that the first penalises large projection errors more severely, while the second penalises projection errors on a proportional basis.

The figures shown in Table 1 illustrate (in a summarised, quantified manner and based on synthetic indicators) the performance of the various institutions as regards projections for GDP growth. In absolute terms, projection errors increase for longer projection horizons, with a very sizeable increase for horizons



### Chart 1

Sources: European Commission, IMF, OECD and Banco de Portugal.

**Notes:** The horizontal axis indicates the date on which the projection was produced (year and semester). The horizontal axis crosses the vertical axis at the actual value for GDP growth rate in the corresponding year.

### Table 1

ROOT-MEAN-SQUARE ERROR FOR GDP PROJECTION, MEAN ABSOLUTE DEVIATION AND RELATIVE PERFORMANCE OF BANCO DE PORTUGAL IN THE PERIOD 2009-2012   IN PERCENTAGE POINTS											
	Root mean square error					Mean absolute deviation					
	BdP	EC	OECD	IMF	BdP	EC	OECD	IMF			
6-month ahead	0.73	1.02	1.17	1.00	0.62	0.86	0.88	0.82			
1-year ahead	1.26	1.61	1.54	1.80	0.99	1.34	1.28	1.70			
1 1/2-years ahead	2.45	2.75	2.79	2.84	2.26	2.55	2.60	2.73			
2-years ahead	2.88	2.82	3.46		2.65	2.47	3.00				
Relative performance of Banco de Portugal (%)											
6-month ahead		-28	-38	-27		-15	-17	-11			
1-year ahead		-22	-18	-30		-6	-2	-26			
1 1/2-years ahead		-11	-12	-14		-4	-6	-10			
2-years ahead		2	-17			17	-4				

Sources: European Commission, IMF, OECD and Banco de Portugal.

exceeding one year. This increase reflects, inter alia, the high level of uncertainty that characterised the Portuguese economy in the period 2009-12. 2009 and 2010 were marked by the impact of the international financial crisis, particularly on foreign demand developments. The subsequent period was affected by the request for financial assistance, the implementation of measures included in the EFAP and the need to adopt additional fiscal consolidation measures.

The relative performance of Banco de Portugal exceeds that of the remaining institutions for projection horizons of up to one year, with lower figures for the root mean square error of projection and the mean absolute deviation. For horizons of over one year, the relative gains of Banco de Portugal projections are more limited, with the two-year analysis being conditioned by the small number of observations available.

### 2.2. Breakdown of Banco de Portugal's projection errors

By breaking down projection errors, it is possible to identify the impact of deviations from assumptions, namely as regards international developments and the adoption of fiscal measures specified only after projections have already been released. Similarly to the previous subsection, Subsection 2.2 looks into projection errors for the period 2009-12.

The breakdown of projection errors entails the development of a counterfactual, *i.e.*, the macroeconomic scenario that would occur if the future external environment and fiscal policy developments was known at the time of projection. For this purpose, the quarterly model used by Banco de Portugal when preparing projections for the Portuguese economy is applied here. The projection error component that does not result from changes in the external environment or fiscal assumptions reflects the impact of behavioural factors that were not anticipated at the time of projection, *e.g.*, unanticipated developments in non-price competitiveness with an impact on the export market share, changes in the behaviour of agents compared with the pre-financial crisis period, the materialisation of uncertainty and risk factors related to the confidence levels of agents or the impact of changes in the institutional framework.

Chart 2 presents the breakdown of Banco de Portugal's projection errors resulting from this exercise for 2009, 2010, 2011 and 2012 in each *Economic Bulletin* issue. The analysis of the external environment of the Portuguese economy took into account the projection errors for variables included in the set of common assumptions in Eurosystem exercises, namely external demand for Portuguese goods and services, interbank money market interest rates, exchange rates and oil prices. Turning to fiscal assumptions, the exercise takes into account deviations from assumptions for developments in government consumption and public sector wages, developments in government transfers to households (mostly related to social benefits and the payment of old age and disability pensions) and developments in direct and indirect taxes. Moreover, the impact from changes in the export market share resulting from factors

### Chart 2



Sources: European Commission, IMF, OECD and Banco de Portugal.

**Notes:** The projection error corresponds to the difference between the value projected and the actual value. A positive value (negative) represents an overvaluation (undervaluation). The horizontal axis indicates the date in which the projection was produced and is identified by the corresponding Banco de Portugal's *Economic Bulletin* issue. The contribution of Portuguese exports market share reflects only the component that is not due to changes in external assumptions, in particular the nominal effective exchange rate.

other than developments in the nominal effective exchange rate was isolated given their impact over the most recent period.

Overall, Banco de Portugal's projection errors have mainly resulted from the non-materialisation of international environment and fiscal assumptions. Moreover, for the most recent period, the materialisation of factors related to non-price competitiveness has resulted in unanticipated market share gains for Portuguese exports.

This breakdown suggests that international environment assumptions have played a key role in terms of both underestimating the contraction in economic activity in 2009 and its subsequent recovery in 2010, particularly when looking into projection horizons of over six months. The projection error for these years was particularly driven by the inability to anticipate the discrete and, partly, temporary nature of the fall in international trade flows in late 2008 and early 2009 and, consequently, its impact on Portuguese exports. International environment developments have, therefore, played a major role both in terms of the contraction in activity in 2009 and its recovery in 2010. It should be noted that, over these years, the contribution of fiscal factors to projection errors was negligible, which implies that the assumptions used were largely correct.

The relatively small contribution of both the residual component and unanticipated changes in the export market share in 2009 indicates that projections would have been correct if the magnitude of the fall in external demand had been anticipated. As regards 2010, the underestimation of a recovery in the course of that year was due to assumptions on external demand growth, which pointed to a greater persistence of the contraction in international trade flows. The residual component indicates that this underestimation of GDP growth in 2010 has been partially offset by other unanticipated factors. One of these factors was a smaller-than-projected drop in the households' savings rate, which seems to have led to consumption growth below that implied by disposable income developments. These developments in savings seem to have resulted from an unanticipated tightening in financing conditions and a rise in precautionary savings, against a background of intensified financial crisis and increasing uncertainty.

Turning to 2011, the underestimation of the fall in activity for projection horizons of over six months mainly reflects the non-incorporation of fiscal consolidation measures associated with the request for financial assistance prior to their presentation in greater detail in mid-May 2011. The component linked to the external environment played a limited role in the underestimation of the fall in GDP in 2011. However, the materialisation of unanticipated export market share gains contributed to mitigate the impact of unexpected consolidation measures. The residual component indicates that, in addition to these assumptions, other factors have contributed, albeit to a lesser extent, to the underestimation of the contraction in activity included in the projections published prior to the request for financial assistance. As such, in 2011 the savings rate was clearly higher than anticipated, although private sector wage growth was smaller than projected before April 2011. As in 2010, these developments reflected a marked deterioration in confidence levels and an increase in liquidity restrictions.

As regards 2012, the underestimation of the contraction in activity mainly reflects the non-incorporation of additional fiscal consolidation measures, which were only known in detail after the release of the State Budget for 2012 (*i.e.*, after the cut-off date for data incorporated in the Autumn 2011 issue of the *Economic Bulletin*), as well as a sharper deterioration in the international environment, particularly as regards the outlook for external demand (whose magnitude only became clear as of the Spring of 2012). However, the impact of an unanticipated deterioration in the outlook for external demand on the contraction in activity seems to have been largely offset by more-favourable-than-expected developments in the market share of Portuguese exports. Moreover, a set of other factors contributed to the underestimation in the projections released before April 2011, most notably, higher-than-expected wage moderation prior to the EFAP.

The breakdown of projection errors suggests that international environment and fiscal assumptions have greatly contributed to those errors over the most recent period. Against a background of high volatility and uncertainty, the difficulty of foreseeing developments in the international environment had a particular impact on the underestimation of the temporary upturn in economic activity in 2010. Over the most recent period, the inability to foresee the nature of the fiscal measures that would be needed to comply with targets for horizons exceeding that of the State Budget in each given year, as well as the sharper deterioration in the international environment, seem to have played a key role in the underestimation of the magnitude of recent recessions.

# 3. Conclusions

Projections regularly published by Banco de Portugal fall within the remit of the central bank's mission concerning the maintenance of price stability and financial system stability. GDP growth projection errors published by the organisations that regularly monitor developments in the Portuguese economy are closely correlated, which reflects the use of very similar instruments and assumptions. Nonetheless, projections produced by Banco de Portugal tend to be more precise. Moreover, the sign of projection errors tends to be common to all institutions.

Projections produced by Banco de Portugal are based on a set of assumptions which have been subject to particular uncertainty over the most recent period, and whose non-materialisation has resulted in significant projection errors. The breakdown of projection errors suggests that the non-materialisation of international environment and fiscal assumptions is behind a considerable share of projection errors over the most recent period, thereby increasing the importance of the risk and uncertainty analysis and the identification of risk factors. Over the most recent period, the materialisation of unanticipated export market share gains seems to have mitigated the impact of a worse-than-expected international environment.

Taking into account the compiled data, the release of alternative scenarios and the presentation of a sensitivity analysis on different assumptions underlying projections could contribute to a better uncertainty and risk analysis.



TRADE AND WAGE INEQUALITY

COMPETITION IN THE PORTUGUESE ECONOMY: ESTIMATED PRICE-COST MARGINS UNDER IMPERFECT LABOUR MARKETS

> FOREIGN INVESTMENT AND INSTITUTIONAL REFORM: PORTUGAL IN EUROPEAN PERSPECTIVE

BUSINESS CYCLE ACCOUNTING FOR PORTUGAL

# TRADE AND WAGE INEQUALITY\*

Luca David Opromolla\*

### ABSTRACT

A classic question in international trade theory is how a change in a country's exposure to trade affects the distribution of resources across economic activities within a country and the distribution of incomes across factors of production. Classical trade theory predicts changes in wage inequality due to reallocation of resources among industries. However, the empirical labor literature points to the importance of within-industry wage inequality and the empirical trade literature emphasizes within-industry, across firms, heterogeneity. To reconcile theory and data, we present a number of recent theoretical developments in the trade literature that emphasize the consequences of a reduction in export and import barriers on within-industry wage inequality. These theories could prove useful to revisit the change in wage inequality in Portugal after the entrance into the EU and to explain more recent patterns.

### 1. Introduction

A classic question in international trade theory is how a change in a country's exposure to trade, and world markets more generally, affects the distribution of resources across economic activities within a country and the distribution of incomes across factors of production. A more specific and recurring question in the media is how globalization (intended as increased economic interdependence of countries) affects wages both in developed and in developing countries.<sup>1</sup>

Standard Heckscher-Ohlin trade theory predicts that when a country with a given ratio of skilled-tounskilled workers integrates with a country with a higher ratio of skilled-to-unskilled workers production shifts, in the first country, towards unskilled-labor-intensive industries. The relative demand for unskilled workers, as well as their wages, rises. On the contrary, production shifts towards skill-intensive industries in the other country. Therefore, wage inequality will fall in an unskilled-labor abundant country when it integrates with a skilled-labor abundant country. However, the recent experience of developing countries seems to contradict this prediction. While globalization was expected to help the less skilled who are presumed to be the locally relatively abundant factor in developing countries, there is overwhelming evidence that these are generally not better off, at least not relative to workers with higher skills or education levels (Goldberg and Pavcnik (2007), Verhoogen (2008)). Similarly, the entry of Portugal into the EU in 1986 was expected to lower inequality through increased demand for low skill-intensive



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<sup>1</sup> For recent contributions, see the papers in Harrison (2007) and the surveys by Goldberg and Pavcnik (2007) and Feenstra and Hanson (2003).

products. However, wage inequality increased sharply in the second half of the 80s and slowed down in the mid-90s (Chart 1).

To be fair with classical trade theory, more sophisticated Heckscher-Ohlin-type models can account for a link between trade liberalization and rising wage inequality in a developing or less-developed country but because such models rely on between-industry shifts as the mechanism through which trade affects labor markets, they can only explain a rise in inequality if trade causes a shift in resources toward skilled-labor-intensive sectors. Empirical studies have typically failed to find evidence of such shifts. Moreover, the empirical labor economics literature shows that the bulk of wage inequality is due to within industry patterns instead of between industry differences. Wage inequality changes not so much because of the reallocation of resources across industries (e.g. from food production to basic metals) but mainly because of changes in the dispersion of wages paid by different firms belonging to the same industry (e.g. food exporters vs. food nonexporters) or because of changes in the dispersion of wages paid to different workers belonging to the same firm (e.g. white-collar vs. blue-collar workers). In section 2, we show that this pattern holds in Portugal, where about 91 per cent of wage inequality is due to within-industry differences.

How to reconcile the contrast between classical trade theory that predicts changes in wage inequality due to reallocation of resources among industries with data that point to a clear dominance of withinindustry wage inequality? To this end, we present a number of recent developments in the trade literature that emphasize the consequences of greater trade liberalization on within-industry wage inequality.

A trait that is common to the new batch of international trade theories is their reliance on the role played by firm heterogeneity. This is justified by the clearly proved existence of large and persistent productivity differences among firms belonging to the same industry (*e.g.* Syverson (2004)), and among exporters, importers and firms that do not trade. For example, exporters are in the minority; they tend to be more productive and larger; yet they usually export only a small fraction of their output. Similar facts hold for importers.<sup>2</sup>

In the core of this paper, we review three categories of models that address, in different ways, the issue of how changes in the barriers to international trade can affect the distribution of wages across firms and workers within an industry. While all the models that we discuss strongly rely on firms' heterogeneity, in some cases firms' heterogeneity is merely taken as an exogenously given characteristic, in other cases it is the result of endogenous choices that lead some firms to recruit more skilled workers than others and to pay higher wages. The first model we discuss is the one of Amiti and Davis (2011) where firms are (exogenously) heterogeneous in terms of productivity and workers are homogeneous. Firms can either sell their product only on the domestic market or also export it. Besides using local inputs, they can import other inputs to produce more efficiently. Because of fairness concerns, more profitable firms pay higher wages. In this setting, trade affects the distribution of wages by affecting the distribution of profits across firms choosing different modes of globalization. Next, we consider the model of Verhoogen (2008) where, within each occupational category, there are workers of different "quality" (ex-ante heterogeneity). Firms are heterogeneous in the sense that, by combining the same kind of inputs, some of them are able to produce goods of higher quality. Higher quality goods are more appreciated in the foreign market. A reduction in export barriers therefore provides a stronger incentive for some firms to upgrade the quality of their product and workforce, and pay higher wages. Finally, we consider the model in Helpman et al., (2010) where workers are also of different quality but this reveals itself only after the match with a firm (ex-post heterogeneity). Helpman et al., (2010) assumes that some firms have a higher incentive to try to identify the quality of a potentially new employee before hiring her/ him. Because replacing a "good" worker is more costly, these firms pay higher wages. A reduction in trade barriers reinforces this mechanism.

<sup>2</sup> Bernard and Jensen (1995), Bernard and Jensen (1999a), Clerides et al., (1998), and Aw and Roberts (2000).

A complementary strand of the labor literature focuses on the role played by technological change. Autor *et al.*, (2006) argue that the changing distribution of job task demands, spurred directly by advancing information technology and indirectly by its impact on outsourcing, goes some distance toward interpreting the recent polarization of the wage structure. Card and DiNardo (2002) claim instead that skill-biased technological change fails to explain the evolution of some dimensions of wage inequality, like the gender and racial wage gaps and the age gradient in the return to education. In this article we do not take a stand on these, equally relevant, lines of research, and we focus on a number of recent trade models that have implications for wage inequality.

The rest of the article is organized as follows. Section 2 shows new evidence about the evolution of wage inequality in the Portuguese manufacturing sector, emphasizing the role played by within-industry wage inequality. In section 3.1 we introduce a standard dynamic industry model with heterogeneous firms to analyze the intra-industry effects of international trade. Despite differences in productivity and profits, in this model all firms pay the same wage. However, this model is at the base of most of the recent studies on trade and wage inequality. Section 3.2 is the core of the article. We present in detail (employing a non-technical approach) three different theoretical frameworks, and discuss their empirical relevance, to study the impact of globalization on the distribution of wages. Section 3.3 briefly overviews other, even more recent, and promising theories that link trade and wages by considering on-the-job search and the organization of the firm. Section 4 concludes.

## 2. Wage inequality in Portugal: Between vs. Within-Industry Dispersion

In this section we analyze the evolution of dispersion in the distribution of wages in the Portuguese manufacturing sector from 1986, the year in which Portugal entered the EU, up to 2009, the latest year of data we have access to. We do so by exploiting the information contained in *Quadros de Pessoal*, a longitudinal dataset matching virtually all firms and workers based in Portugal.<sup>3</sup>

We explore how important is the dispersion in wages across industries with respect to the dispersion in wages across firms within an industry. The answer to this question justifies the choice of theoretical models discussed in section 3. Our measure of wage dispersion is the standard deviation of the (log) firm average hourly wage. Chart 1 shows the evolution over time of overall wage dispersion (solid line), and of its within-industry component (dashed line). Overall wage dispersion takes into account differences in the average wage paid by firms. The within-industry component of wage dispersion does the same, after controlling for the fact that firms belonging to different industries (or to the same industry in different years) pay wages that are on average different. In other words, the solid line represents the overall dispersion in wages (across firms) while the dashed line shows how much of the overall dispersion is due to differences in wages within industries; the vertical distance between the two lines represents the dispersion in wages due to systematic differences in pay across industries.<sup>4</sup>

Chart 1 conveys three striking messages. First, the dispersion in wages has greatly increased from the mid 80s to the early 90s, remaining stable afterwards. Second, the within-industry component represents the large majority (about 91 per cent) of wage inequality. Third, the importance of the within-industry component is fairly stable over time, since it follows closely the evolution of the overall dispersion in

**<sup>3</sup>** See the Annex for more details. *Quadros de Pessoal* has been used by, amongst others, Cabral and Mata (2003) to study the evolution of the firm size distribution; by Blanchard and Portugal (2001) to compare the U.S. and Portuguese labor markets in terms of unemployment duration and worker flows; by Cardoso and Portugal (2005) to study the determinants of both the contractual wage and the wage cushion (difference between contractual and actual wages); by Carneiro *et al.*, (2012) who, in a related study, analyze how wages of newly hired workers and of existing employees react differently to the business cycle; by Martins (2009) to study the effect of employment protection on worker flows and firm performance. See these papers also for a description of the peculiar features of the Portuguese labor market.

<sup>4</sup> See the Annex for more details about the construction of Chart 1. Table 1 in the Annex reports summary statistics for the hourly wages in 2009 by CAE (Classificação Portuguesa de Actividades Económicas) Rev.3 industries.



Source: Quadros de Pessoal.

wages. The takeaway message is that changes in wage inequality in Portugal in the last two decades are due to changes in within-industry wage inequality. Chart 1 confirms the importance of considering models where trade can affect within-industry wage inequality.

A number of other papers have studied the evolution of wage inequality in Portugal. Cardoso (1997) and Cardoso (1998), using the same data used in this study, analyze the evolution of wage inequality between 1982 and 1993, reporting an increase in several measures of wage inequality during the period. Cardoso (1998) confirms that changes taking place within economic activities, are the main forces driving changes in the wage pattern.<sup>5</sup>

Centeno and Novo (2009), still using data from *Quadros de Pessoal*, link the evolution of wage inequality to changes in the supply of high-skilled workers and polarization of employment demand.

## 3. Theoretical Models of Trade and Wages

We turn now to the theoretical part of the paper. We present, in the next section, an overview of Melitz (2003), one of the two standard models of trade with heterogeneous firms.<sup>6</sup> This is the base for the models discussed in section 3.2, which largely extend the simple treatment of the labor market of Melitz (2003) to better address the impact of trade on wages.

<sup>5</sup> Consistent with the approach in this paper, Cardoso (1998) dismisses explanations that rely on shifts in the demand for labor across economic activities. Curiously, this includes "old" international trade theories.

<sup>6</sup> The other standard approach is Eaton and Kortum (2002). They develop a Ricardian trade model that incorporates realistic geographic features into general equilibrium.

# 3.1. The base of the pie: Melitz (2003)

Recent empirical research using longitudinal plant or firm-level data from several countries has established a number of robust stylized facts regarding the productivity distribution of firms, its relations with firms' trade status, and the effect of trade liberalization on aggregate productivity. A number of studies have overwhelmingly substantiated the existence of large and persistent productivity differences among firms belonging to the same industry. For example, Syverson (2004) reports that, within narrowly-defined industries in the U.S., the difference between the 90th and the 10th percentiles of the firm-level productivity distributions is about 99 log points for total factor productivity (TFP) and about 140 log points for labor productivity. This corresponds to a nearly 2.7-to-1 ratio in TFP and 4-to-1 ratio in value added per labor unit (employee or employee-hour).<sup>7</sup> Moreover, some studies have shown that productivity differences are systematically correlated with firms' export and/or import status. Exporters and, even more importers, are generally more productive than other firms. Bernard and Jensen (1999a) report plant labor productivity differentials 16 – 19 per cent higher for exporters in the same four-digit industry. An important observation, especially for policy purposes, is that while exporting plants have substantially higher productivity levels, there is little evidence that exporting increases plant productivity growth rates. The higher productivity of exporters largely predates their entry into exporting.

Finally, other studies find evidence that trade liberalization spurs productivity growth in the tradable sector and a large fraction of this growth is linked to within industry market share reallocations towards more productive exporting plants. Pavcnik (2002) finds that market share reallocations significantly contribute to productivity growth in the tradable sector following trade liberalization in Chile. In a related study, Bernard and Jensen (1999b) find that TFP at continuing manufacturing plants grew at an average annual rate of 1.42 per cent from 1983 to 1992 and 42per cent of aggregate TFP growth came about because of increasing output shares at more productive plants.

Based on the above facts, Melitz (2003) proposes a dynamic industry model with heterogeneous firms to study the role of international trade as a catalyst for inter-firm reallocations within an industry. Melitz (2003) considers an industry where firms are exogenously heterogeneous in terms of productivity. There is only one pure production input, called labor, and the more productive firms are able to produce more units of output for the same amount of inputs.<sup>8</sup> Given an isoelastic demand structure and monopolistic competition, more productive firms have higher revenues and are larger. Due to the presence of a fixed cost of participating in the domestic market, only firms that satisfy a minimum level of efficiency are able to make positive profits and stay in the market. Similarly, exporting requires the payment of a (higher) fixed cost and of a variable trade cost. As such, only the most productive, among the domestic producers, find it profitable to export.

Melitz (2003) shows how, when countries open to international trade, only the most productive firmsthose that are able to cover the export fixed cost with their sales-enter the export market. The pressure on wages due to the higher labor demand by new exporters (and potential entrants) drives the least productive firms out of the market. Further exposure to trade, in the form of an additional reduction in tariffs or transport costs, implies further reallocation of resources towards the most productive firms within an industry. Overall, aggregate productivity grows when trade barriers are reduced. The main message from Melitz (2003) is that aggregate productivity grows thanks to a reallocation of resources (*i.e.* labor) from the least productive firms (*i.e.* exiting and surviving domestic producers) to the most productive ones (*i.e.* current and new exporters). However, reallocation of workers across firms does not affect wage inequality in the Melitz (2003) model since labor is homogeneous (*i.e.* all workers share

**<sup>7</sup>** Syverson (2004) uses the 1977 Census of Manufactures to compute productivity distribution moments for 443 four-digit SIC (Standard Industrial Classification) manufacturing industries.

<sup>8</sup> An isomorphic interpretation is that more productive firms are able to produce the same quantity of goods, but of higher quality, with the same amount of inputs.

the same characteristics) and the labor market is perfectly competitive. As such, all workers employed by firms belonging to the same industry receive exactly the same wage. In the next section, we show how extensions of the Melitz (2003) basic framework can shed light on interesting linkages between the extent of barriers to international trade and the dispersion in wages.

### 3.2. Filling the pie: three theories of trade and wages

The three theoretical mechanisms that we present in the next section rely on different combinations of firm and worker heterogeneity. Amiti and Davis (2011) assumes homogeneous labor and exogenous differences in firms' efficiency in the domestic and foreign markets. Verhoogen (2008) assumes that firms are heterogeneous in their capability of combining different inputs to reach a given quality level for the products that they sell. Because of that they have different incentives to attract observationally better workers and they end up with workforces that are heterogeneous in terms of skills. Helpman *et al.*, (2010) shows that more productive firms have a higher incentive to screen and hire workers that are ex-ante equal but ex-post more able.

Both workers' and firms' heterogeneity play a role in the theory. This parallels what the data say. Addison *et al.*, (2013), using matched employer-employee data for Portugal for more than two decades, provide a nice decomposition of the variation in log real hourly wage into components related to firms', workers', and job title's characteristics (both observed and unobserved). They find that worker permanent heterogeneity is the most important source of wage variation (36 per cent), and that the unobserved component plays a more important role (21 per cent) than the observed component (15 per cent). Firm permanent effects are less important but still quite sizable (28.7 per cent). Job title effects explain about 10 per cent of wage variation. In a related paper, Moxnes *et al.*, (2013) study if exporters' superior performance is due to intrinsic firm quality or to more able workers. Using Norwegian matched employer-employee data, they show that the exporter wage premium falls by roughly 50 per cent after controlling for observed and unobserved worker characteristics, while the TFP premium falls by 25 – 40 per cent, suggesting that sorting explains up to half of these premia. Overall, workers' and firms' heterogeneity seem to play equally important roles. This confirms the importance of all the three theoretical mechanisms discussed next for addressing the impact of trade on wage inequality.

### 3.2.1. Exports, imports, and wage inequality

The first model we discuss is developed in Amiti and Davis (2011). They provide a simple extension of Melitz (2003) that introduces a link between a firm's performance and the wages it pays to its workers. Compared to Melitz (2003), Amiti and Davis (2011) consider a wider array of trade activities: besides selling its product on the domestic market and eventually exporting it to other countries, a firm can also import intermediate goods. Importing, like exporting, requires the payments of a fixed cost but the possibility of using foreign-produced intermediate inputs (and to combine them with local inputs) allows firms to reduce their marginal cost of production, thereby increasing their potential for sales both on the domestic and export markets. The decision to include an import choice into the model is motivated by the evidence on the large and growing importance of trade in intermediates (Yi (2003)) and by the goal of the authors to show the importance of distinguishing between the effects of changes in output and inputs tariffs. As in Melitz (2003), participation to the domestic and export markets requires the payment of a fixed cost. Due to the fixed costs, only firms that satisfy a minimum level of efficiency are able to make positive profits and stay in the market. Similarly, only firms that are efficient enough find it profitable to pay the fixed cost of exporting or importing.

If the description of the model ended now there would be a clear productivity ranking of firms according to their trade status. Domestic firms would be the least productive and exporter-importer would be the most productive firms. Intermediate firms would be either exporter-only (*i.e.* export but not import)

or importer-only depending on the relative magnitude of the fixed and variable costs of exporting and importing. For example if, all else equal, the fixed cost of importing were higher than the one of exporting there would be no import-only firms. However, Amiti and Davis (2011) allow for an extra layer of heterogeneity by making the variable export and import costs firm-specific: while a part of these costs is common to all firms, another part is specific to the firm so that some firms are more efficient than others at exporting and/or importing. Moreover, the size of the firm-specific component can be correlated with the overall efficiency of the firm. For example, some exporters that face relatively small variable export costs can be less efficient (in the domestic market) than some nonexporters.<sup>9</sup> The additional layers of heterogeneity imply that all types of firms (domestic, export-only, import-only, exporter-importer) can co-exist in equilibrium.

Amiti and Davis (2011) further assume that labor is homogeneous but labor markets are imperfect. They do that by assuming a fair-wage constraint (similarly to Egger and Kreickemeier (2009)). The wage is increasing in the profitability of the firm. Workers demand these wage premia as a condition of exerting effort because it is considered fair that a more profitable firm pays a higher wage (Akerlof (1982)). Firms are willing to pay these wages because it is necessary to elicit effort. The wages are not bid down because all workers are identical and once hired any other worker will likewise demand the fair wage. In practical terms, wages are a positive function of profits. All else equal, a firm that exports a larger share of its output or imports a higher share of its inputs will have higher profits and wages. This is consistent with the data: Martins and Opromolla (2012) show that in Portugal there is a wide difference between the average hourly wage paid by firms that trade and firms that do not trade. Using worker-level data for manufacturing firms from *Quadros de Pessoal* they find that the unconditional *(i.e.* not controlling for firms' and workers' characteristics) wage premium is 2.8 per cent for firms that export (but do not import), 27.5 per cent for firms that import (but do not export), and 33.8 per cent for firms that both export and import.

In this framework, trade affects wage inequality by affecting firms' profits and their mode of globalization. Therefore, to understand how a trade liberalization affects wage inequality within an industry we must understand how it affects the distribution of profits across the firms that operate in the industry. Amiti and Davis (2011) show that a decline in output tariffs reduces wages of workers at firms that sell only in the domestic market, but raises wages of workers at firms that export. Similarly, a decline in input tariffs raises the wages of workers at firms using imported inputs, but reduces wages at firms that do not import inputs. Variations in tariffs also drive some firms out of the market. The overall effect on wage inequality depends on the initial distribution of firms by productivity and trade status. Therefore, the effect of a reduction in output or input tariffs (or a combination of the two) on wage inequality varies across industries. The main theoretical result of Amiti and Davis (2011) is that the wage consequences of a particular tariff change depend on the mode of globalization of the firm.<sup>10</sup> It is important to note that the theoretical results in Amiti and Davis (2011) are not limited to the case of changes in tariffs: they carry through for any change in the relative marginal cost of serving final goods markets or sourcing inputs from foreign *vs.* domestic markets. This includes changes in transport costs, regulation, or other barriers that affect these relative marginal costs.

**<sup>9</sup>** The empirical evidence confirms that the productivity distributions of exporters and nonexporters partly overlap. Impullitti *et al.*, (2013) provide an extension of Melitz (2003) where firms are subject to idiosyncratic productivity shocks. The presence of sunk costs of exporting makes the decision to participate in the foreign market history-dependent. In this setting, the efficiency distributions of exporters and nonexporters overlap along the band of inaction: the most efficient nonexporters lie to the right of (*i.e.* are more efficient than) the least efficient exporters.

**<sup>10</sup>** Amiti and Davis (2011) confirm the main predictions of their model using a rich data set covering the Indonesian trade liberalization of 1991-2000.

### 3.2.2 Trade, quality upgrading and wage inequality

The next model we discuss, Verhoogen (2008), focuses on shifts in the within-plant product mix between goods of different qualities destined for different markets as a mechanism linking trade and labor-market outcomes. Some firms pay higher wages than others because they recruit workers that are "better" in terms of some observable characteristics (*i.e.* education, experience). Verhoogen (2008) observes that, during the late-1994 Mexican peso crisis, initially more productive plants increased the export share of sales, wages, the wage premium paid to white-collar workers, and ISO 9000 certification (an international production standard commonly associated with product quality) more than initially less productive plants. Since these initially more productive plants were already paying higher wages, wage inequality considerably increased after the peso devaluation. Most of the increase was due to the within-industry component.

Verhoogen (2008) explanation for these concurrent changes is the following. Following Melitz (2003), the peso devaluation provided a stronger incentive to start exporting, or to increase exporting, to initially more productive firms. As suggested by lacovone and Javorcik (2012), firms might need, before exporting, to make additional investments to make their product more desirable to foreign consumers.<sup>11</sup> Wealthier foreign consumers, in particular, might have a stronger preference for quality. Therefore, new exporters and current exporters increasing the export share of their sales should invest in increasing the quality of their product. Doing that might require, among other things, recruiting a more qualified labor force, and therefore paying higher wages.

More specifically, Verhoogen (2008) considers a two-country model where Northern (U.S., in his application) consumers value quality more than Southern (Mexican) consumers. All else equal, Northern consumers are willing to pay a higher price, than Southern consumers, to buy a product with the same quality level.

On the supply side, production technology is such that each unit of output carries fixed factor requirements: one white-collar worker, one blue-collar worker, and one machine. However, each of these inputs is available in different "qualities". Recruiting a more qualified blue-collar worker, for example, allows a firm to produce a higher quality product. Moreover, the contribution of the more qualified blue-collar worker depends on the "quality" of all the other inputs (white-collar workers and machines) that are currently used. This occurs because the production technology exhibits what is technically called "supermodularity" (as opposed to submodularity) or complementarities. Milgrom and Roberts (1990) explain that two tasks are complementary if performing one better raises the marginal product of better performance in the other. On the contrary, when a production function is submodular, superior performance of one task mitigates the need for superior performance in the others. Grossman and Maggi (2000) provide some examples: as an example of supermodularity, Japan tends to excel in industries requiring care and precision in a long sequence of production stages. Its exports include many sophisticated consumer goods, such as automobiles and high-end consumer electronics. Whereas the United States (as an example of submodularity) exports many goods and services whose value reflects disproportionately the input of a few very talented individuals. Its highly successful software industry is an example of this. The same applies to Italian innovative furniture styles, fashion designs, and movies.

Verhoogen (2008) assumes that the strength of the supermodularity "reinforcing mechanism" is heterogeneous across plants: some firms are more "productive" than others in the sense that (i) they can produce a higher quality product using a given set of inputs, and (ii) a marginal increase in the quality of one of the inputs (ex. blue-collar worker) marginally increase the quality of the product by more than in other firms. Obviously, these firms have a higher incentive of recruiting "better" workers and using

<sup>11</sup> lacovone and Javorcik (2012) provide anecdotal evidence from their August 2007 visit to a leading Mexican company producing fruit and vegetable juices. They explain that, 'while Mexican consumers prefer cartons, US buyers have a preference for plastic and glass containers. In the juice industry, package attractiveness plays a very important role. To improve the quality of its packaging, the company opted for a new technology where export-destined containers are covered with sleeves on which product labels are printed, as this produces a more attractive appearance than printing directly on a container.'

better machines. Higher quality inputs are, however, costlier. There are many reasons why this is true. Consider, for example, plants that face worker quality-wage schedules that are upward-sloping (*i.e.* recruiting higher quality workers implies the payment of a higher wage). This is consistent with: (i) a model in which worker quality represents general skill, workers are heterogeneous in skill levels within each occupational category, and plants must pay high wages to attract high-skill workers, as in Kremer (1993); a model in which worker quality represents effort and plants must offer efficiency wages in order to induce workers to supply it (Akerlof (1982); Shapiro and Stiglitz 1984; Bowles 1985); or a model in which worker quality represents plant-specific skills and workers bargain for a share of the gains to investments in those skills (Hashimoto 1981). For Verhoogen (2008) purposes, the important point is that worker quality improves product quality and is costly to the plant to acquire.

Each plant chooses the white-collar wage, the blue-collar wage, capital intensity, and output price to maximize profits, separately for each production line. The input decisions determine quality; quality and price pin down demand and hence output. Verhoogen (2008) shows that more productive plants produce higher-quality goods, pay higher wages to both white-collar and blue-collar workers, are more capital-intensive, and charge higher prices than less productive plants. Moreover, if a plant enters both the Southern and the Northern markets, it chooses greater quality, prices, wages, and capital intensity for goods sold in the North than for goods sold in the South because of the North stronger preference for quality. All else equal, plant size and wages are positively correlated: more productive plants hire more workers (because they sell more) and pay higher wages. The model thus provides a natural explanation for the employer size-wage effect, documented by Brown and Medoff (1989) and others.

In this context, an increase in the incentive to export to a more developed country generates differential quality upgrading: initially more-productive plants increase exports, produce a greater share of higherquality goods, and raise wages relative to initially less-productive plants in the same industry. Since initially more-productive plants also tend to be initially higher-wage, this process increases within-industry wage dispersion. Verhoogen (2008) finds evidence consistent with an increase in wage inequality through trade and quality-upgrading mechanism for Mexican plants trading with the U.S. However, the insights from the theory are more general. The mechanism proposed in Verhoogen (2008) is relevant to understand the effects of trade on sectors where there is scope for significant quality-upgrading, and where the sensitivity of consumers to quality is highly heterogeneous across countries. Changes in the incentive to export can take different forms: for example, variations in exchange rates, transport costs, contract enforcement laws.

## 3.2.3. Trade, unobservable workers' characteristics, and wage inequality

Helpman *et al.*, (2010) propose a framework for examining the determinants of wage inequality that emphasizes within-industry reallocation, labor market frictions, and differences in workforce composition across firms.

Like in Verhoogen (2008), firms can either produce for the domestic market or also export (but not import as in Amiti and Davis (2011)). As in Melitz (2003), the presence of fixed costs regulates the presence of firms on the domestic and export markets. Production requires workers and workers are heterogeneous in terms of their ability. How do firms match with workers then? Helpman *et al.*, (2010) assume that the labor market is characterized by search and matching frictions a la Diamond-Mortensen-Pissarides: a firm pays a search cost to find and match with a worker. The magnitude of the search cost is endogenously determined by the tightness of the labor market: meeting a new worker is costlier if there are few workers searching for employment with respect to the firms' overall demand of new workers.

The authors assume that the output of each variety depends on the productivity of the firm, the measure of workers hired, and the average ability of these workers. However, unlike in Verhoogen (2008), worker ability cannot be costlessly observed when firms and workers are matched. More specifically, the ability

of a worker can be interpreted either as match-specific and independently distributed across matches or as a general talent of a worker that does not depend on his match, but is unobservable to both workers and firms. Of course, whatever the interpretation, a worker's ability affects production. The role of the workforce average ability can be interpreted either as capturing human capital complementarities (e.g. production in teams where the productivity of a worker depends on the average productivity of her team) or a managerial time constraint (e.g. a manager with a fixed amount of time who needs to allocate some time to each worker, as in Caliendo and Rossi-Hansberg (2012)). Whatever the interpretation, a key feature of the production technology is the presence, as in Verhoogen (2008), of complementarities in worker ability: the productivity of a worker is increasing in the abilities of other workers employed by the same firm. Therefore, a worker with a given ability can have a positive or negative marginal product, depending on the ability of his co-workers. Jin and Martins (2010) find evidence consistent with the presence of complementarities related to schooling in the Portuguese labor market. Using data from Quadros de Pessoal, they find that the firm-wide returns to education are higher than the private returns, and that less educated workers within a firm benefit from increases in their firm's average school level. Similarly to Verhoogen (2008), more productive firms have a higher incentive at recruiting workers that are, on average, more able. Since ability is not readily observable, firms have to undertake costly investments (see Barron et al., (1985)) to obtain an imprecise signal of a worker's ability. The access to the screening technology is the same for all firms but different degree of screening are possible (at a cost), and more productive firms have a higher incentive to screen.

After having observed its productivity, a firm chooses whether or not to produce, whether or not to export, the measure of workers to sample, and the screening ability threshold (and hence the measure of workers to hire). Once these decisions have been made, the firm and its hired workers engage in strategic bargaining with equal weights over the division of revenue from production in the manner proposed by Stole and Zwiebel (1996a) and Stole and Zwiebel (1996b): the firm and the workers receive (different) constant fractions of the firm's revenue. Anticipating the outcome of the bargaining game, the firm maximizes its profits. More productive firms have higher revenues, a higher incentive to sample more workers, screen to a higher ability threshold. Under the assumption that screen costs increase fast enough (with the ability threshold) and workers' abilities are dispersed enough, more productive firms are also bigger (hire more workers). The crucial implication of Helpman, Itskhoki, and Redding (2010)'s model is that (i) through the bargaining process (by adjusting employment) firms are able to push wages down to the replacement cost of a worker, and (ii) the latter is higher for larger firms since (iii) larger firms have workers of higher average ability. Replacing a worker is costlier for larger firms pay higher wages.

When the economy is opened to trade, the selection of more productive firms into exporting increases their revenue relative to less productive firms, which further enhances their incentive to screen workers to exclude those of lower ability. This mechanism generates a wage-size premium and implies that exporting increases the wage paid by a firm with a given productivity.

### 3.3. On the job search and the organization of the firm

The choice of the models presented in the previous subsection is clearly, given space constraints, nonexhaustive. Other relevant theories of how trade affects within-industry wage inequality have been recently advanced. Two interesting strands of research include models that incorporate on-the-job search and that analyze the organization of the firm. Felbermayr *et al.*, (2012) and Caliendo and Rossi-Hansberg (2012) are two important examples in these lines of research. Felbermayr *et al.*, (2012) incorporate directed labor market search and convex adjustment costs into a model of international trade with heterogeneous firms and homogeneous workers á la Melitz to study how trade affects residual wage inequality. The latter is defined as inequality in wages after taking into account differences in workers' observable characteristics (*e.g.* education, experience, etc.). They show that trade liberalization increases real wages of all employed workers. However, by changing the allocation of workers across firms, it may result in higher inequality and unemployment.

Caliendo and Rossi-Hansberg (2012) emphasize that a firm's productivity depends on how the firm is organized. They develop a theory of an economy where firms with heterogeneous demands use labor and knowledge to produce. Entrepreneurs decide the number of layers of management and the knowledge and span of control of each agent. In a companion paper, Caliendo *et al.*, (2012), it is shown, using French data, that the effect of changes in firm size and firm export status on wages depends crucially on whether they trigger a change in organization. If they do not, wages rise while, if they do, wages in all pre-existing layers fall. Their results seem to be quite robust and extend to other countries: Mion and Opromolla (2013) show that all the main results contained in Caliendo *et al.*, (2012) are also valid in the Portuguese case.

## 4. Conclusions

A classic question in international trade theory is how a change in a country's exposure to trade affects the distribution of resources across economic activities within a country and the distribution of incomes across factors of production. Recent advances in international trade empirical research have emphasized heterogeneity of firms belonging to the same, narrowly defined, industries. Trade theories have followed. A standard trade model, Melitz (2003), emphasizes the role of international trade as a catalyst for interfirm reallocations within an industry. At the same time, labor market empirical evidence has identified the importance of within-industry wage inequality. The lessons from the new trade theories are potentially important for Portugal: we show that within-industry wage inequality (i) represents a dominant component of overall wage inequality and (ii) its evolution parallels that of overall wage inequality since the mid 80s. To reconcile theory and data, we present a number of recent theoretical developments in the trade literature that, relying on different combinations of firm and worker heterogeneity, emphasize the consequences of a reduction in export and import barriers on within-industry wage inequality. These theories could prove useful to revisit the change in wage inequality in Portugal after the entrance into the EU and to explain more recent patterns.

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#### Annex: Quadros de Pessoal

Currently, *Quadros de Pessoal* collects data on about 350,000 firms and 3 million employees. For this study, we were able to gain access to information from 1986 to 2009.<sup>12</sup>

The data are made available by the Ministry of Employment, drawing on a compulsory annual census of all firms in Portugal that employ at least one worker. Each year, every firm with wage earners is legally obliged to fill in a standardized questionnaire. Public administration and non-market services are excluded. Reported data cover the firm itself, each of its plants, and each of its workers. Variables available in the dataset include the firm's location, industry, total employment, sales, ownership structure (equity breakdown among domestic private, public or foreign), and legal setting. The worker-level data cover information on all personnel working for the reporting firms in a reference week. They include information on gender, age, occupation, schooling, hiring date, earnings, hours worked (normal and overtime), etc. The information on earnings includes the base wage (gross pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly paid components.<sup>13</sup> It does not include employers' contributions to social security.

Each firm entering the database is assigned a unique, time-invariant identifying number which can be used to track firms over time. The Ministry of Employment implements several checks to ensure that a firm that has already reported to the database is not assigned a different identification number. Similarly, each worker also has a unique identifier, based on a worker's social security number, allowing to follow individuals over time. The administrative nature of the data and their public availability at the workplace–as required by the law–imply a high degree of coverage and reliability. The public availability requirement facilitates the work of the services of the Ministry of Employment that monitor the compliance of firms with the law (*e.g.*, illegal work).

(Log) hourly wage is computed adding base and overtime wages plus regular benefits (at the monthlevel) and dividing by the number of regular and overtime hours worked in the reference week multiplied by 4.3. In every year, we apply a trimming of the top and bottom 0.5 per cent. Regular and overtime hours worked are set to (i) missing if (individually) greater than 480 per month, (ii) to zero if negative. Wages were deflated using the Consumer price index (CPI - Base 2008) by Special aggregates provided by Statistics Portugal.

In Chart 1, we consider all the firms located in Continental Portugal, and all their, single-job, full- time employees, between 16 and 65 year old, and working between 25 and 80 hours (base plus overtime) per week. The (real) hourly wage in euros is based on the total number of hours worked (normal plus overtime) and is constructed as the sum of the base wage plus overtime wages and regular benefits. For each firm-year pair we compute the firm average hourly wage. For each year, we compute the standard deviation (across firms) of the average log hourly wage. We then regress the firm average log hourly wage on a full set of NACE2 industry dummies interacted with year dummies. The standard deviation of the residuals is our measure of within-industry wage dispersion. The CAE industrial activity classification used for the 1986-1994 period is Rev. 1, for the 1995-2002 period is Rev. 2, for the 2003-2006 period is rev 2.1, and for the 2007-2009 period is Rev. 3. Due to imperfect consistency of the classification over the whole sample period we split the sample in three periods: 1986-1994, 1995-2006, and 2007-2009.

<sup>12</sup> Information for the years 1990 and 2001 is only partly available due to issues arisen in the collection of the data.

**<sup>13</sup>** It is well known that employer-reported wage information is subject to less measurement error than worker-reported data. Furthermore, the *Quadros de Pessoal* registry is routinely used by the inspectors of the Ministry of Employment to monitor whether the firm wage policy complies with the law.

## Table 1

HOURLY WAGE BY CAE REV.3 INDUSTRY, 2009						
CAE Rev. 3 2-digits Category	Mean	Min	Мах	Median	Obs.	
Food products	611.3232	418.7342	3758.958	558.3123	5259	
Beverages	835.0713	418.7342	3112.882	743.5869	436	
Textiles	621.8053	418.7342	2719.79	567.2627	1756	
Wearing apparel	543.6384	418.7342	3152.675	500.5075	4274	
Leather and related products	575.5218	418.7342	2842.74	524.7577	1609	
Wood and products of wood and cork, except furniture; articles of straw and plaiting materials and plaiting	646.1517	418.7342	4652.602	587.8625	2522	
Paper and paper products	766.2006	418.7342	4101.275	677.5777	335	
Printing and reproduction of recorded media	762.844	418.7342	2700.017	702.4452	1539	
Chemicals and chemical products	990.7746	418.7342	5502.539	809.8291	516	
Basic pharmaceutical products and pharmaceutical preparations						
pharmaceutical preparations}	1635.047	418.7342	4203.867	1534.768	97	
Rubber and plastic products	830.6631	418.7342	3719.723	783.8083	753	
Other non-metallic mineral products	732.0034	418.7342	5102.788	656.8905	2464	
Basic metals	855.3523	418.7342	3081.462	753.889	242	
Fabricated metal products except machinery and equipment	745.774	418.7342	5332.813	655.5926	6067	
Computer, electronic and optical products	1086.937	418.7342	3771.163	872.1747	136	
Electrical equipment	870.5071	418.7342	3578.781	785.8571	400	
Machinery and equipment n.e.c.	907.3269	418.7342	5201.302	831.4076	1043	
Motor vehicles, trailers and semi-trailers	845.8602	418.7342	2907.048	776.5099	389	
Other transport equipment	900.3931	418.7342	3344.354	787.7833	111	
Furniture	573.0704	418.7342	2184.985	511.7862	2836	
Repair and installation of machinery and equipment	725.0231	418.7342	3765.643	647.8442	1056	

Source: Quadros de Pessoal.

**Notes:** Industries "Manufacture of tobacco products" and "Manufacture of coke and refined petroleum products" are not reported in this table due to confidentiality reasons related to the small number of observations.

# COMPETITION IN THE PORTUGUESE ECONOMY: ESTIMATED PRICE-COST MARGINS UNDER IMPERFECT LABOUR MARKETS\*

João Amador\*\* | Ana Cristina Soares\*\*

#### ABSTRACT

This article estimates price-cost margins for the Portuguese markets in a context of imperfect competition in the labour market. The database used includes virtually the universe of Portuguese firms for the period 2005-2009. The results strongly reject the hypothesis of perfect competition in both labour and product markets. Estimated price-cost margins are very heterogeneous across markets and the average for the overall economy ranges between 25 and 28 per cent, depending on the variables used to weight each market. In addition, the tradable sector presents a lower price-cost margin than the non-tradable sector. According to the methodology used, workers' bargaining power in the Portuguese economy is approximately 13 per cent, without a clear distinction between tradable and non-tradable sectors. Finally, workers' bargaining power is positively correlated with price-cost margins.

## 1. Introduction

Competition in the product market is a key ingredient for an efficient allocation of resources in the economy, thereby promoting a higher aggregate welfare. Therefore, the identification of markets where there are large deviations from the perfect competition paradigm is an important policy concern. From a theoretical point of view, market power relates to firms' ability to increase profits by sustaining prices above marginal costs. However, establishing robust measures of competition is a strong challenge both from a theoretical and empirical point of view.

This article uses the methodology presented by Roeger (1995), which closely relates to the approach proposed by Hall (1988), to test whether there is a significant gap between prices and marginal costs in Portuguese markets, *i.e.*, how distant are markets from the perfect competition paradigm. The methodology proposed by Hall (1988) for the estimation of price-cost margins is based on the relation between the Solow residual and the growth rate of inputs. However, this relation cannot be estimated by standard econometric methods such as OLS, since input growth rates are likely to be correlated with technological progress, which is not observable. In this context, Hall (1988) suggests the use of instrumental variables. However, finding suitable instruments is, in general, a severe obstacle. More recently, other authors propose the use of the generalized method of moments, such as Dobbelaere (2004), or the use of a control function, as Olley and Pakes (1996) and Levinsohn (1993).

An alternative methodology was proposed by Roeger (1995). This methodology uses the difference

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between the Solow residuals obtained through profit maximization and cost minimization problems of the firm, as a way to overcome the main source of endogeneity in the formulation of Hall (1988). In the standard version of these methodologies, constant returns to scale and the existence of homogeneous inputs that adjust instantly in perfectly competitive markets are generally assumed. However, the literature has discussed the validity of these assumptions, particularly with respect to perfect competition in the labour market. In fact, recent empirical evidence suggests that the level of product market imperfection is significantly underestimated when the degree of imperfection in the labour market is ignored.

In this context, both methodologies were modified to estimate simultaneously product and labour market imperfections, measured by the price-cost margin and workers' bargaining power, respectively. Beyond the explicit test of perfect competition, one of the advantages of both Hall (1988) and Roeger (1995) methodologies is that differences between technologies across sectors are partially taken into account by the use of production functions.

This article contributes to the assessment of competition in the Portuguese economy, complementing the alternative approaches presented in Amador and Soares (2012a,b). A distinctive feature of the article is the coverage of a large number of markets in the economy (including services) and the distinction between tradable and non-tradable sectors. This distinction is relevant given the potential disciplinary effect of international competition and the nature of the sectoral adjustment process currently underway in the Portuguese economy. Other distinctive features are the use of firm-specific measures of the user cost of capital and depreciation rates, the inclusion of tangible and intangible assets, and the test for sample selection bias.<sup>1</sup> The data used in this article is based on information on the annual accounts of Portuguese firms reported under *Informação Empresarial Simplificada (IES)* for 2005-2009.

The article concludes that the assumption of perfect competition in Portuguese product markets is widely rejected, though there is substantial heterogeneity in price-cost margin estimates. Allowing for imperfect competition in the labour market, the estimated price-cost margin for the overall economy ranges between 25 and 28 per cent, depending on the variables used to weight each market. Additionally, the price-cost margin in the tradable sector is lower than in the non-tradable sector. Similarly, perfect competition in the labour market is rejected in around 75 per cent of the markets. The workers' average bargaining power in the Portuguese economy lies between 12 and 14 per cent, according to weights considered for each market, without a clear distinction between tradable and non-tradable sectors. Nevertheless, there is a significant dispersion across markets. Consistent with the results presented in the empirical literature, estimates for workers' bargaining power are positive and strongly correlated with price-cost margins across markets in the Portuguese economy.

The article is organized as follows. The next section briefly describes the methodology used in the estimation of price-cost margins under competitive and imperfect labour markets. Next, section 3 describes the database and presents the definition of the variables. Section 4 presents the results, highlighting the difference between tradable and non-tradable sectors. Section 5 presents some concluding remarks.

#### 2. Methodology

Technological progress and market power are strongly related from a theoretical and empirical point of view. The seminal contribution of Solow (1957) introduced growth accounting to identify the role of technological progress. Later, Hall (1988) and Roeger (1995) relaxed the assumption of perfect competition in the product market, allowing for the estimation of markups. The standard formulation relies on the assumptions of efficient and homogeneous input markets, instantaneous adjustment of all input factors and constant returns to scale. Subsequently, the assumption of perfect competition in the labour market was relaxed, allowing for the joint estimation of price-cost margins and workers' bargaining power.

<sup>1</sup> For more details on the methodology used in this article and additional results see Amador and Soares (2013).

#### 2.1 Price-cost margin estimation under competitive labour markets

Considering a neoclassical production function, the assumption of efficient input markets drives the standard equality between the value of marginal productivity and the corresponding price of the input. Consequently, input elasticities correspond to their weight in output. Therefore, in the presence of market power and assuming constant returns to scale, the Solow residual (SR) can be rewritten as follows:

$$SR = \left(1 - \frac{1}{\mu}\right) (\Delta q - \Delta k) + \frac{1}{\mu} \theta \tag{1}$$

where  $\mu$  is the markup,  $\theta$  represents the growth rate of Hicks-neutral technological progress and q and k are the logarithms of output and capital, respectively. Therefore, the classical price-cost margin can be obtained from the estimate of the parameter  $(1-1/\mu)$  in equation 1. This parameter corresponds to the Lerner index, defined as (P - MgC)/P, where P and MgC represent the price and marginal cost, respectively. However, the last term in equation 1 is not observable, thus the OLS estimator is inconsistent. The solution proposed by Hall (1988) consists in using instrumental variables. However, it is usually difficult to obtain suitable instruments and results tend to be sensitive to this choice. In this context, Roeger (1995) proposed an alternative approach.

Considering the firm's dual problem, *i.e.*, cost minimization for a given level of output, along with the assumption of imperfect competition in the product market and constant returns to scale, the Solow residual of the dual problem  $(SR^d)$  is:

$$-SR^{d} = (1 - \frac{1}{\mu})(\Delta p - \Delta r) - \frac{1}{\mu}\theta$$
<sup>(2)</sup>

where p is the logarithm of the price and r is the logarithm of the cost of capital. Finally, adding the primal and dual Solow residuals (equations 1 and 2), it is possible to write:

$$SR - SR^{d} = \left(1 - \frac{1}{\mu}\right) \left[ (\Delta p + \Delta q) - (\Delta r + \Delta k) \right]$$
(3)

Consequently, the term related to technological progress in equation 3 is eliminated, solving the inconsistency problem mentioned above. This approach allows for the estimation of the price-cost margin consistently by OLS. Furthermore, this formulation avoids the use of deflators, which is a source of measurement error, particularly when firm level data is used. However, a measure of the cost of capital is required.

#### 2.2 Price-cost margin estimation under imperfect labour markets

In the previous subsection market power was estimated assuming that workers receive perfectly competitive wages, *i.e.*, assuming that their bargaining power is null. However, this assumption is not supported by empirical evidence.

The approaches suggested by Hall (1988) and Roeger (1995) can be modified to account for imperfect competition in the labour market (see Crépon *et al.*, (2005), Dobbelaere (2004) and Abraham *et al.*, (2009)). Under imperfect labour markets, wages (W) and the number of workers (L) are simultaneously chosen according to a standard Nash bargaining problem, which involves sharing the surplus between firms that maximize profits and workers whose utility depends on employment and wages, that is:

$$\max_{L,W} \Omega = \left[ (W - \overline{W})L \right]^{\varphi} (PQ - WL)^{(1-\varphi)}$$
(4)

where W is the reservation wage (related to the best alternative wage in the labour market and unemployment benefits), P and Q represent the price and quantity sold, respectively. In addition,  $1 \ge \varphi \ge 0$  represents the bargaining power of the workers, where  $\varphi = 0$  corresponds to competitive labour markets and  $\varphi = 1$  to a total appropriation of the firm's surplus by the workers. <sup>2</sup> In this context, assuming imperfect competition and an isoelastic demand function, the Solow residual can be written as:

$$SR = \left(1 - \frac{1}{\mu}\right) (\Delta q - \Delta k) + \left(\frac{\varphi}{1 - \varphi}\right) (\alpha^{L} - 1) \left[\Delta l - \Delta k\right] + \frac{1}{\mu} \theta$$
(5)

where  $\alpha^{L}$  represents the weight of labour costs in output. The dual counterpart of this problem is:

$$-SR^{d} = \left(1 - \frac{1}{\mu}\right)(\Delta p - \Delta r) + \left(\frac{\varphi}{1 - \varphi}\right)(\alpha^{L} - 1)\left[\Delta w - \Delta r\right)\right] - \frac{1}{\mu}\theta$$
(6)

where w is the logarithm of wages. Thus, allowing for imperfect competition in the labour market and assuming constant returns to scale, the modified Roeger (1995) approach is:

$$SR - SR^{d} = \left(1 - \frac{1}{\mu}\right) \left[\left(\Delta p + \Delta q\right) - \left(\Delta r + \Delta k\right)\right] + \frac{\varphi}{(1 - \varphi)} (\alpha^{L} - 1) \left[\left(\Delta l + \Delta w\right) - \left(\Delta r + \Delta k\right)\right]$$
(7)

This equation allows for the joint estimation of price-cost margins and workers' bargaining power. The exclusion of the last term induces a bias in the price-cost margin estimate, which is higher the higher the bargaining power, the weight of labour costs in output and the larger the difference between the growth rate of nominal labour and capital costs.

#### 3. Database and variable definitions

#### 3.1. Database description

The data used in this article draws on the annual accounts of Portuguese firms reported under *Infor-mação Empresarial Simplificada (IES)* for 2005-2009.<sup>3</sup> This database provides very detailed information on items of the balance sheet and income statements for virtually the universe of non-financial firms. The initial raw dataset coincides with the one used in Amador and Soares (2012a,b). However, at odds with these articles, the information drawn from *Central de Balanços* for 2000-2004 was not considered. Since *Central de Balanços* contains information on a sample of Portuguese firms, comprising mainly large ones, the final set of information was insufficient to ensure the significance of the estimated parameters. On the contrary, in the case of *IES*, despite being available on a comparable basis for a limited number of years, its almost universal coverage provides a substantial set of observations.

**<sup>2</sup>** There are alternative models of negotiation between firms and workers where wages and number of workers are decided sequentially (see, *e.g.*, Walque *et al.*, (2009)). In addition, there are methodological options in the Nash bargaining setup that may change results, namely the firm's thread point at the moment of negotiation. In this context, the definition of capital stock (gross or net), as well as the use of GVA alternatively to output can also change results.

**<sup>3</sup>** Although *IES* formally began in 2006, it included a report for 2005. For this reason, for the purpose of this article, *IES* is considered from 2005 onwards.

Some observations were eliminated from the database to ensure robust estimations. Firstly, firms reporting less than two consecutive observations were eliminated. Additionally, only firms reporting strictly positive sales, labour costs, intermediate inputs and net capital stock (tangible and intangible) were considered. Secondly, observations associated to depreciation rates and share of labour costs and intermediate inputs in total sales outside the [0,1] range were excluded. Moreover, observations below the 1st percentile and above the 99th percentile in the distribution of growth rates of sales, labour costs, intermediate inputs and tangible and intangible assets were excluded. Thirdly, consistent with profit maximization in the long run, firms exhibiting negative operational profits were withdrawn, representing approximately 22 per cent of the observations in the database. However, this option may increase the potential for the existence of a sample selection bias. Although this problem is typically disregarded in the literature, in this article the impact of selection bias is assessed through the two-step Heckman (1979) procedure. Finally, sectors as "Agriculture, Mining and Quarrying", "Education" and "Health" were disregarded given their low share in total gross value added (GVA) or the significant relevance of the general government in the functioning of the market.

Given the reduced number of observations for each firm over the period considered, price-cost margins were estimated at market level, *i.e.*, we assume that price-cost margins and bargaining power are the same for all firms within each market. Nevertheless, it is necessary to establish a criterion to define markets. In order, to overcome the well known difficulties in establishing relevant markets, the standard approach in the literature is to use an economic activity classification. Similarly to Amador and Soares (2012a,b), markets are defined at 3-digit level in NACE Rev. 1. However, markets with less than 5 observations for a given year were eliminated. Overall, the article considers a total of 156 markets, 108 of which are considered tradable and 48 as non-tradable. As discussed in Amador and Soares (2012a), the set of tradable markets includes all manufacturing markets plus those where the exports to sales ratio exceeds 15 per cent.<sup>4</sup> In this sample, the non-tradable sector represents 56 per cent of GVA, 61 per cent of sales and 54 per cent of total employment in the period 2006-2009.

#### 3.2 Definition of variables and descriptive statistics

The set of variables required to estimate equation 7 is relatively large. Firstly, output corresponds to sales of goods and services, and its growth rate is  $\Delta p_t + \Delta q_t$ . Secondly, labour costs are given by nominal wages and other benefits including social security contributions, and its growth rate is represented by  $\Delta l_t + \Delta w_t$ . Thirdly, shares of labour costs and intermediate inputs ( $\alpha^L$  and  $\alpha^M$ ) consist of the ratios of labour costs and costs of goods and services to sales, respectively. Chart 1 displays the distribution of these shares for Portuguese firms in 2008, distinguishing between those operating in tradable and non-tradable sectors. The average share of labour costs and intermediate inputs are 25 and 62 per cent, respectively. The distribution of labour cost shares is positively skewed, presenting greater dispersion in the tradable sector. In contrast, the distribution of intermediate inputs shares is negatively skewed in the non-tradable sector and closer to a Gaussian distribution in the tradable sector.

The estimation of equation 7 also requires information on the stock of capital and its user cost. Differently from most studies, the stock of capital considered in this article includes both tangibles and intangibles. If intangibles are dismissed, results can be substantially biased, particularly in services markets where these assets tend to have an extremely relevant role.

The user cost of capital is the price to pay for hiring or purchasing one unit of capital services and includes a measure of the financial cost of capital and the depreciation rate. Unlike most studies in the literature, this cost was calculated at firm level, which is likely to reduce measurement error. Following Hall and

**<sup>4</sup>** Note that the set of markets considered in the article does not fully coincide with the one used in Amador and Soares (2012a,b) basically due to the exclusion of the information obtained under *Central de Balanços* (2000-2004).

#### Chart 1



Source: Author's calculations.

Jorgenson (1967), the user cost of capital of firm *i* in year *t* is defined as  $r_{i,t} = (i_{i,t} - \hat{P}_{I,t} + \delta_{i,t})P_{I,t}$ , where  $i_{i,t}$  is the financial cost of capital,  $\delta_{i,t}$  is the depreciation rate,  $P_{I,t}$  and  $\hat{P}_{I,t}$  represent the level and growth rate of investment goods prices, respectively. These elements derive from the standard equation that relates the value of an asset to the discounted real flows of rentals expected over its lifetime.<sup>5</sup>

The depreciation rate at firm level is calculated as the ratio of total depreciations in year t to gross capital stock in year t-1, *i.e.*, for firm i in year t,  $\delta_{i,t} = \text{depreciation}_{i,t} / K_{i,t-1}$ . The calculation of firm-level depreciation rates makes it possible to capture some of the heterogeneity in the stock of capital. Chart 2 a) presents the distribution of the depreciation rate for Portuguese firms in 2008. The distribution is positively skewed and the average for the overall economy lays around 10 per cent, with no significant differences between firms in tradable and non-tradable markets. These figures are in line with those used in similar articles. For example, Christopoulou and Vermeulen (2012) use a rate of 8 per cent with longitudinal data, Boulhol *et al.*, (2006) uses rates of 5 and 7 per cent, while Konings and Vandenbussche (2005) assume a depreciation rate of 10 per cent.

While the calculation of the depreciation rate is relatively straightforward, the calculation of financial cost of capital is more complex. This article assumes that the financial cost of capital is given by the ratio between interest and financial debt for each firm and year. Thus, it is assumed that funding through equity is equivalent to funding through debt. Chart 2 b) shows the distribution of the financial cost of capital of Portuguese firms in 2008. The distribution is positively skewed, with an average of approximately 15 per cent and a median of 10 per cent. Additionally, the density in the tail that corresponds to lower costs of capital is higher in the non-tradable sector than in the tradable sector. Finally, regarding the deflator of investment goods ( $P_{I_t}$ ), it was obtained directly through national accounts.

<sup>5</sup> For more details on the methodologies used to measure the capital stock and its user cost see OECD (2001).





In order to avoid a substantial loss of observations, the financial cost of capital of the firms that report no debt, interest payments or ratios outside the [0,1] range was considered equal to the average of the respective market in each year. Chart 3 displays the distribution of the user cost of capital of Portuguese firms, using the imputation referred above. This distribution is positively skewed with an average of about 20 per cent.

## Chart 3



DISTRIBUTION OF THE USER COST OF CAPITAL AT FIRM-LEVEL IN 2008



Note: The distribution displayed in the chart corresponds to the real financial cost of capital added to the depreciation rate.

#### 4. Results

In this section we test the paradigm of perfect competition in Portuguese product markets in the period 2006-2009, allowing for imperfect labour markets, *i.e.*, estimating equation 7 for each market and distinguishing those with a tradable and non-tradable nature. The equation is estimated by OLS with clustered errors (benchmark specification). In addition, regressions with fixed effects, random effects and the two-step Heckman procedure are also estimated to ensure robust results. Furthermore, aggregations for some sectors are presented, as well as for the overall economy.

The perfect competition paradigm is widely rejected in Portuguese product markets. At a significance level of 5 per cent, estimated price-cost margins are statistically different from zero for virtually all markets considered (95 per cent of the markets). Chart 4 a) ranks estimated price-cost margins from the highest to the lowest, uncovering a substantial heterogeneity across markets. Price-cost margins range between a minimum of 6 per cent and a maximum of 62 per cent. The comparison between tradable and non-tradable sectors suggests lower competition intensity in the latter, with unweighted price-cost margins of 26 and 29 per cent, respectively. This difference is slightly higher when manufacturing and non-manufacturing sectors are compared. The price-cost margin for the overall Portuguese economy stands at 27 per cent.

Given the relevance of the results in terms of policy, the comparison of price-cost margins obtained through different econometric approaches is particularly important. Chart 4 b) reports price-cost margins estimated by fixed effects, random effects and two-step Heckman procedure for each market, sorted according to the benchmark specification.<sup>6</sup> It should be noted that the rank of markets obtained through the different specifications is largely unchanged, implying that the identification of markets with a



# Chart 4

Source: Author's calculations.

**Note:** Each market corresponds to a 3 digit level in NACE Rev. 1 classification. Black bars identify non-tradable markets as defined in Amador and Soares (2012a). Coefficients were obtained through OLS regressions with cluster errors, for each market (benchmark specification). Grey bars correspond to coefficients not significant at 5 per cent, in at least one specification.

**6** The two-step Heckman procedure was used to test and correct the potential sample selection bias associated with the exclusion of a substantial number of firms with negative operational profits. The inverse Mills ratio is significant for around 30 percent of the markets, at a 5 per cent significance level. The explanatory variables in the participation equation are firm's age, sales and lagged total assets, in logarithm. Furthermore, the introduction of annual dummies in the remaining econometric approaches did not affect the results, thus they were not included. The Hausman test was also performed for each market and random effects were rejected in around 45 per cent the markets at a 5 per cent significance level.

potentially less intense competitive environment does not change. The share of markets where there is statistical evidence to reject the perfect competition paradigm is below 8 per cent for all specifications, and these markets belong exclusively to the manufacturing sector.

One of the results in the literature is that estimates for the price-cost margin are higher if the methodology allows for the existence of imperfect competition in the labour market, *i.e.*, when workers hold some bargaining power. Under this assumption, the regression captures the overall surplus extracted by the firm to the consumer through its market power, including the part that is transferred to the workers through their bargaining power in the labour market. In fact, by assuming perfect competition in the labour market (null bargaining power for the workers), labour costs are incorrectly assumed to translate workers' productivity, thus underestimating firm's market power. Chart 5 illustrates this result by comparing price-cost margins presented above with those obtained assuming perfect competition in the labour market. The average underestimation is 11 p.p., though in some markets the bias reaches values above 35 p.p.. The results in the empirical literature have also pointed a substantial underestimation. Bassanetti et. al. (2012) refers an underestimation of 10 p.p.. Considering only the manufacturing sector, Dobbelaere (2004) reports a higher underestimation, around 20 p.p.. Still, there is a high correlation between estimated price-cost margins in both contexts (80 per cent), *i.e.*, markets associated to lowest competition intensity do not change substantially.

The estimate for the term  $\varphi / (1 - \varphi)$  in equation 7 makes it possible to recover the parameter for the workers' bargaining power ( $\varphi$ ) in each market. Chart 6 a) reports workers' bargaining power in each market sorted in descending order. As reported for the product market, the assumption of perfect competition in the labour market is widely rejected (in about 75 per cent of the markets, at a significance level of 5 per cent). This percentage is higher in the non-tradable (85 per cent) than in tradable sector (72 per cent).



Notes: Each market corresponds to a 3 digit level in NACE Rev. 1 classification. Black dots identify non-tradable markets as defined in Amador and Soares (2012a). Coefficients were obtained through OLS regressions with cluster errors, for each market.

Workers' bargaining power is very heterogeneous, reaching values higher than 30 per cent in specific markets of "Transports" and "Real estate activities" but also very low figures in markets related to "Trade" and the manufacturing sector. Negative values are abnormal and are associated to non significant estimates, *i.e.*, markets where it is not possible to reject the existence of perfect competition in the labour market. Unweighted average bargaining power for the overall economy stands at 14 per cent, close to the figures found for tradable and non-tradable sectors. Regarding the results for different formulations, chart 6 b) overlaps estimates sorted according to the benchmark specification. The results are broadly consistent, though it can be seen that some estimates obtained using fixed effects differ from the benchmark specification but the overall rank is maintained.

As it is suggested in the empirical literature, results show that the degree of imperfection in the product market is closely related to the degree of imperfection in the labour market. The correlation between price-cost margins and workers' bargaining power across markets is around 81 per cent (Chart 7). For example, Estrada (2009) reports a correlation of 50 per cent for several EU countries for the period 1980-2004. Considering only the manufacturing sector, Boulhol *et al.*, (2006) studied 20 markets in the UK in the period 1988-2003 and reports correlations of 71 and 53 per cent in different specifications, while Dobbelaere (2004) reports a correlation of 87 per cent for a set of Belgian firms in the period 1988-1995. The latter article presents two alternative explanations for the positive correlation between price-cost margins and workers' bargaining power. One explanation is that a high bargaining power leads to increased wages and the reduction of the rents kept by the firm. Consequently, some firms exit the market, thus reducing the intensity of competition in the product market. In this context, Blanchard and Giavazzi (2003) suggest a model that relates labour and product market imperfections.



Source: Author's calculations.

**Notes:** Each market corresponds to a 3 digit level in NACE Rev. 1 classification. Black bars identify non-tradable markets as defined in Amador and Soares (2012a). Coefficients were obtained through OLS regressions with cluster errors, for each market (benchmark specification). Grey bars correspond to coefficients not significant at 5 per cent, in at least one specification.

# Chart 7 PRODUCT AND LABOUR MARKET IMPERFECTION | PER CENT



Source: Author's calculations.

**Notes:** Each market corresponds to a 3 digit level in NACE Rev. 1 classification. Black dots identify non-tradable markets as defined in Amador and Soares (2012a). Coefficients were obtained through OLS regressions with cluster errors, for each market.

The top block of Table 1 reports estimated price-cost margins, aggregating markets into sectors and considering several weights (markets, sales, GVA and employment).<sup>7</sup> Similarly, the bottom block of the table displays workers' bargaining power. "Electricity" and "Construction" exhibit the highest price-cost margins (above 35 per cent) and are associated to workers' bargaining power above that of other sectors of the economy (around 14 and 20 per cent, respectively). In contrast, the lowest price-cost margins are associated to "Trade" and, to a lesser extent, the manufacturing sector. In these cases, the bargaining power is also lower than that of other sectors of the Portuguese economy. Furthermore, results obtained with various weighing variables and alternative specifications are not substantially changed.

Studies for other countries report estimates for price-cost margins and bargaining power. However, the articles exhibit substantial differences in terms of sectors included, sample periods, characteristics of the databases and methodological details, which limits comparability. Estrada (2009) uses industry data and reports price-cost margins for Germany, Spain, Italy and France of 34.7, 25.3, 22.8 and 16.2 per cent, respectively, and workers' bargaining power of 20.2, 7.2, 12.6 and 14.2 per cent, respectively. Additionally, Moreno and Rodriguez (2010) uses a sample of 2000 Spanish manufacturing firms in the period 1990-2005 and reports a price-cost margin under imperfect labour markets of 17.6 per cent and a coefficient for workers' bargaining power that lies between 13 and 15 per cent. Similarly, Dobbelaere (2004) and Abraham *et al.* (2009) report an average price-cost margin of 33 to 26 per cent for the Belgian manufacturing sector, along with a bargaining power of 24 and 12 per cent, respectively. Considering a set of French firms in the manufacturing sector, Crépon *et al.* (2005) reports a price-cost margin of 30 per cent and a high parameter for workers' bargaining power (66 per cent).

<sup>7</sup> The weights used are based on the average period of 2006-2009.

## Table 1

PRICE-COST MARGIN AND BARGAINING POWER FOR SOME SECTORS									
	Nb. of markets (1)	Non-rejection of perfect competition (percentage of	Min.	Max.	Median	Unweig- hted average	Weighted averag		erage
		markets) (2)					Sales	GVA	Employ- ment
Price-cost margin									
Overall economy	156	5	6.1	61.7	25.2	26.6	24.9	27.7	25.7
						(5.4)	(3.1)	(4.2)	(1.9)
Manufacturing	93	9	6.1	46.8	24.8	24.7	24.2	25.3	24.7
						(6.4)	(5.5)	(4.6)	(3.0)
Non-manufacturing	63	0	7.7	61.7	27.8	29.5	25.3	28.8	26.2
						(5.4)	(2.8)	(4.1)	(1.6)
Tradable	108	7	6.1	56.1	25.0	25.8	24.7	25.7	25.4
						(6.2)	(4.8)	(4.0)	(2.6)
Non-tradable	48	0	7.7	61.7	26.9	28.5	25.1	29.3	25.9
						(3.7)	(2.8)	(4.2)	(1.7)
Electricity and water supply	3	0	29.6	39.2	38.6	35.8	38.0	38.1	38.5
						(6.6)	(6.6)	(6.6)	(6.7)
Construction	5	0	28.3	47.5	39.3	38.9	44.6	44.1	43.2
						(2.8)	(0.7)	(0.7)	(0.7)
Trade	23	0	7.7	57.7	19.0	20.9	17.2	19.7	20.4
						(1.8)	(0.9)	(0.9)	(1.0)
Transports and	10	0	21.4	F.C. 1	27.0	21 7	26.9	26.2	27 F
communications	10	0	Z1.4	30.1	27.8	31./ (с.г.)	20.8	20.3 (F 1)	(27.5
Oth an ann i ana	22	0	0.2	C1 7	24.0	(0.5)	(5.0)	(5.1)	(3.7)
Other services	22	0	9.2	61.7	34.0	34.4	32.8	30.3	21.8 (1.7)
						(3.9)	(1.7)	(1.7)	(1.7)
Bargaining power									
Overall economy	156	24	-8.6	34.1	13.5	13.5	11.9	12.9	12.8
						(5.2)	(2.6)	(3.4)	(2.2)
Manufacturing	93	30	-8.6	30.7	13.8	13.1	11.8	13.0	13.4
						(5.8)	(5.6)	(4.4)	(2.9)
Non-manufacturing	63	14	-1.2	34.1	12.3	14.0	11.9	12.8	12.4
						(5.2)	(2.2)	(3.3)	(2.0)
Tradable	108	28	-8.6	34.1	13.9	13.5	11.5	11.8	12.7
						(5.6)	(5.0)	(4.0)	(2.5)
Non-tradable	48	15	-1.2	27.0	12.2	13.5	12.2	13.7	12.8
						(3.7)	(2.1)	(3.3)	(2.1)
Electricity and water supply	3	67	7.6	25.7	8.6	14.0	9.7	10.5	16.0
						(6.7)	(4.5)	(4.5)	(4.7)
Construction	5	0	16.0	24.7	19.1	20.6	23.4	23.2	22.8
						(2.4)	(0.6)	(0.6)	(0.6)
Trade	23	4	4.7	27.0	10.0	11.4	9.4	10.9	11.6
						(1.7)	(0.8)	(0.8)	(1.0)
Transports and	4.5	26					40 -		40.5
communications	10	20	5.3	34.1	16.4	16.1	13.5	12.7	13.0
	22	10	1 2	20.2	145	(5.0)	(4.4)	(4.5)	(3.2)
Other services	ZZ	Ið	-1.2	30.3	14.5	14.Z	11.0 (1.9)	9.7 (2.2)	0.U
						(4.0)	(1.0)	$(\angle . \angle)$	(3.5)

Source: Author's calculations. Notes: (1) Each market corresponds to a 3 digit level in NACE Rev. 1. Coefficients were obtained by OLS with cluster errors, for each market. Standard errors, reported in parenthesis, were computed using the delta method (Greene (1993)). (2) The non-rejection of the hypothesis of perfect competition is evaluated at a significance level of 5 per cent.

## 5. Conclusions

This article is based on the methodology proposed by Roeger (1995) to estimate price-cost margins in the Portuguese economy for the period 2006-2009, allowing for imperfect competition in the labour market. The perfect competition paradigm is widely rejected in the Portuguese economy both in product and labour markets.

The hypothesis of perfect competition in the product market is not rejected in only 5 per cent of the markets. Estimated price-cost margins are very heterogeneous across markets and figures for the overall economy range between 25 and 28 per cent, depending on the weight used for each individual market. In addition, the price-cost margin in the tradable sector is lower than the one observed in the non-tradable, consistently with the pattern observed in previous studies. Moreover, disregarding labour market imperfection implies that the price-cost margin is underestimated on average by 11 p.p..

In approximately 25 per cent of the markets, the hypothesis of perfect competition in the labour market cannot be rejected. The average workers' bargaining power in the Portuguese economy lies between 12 and 14 per cent, depending on the weight used for each market. Additionally, there is substantial heterogeneity across sectors, reaching higher values for "Construction" and "Transports and Communications". Finally, as mentioned in the literature, workers' bargaining power is strongly and positively correlated with the price-cost margin across markets.

This article confirms previous findings on the existence of a significant scope to improve competition in Portuguese product markets, particularly in the non-tradable sector. The inexistence of a suitable competitive setup in the past may have favoured an over allocation of resources in this sector. Therefore, the improvement of competition is a crucial condition for a successful and sustainable adjustment process in the Portuguese economy, based on an efficient allocation of resources across firms and markets.

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# FOREIGN INVESTMENT AND INSTITUTIONAL REFORM: PORTUGAL IN EUROPEAN PERSPECTIVE\*

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#### ABSTRACT

As intraregional transaction costs across the globe were reduced, national jurisdictions tended to rely more heavily on business facilitation measures that provide incoming firms with a suitable business environment. It is therefore of utmost importance to understand the role played by the institutional framework on inward Foreign Direct Investment (FDI), as well as to evaluate the potential benefits and costs in terms of FDI inflows of improving/reforming national institutions. This article points out the major institutional gaps between Portugal and the most institutionally advanced countries in the European Union (EU) for those areas impacting FDI positively, and estimates and assesses the expected benefits, the required reform efforts, and the efficiency of reform options corresponding to a convergence of Portuguese institutions with the EU's best institutional standards. Reform options are evaluated through three distinct institutional databases: the 2013 Index of Economic Freedom, the 2006 Political Risk Rating from the International Country Risk Guide, and the 2013 Doing Business. Our results indicate that institutional reforms promoting a leaner bureaucracy, lowering political risk, corruption, and the constraints on the flow of investment capital, improving the respect and protection of property rights, and promoting a strong and impartial legal environment-institutional areas where Portugal is behind the EU's best institutional standards-may significantly affect the amount of bilateral inward FDI that is targeted to Portugal. Business friendly regulations per se have an estimated second order effect on FDI. Closing the Portuguese institutional gap vis-à-vis the EU's most institutionally advanced countries has an estimated effect on FDI that can go up to 60 percent.

## 1. Introduction

Since the 1990s, Foreign Direct Investment (FDI) has gained importance in an increasingly globalized economy, for both developing and developed countries, and Portugal is no exception. The United Nations Conference on Trade and Development (UNCTAD) reports an increase in FDI stocks for Portugal from 14 to over 45 percent of GDP, in the period between 1990 and 2011. This figure compares with an increase from 13 to 28 percent in developing countries and from 9 to 30 percent in developed economies.

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From the viewpoint of host countries, FDI brings several advantages in addition to the direct effects on output and employment levels. FDI is often associated with technological transfer, the introduction of management skills and business culture, and changes in the productive structure of a country. In addition to the business environment, it may be a lever to improve local host country institutions (Larraín and Tavares, 2004). As such, FDI may be more conducive to long-run growth and development than other forms of portfolio inflows or trade in goods and services (Barrell and Pain, 1997; Borensztein *et al.*, 1998). FDI may also impact the balance of payments, as multinational firms have a greater propensity to export than do domestic firms.

It is therefore not surprising that a substantial amount of research has been devoted to explore the determinants of FDI. A first wave of research articles focused solely on economic and geographic determinants, including host-country market size, economic growth, openness, and the geographical distance between countries (e.g. Culem, 1988; Grubert and Mutti, 1991; Wheeler and Mody, 1992; Tsai, 1994; Barrell and Pain, 1996; Cassou, 1997; Love and Lage-Hidalgo, 2000; Bevan and Estrin, 2004; Janicki and Wunnava, 2004). However, as FDI increased worldwide, so did the awareness of the importance of institutional factors associated with regional integration agreements. As intraregional transaction costs across the globe were reduced, national jurisdictions tended to rely more heavily on business facilitation measures that provide incoming firms with a suitable business environment. An institutional and beneficial "race to the top" is taking place among jurisdictions (UNCTAD, 1999).

A second wave of research articles, suggesting that institutional and political risk factors have a role in explaining inward FDI, has therefore emerged (e.g. Schneider and Frey, 1985; Wei, 2000; Wei and Shleifer, 2000; Biswas, 2002; Larraín and Tavares, 2004; Bénassy-Quéré *et al.*, 2007). Better institutions promote FDI for a variety of reasons. First, good governance is associated with higher economic growth, itself an important driver of FDI. Second, better governance is usually associated with lower corruption and business costs. Finally, good institutions foster political stability and decrease political uncertainty. FDI is expected to flow to countries with a stable economic environment and strong institutions, where, *ceteris paribus*, running a business is a more promising endeavor. The framework above suggests the relevance of studying institutional improvements/reforms as a means to attract larger amounts of FDI.

This article starts by evaluating the role played by different institutional areas in incoming bilateral FDI. The results suggest that a strong and impartial legal environment, characterized by low corruption levels and the respect and protection of property rights, an independent financial system and a leaner bureaucracy, and few constraints on the flow of investment capital, are major institutional drivers of inward FDI. Business friendly regulations *per se* play a lesser role.

The article then assesses the relative performance of Portuguese institutions within the EU for those areas impacting FDI positively, and estimates the expected benefits, the required reform efforts, and the efficiency of reform options corresponding to a convergence of Portuguese institutional with the EU's best institutional standards, as measured by the performance of the most institutionally advanced countries. Reform options are evaluated according to the latest institutional data we had access to, namely the 2013 Index of Economic Freedom, the 2006 Political Risk Rating from the International Country Risk Guide, and the 2013 Doing Business. Our conclusions indicate that the Portuguese institutional framework is well below the best European practices in those areas whose effect on inward FDI is largest. Institutional improvements implying a convergence with the most institutionally advanced countries may boost inward FDI around 60 percent, *ceteris paribus*. These are very important effects for a small open economy seeking to attract larger amounts of FDI.

The article is organized as follows. Section 2 describes the data collected and used in the empirical analysis. Section 3 presents the econometric methodology. Section 4 estimates the effect of institutions on inward FDI. Section 5 analyzes the prospects for institutional reform in Portugal, corresponding to a convergence of the Portuguese institutional performance with the best European practices. Section 6 concludes.

#### 2. Data

We first identify the key institutional areas that drive inward FDI, using a cross-section of incoming FDI stocks from 86 source countries to 28 European host countries. Both source and host countries were selected according to data availability. Over 90 percent of Europe's inward FDI originates from the source countries included, and selection bias should therefore not be a major issue. The literature has advocated the use of FDI stocks relative to flows, as the former are based on accumulated flows – hence less volatile – and are the relevant decision variable for a firm in the long term. In addition, FDI stocks are a better measure of capital ownership (Bénassy-Quéré *et al.*, 2007). We use a 3-year average for FDI stocks, a practice followed in the literature (Wei and Shleifer, 2000; Stein and Daude, 2007) to avoid the influence of sudden changes in FDI's valuation. We analyze the period 2005–2007, in order to avoid the effects of the 2008 financial crisis on FDI. Data were collected from the Eurostat database.

We explain incoming FDI according to an augmented gravity-type model, using geographic, economic, and institutional regressors. As for geographical factors, we include the physical distance between host and source countries' capitals – which can be seen as a proxy for transaction costs, including transport and communication costs, and cultural and language barriers – and a border dummy variable, which takes the value of 1 only if source and host countries share a common border. A greater distance between source and host countries is expected to have a negative impact on FDI, whereas a common border should have a positive effect.

Our key economic variables are the host country's GDP (a proxy for market size), the GDP growth rate (a proxy for market growth), and labor costs. One cannot include per capita GDP and labor costs simultaneously in the model, as these variables are highly correlated. GDP and GDP growth are expected to have a positive impact on FDI. The role of labor costs is less straightforward, since they may reflect labor productivity. We also consider the degree of openness – the share of imports plus exports over GDP – as a measure of trade flows. Naturally, openness should have a positive effect on inward FDI. Our study also considers the role of education, measured by the mean years of schooling in each country. Education may have an ambiguous effect on FDI, since more education, on the one hand, implies higher labor productivity, but, on the other, is associated with higher wage costs (Altomonte and Guagliano, 2003). Finally, we include the Effective Average Tax Rate (EATR) as a measure of the tax burden.<sup>1</sup>

GDP, growth, and openness were collected from the Eurostat database, and labor costs from AMECO. Mean years of schooling were taken from Barro and Lee's (2010) database, whereas the effective average tax rate was kindly provided by Michael Overesch.<sup>2</sup> Regressors are for the year 2004, with the exception of mean years of schooling, which was collected for 2005 due to data restrictions. We explain average incoming FDI for the 2005–2007 period using economic and institutional data for the year 2004 so that potential endogeneity issues are avoided. These are particularly important for GDP and GDP growth (Borensztein *et al.*, 1998; Barrell and Pain, 1997).

To obtain a characterization of the institutional environment that is as complete as possible, we use three distinct databases: the Index of Economic Freedom from the Heritage Foundation, the Political Risk Rating database from the Political Risk Services Group, and the Doing Business database from the World Bank.

Data for the Index of Economic Freedom cover the institutional framework in the second half of 2003 and in the first half of 2004. The Index of Economic Freedom is composed of ten different components:

<sup>1</sup> The statutory tax rate is the relevant variable for companies seeking to shift income towards low tax countries, whereas the effective average tax rate reflects the incentives (such as investment tax credits and accelerated depreciation) that are granted to firms when the investment occurs (Grubert and Mutti, 1991). The effective marginal tax rate captures incentives to use new capital once the location choice has been made. The effective average tax rate should thus be the most important decision variable for multinationals seeking to invest abroad (Devereux and Griffith, 1998).

<sup>2</sup> See Overesch and Rincke (2009).

business freedom, trade freedom, fiscal freedom, government freedom, monetary freedom, investment freedom, financial freedom, property rights, corruption freedom, and labor freedom. It is expected that societies with better scores in terms of economic freedom attract higher levels of FDI, as they offer investors greater protection of property rights, lower tax burdens, fewer restrictive regulations, less bureaucracy, and less corruption.<sup>3</sup>

The Political Risk Rating, collected for the year 2004, comprises twelve indicators: government stability, socioeconomic conditions, investment profile, internal conflicts, external conflicts, corruption, military in politics, law and order, religious tensions, ethnic tensions, democratic accountability, and bureaucracy quality. Naturally, higher instability levels and economic as well as political uncertainty make investments riskier, leading to an expected decrease in incoming FDI. It is worth emphasizing that the indicator "corruption freedom" from the Index of Economic Freedom evaluates the overall level of corruption within a society, whereas the indicator "corruption" from the Political Risk Rating assesses only the prevalence of corruption within the political system.

Finally, the Doing Business database evaluates the cost of starting, operating, and closing a medium-sized firm in a given country, complementing the more generic information on business regulations reported by the Index of Economic Freedom, namely the business freedom indicator. The data collected respect the 2006 report, which addresses business regulations as of June 1, 2005, and cover 33 variables in nine different areas – starting a business, dealing with construction permits, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts, and closing a business.<sup>4</sup> For convenience, we constructed an index for each of these nine areas.<sup>5</sup>

To ease comparisons across institutional indicators, all indexes for the three institutional databases were rescaled to the 0–10 range, with higher scores always indicating better performances.

In Section 5 we rely on more recent available institutional data – from the 2013 Index of Economic Freedom, the 2013 Doing Business report, and the 2006 Political Risk Rating – to evaluate institutional reform in Portugal taking the current institutional status as bottom line.<sup>6</sup>

#### 3. Econometric Methodology

We use the gravity model to study the determinants of inward bilateral FDI. The gravity model was developed in the context of international trade (Eaton and Tamura, 1995), but it has also been successfully applied to explain bilateral FDI (Wei, 2000; Wei and Shleifer, 2000). In its simplest formulation, the gravity model states that the larger the economic mass of the countries involved and the smaller the distance between them, the higher the predicted bilateral inward FDI. In this article we use an augmented version of the original gravity model that takes into account other economic and institutional factors affecting incoming FDI.

**<sup>3</sup>** The Index of Economic Freedom is available at http://www.heritage.org/index. Economic freedom is the right of every citizen to control his or her own labor and property. As put forward by the Heritage Foundation, "In a free society, individuals are free to make their own production and consumption decisions, protected and unconstrained by the state".

<sup>4</sup> The Doing Business report is a co-publication of the World Bank and the International Finance Corporation, and the data are available at http://www.doingbusiness.org. Data for the nine different areas of Doing Business were first made available in the 2006 report.

**<sup>5</sup>** First, we converted to an index all the 33 variables of the Doing Business report, using the min-max standardization method, according to which the value of a variable is scaled and converted into an index reflecting its relative position in the effective range taken by that same variable (given by the distance between the maximum and the minimum value). We thereafter aggregated, through a simple average, all indexes that characterize a given area of doing business.

<sup>6</sup> For the Political Risk Rating, the latest data we had access to respects 2006.

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Denoting by j the source country and by i the host country, we estimate the following augmented gravity-type equation in multiplicative form<sup>7</sup>

$$FDI_{ii} = \exp[\alpha c_i + \beta_1 DISTANCE_{ii} + \beta_2 ECO_i + \beta_3 INST_i]\zeta_{ii}$$
(1)

where  $FDI_{ij}$  is the inward FDI stock from country *j* to country *i*,  $DISTANCE_{ij}$  is a vector composed of the physical distance between country *j*'s and country *i*'s capitals and the border dummy variable;  $ECO_i$  is a vector containing economic indicators for the host country, namely GDP, GDP growth, labor costs, the degree of openness, education, and the effective average tax rate;  $INST_i$  is a vector of institutional variables for the host country;  $c_j$  are source country dummies;  $\zeta_{ij}$  is an error term; and finally,  $\alpha, \beta_i, \beta_j, \beta_i$  are vectors of parameters to be estimated.

We use two alternative approaches to evaluate the effects of institutions of FDI. In the first, we summarize each institutional database in a smaller set of information, by taking the simple average of those indicators that are highly correlated. These new constructed indicators can be interpreted as representing the overall institutional performance. In the second, we evaluate the individual effect of institutions on inward FDI – an empiricist approach widely followed in the literature (Chakrabarti, 2001; Walsh and Yu, 2010).

It should be pointed out that most institutional indicators aggregate qualitative information over a multidimensional set of elements. Although our analysis identifies which institutional areas are most relevant to boost inward FDI, as well as those which should be targeted in a reform package, it does not provide sufficient information to allow the design of specific reform proposals. Such exercise would require detailed information on each specific institutional area, something that is outside the scope of this article.<sup>8</sup>

#### 4. Institutional Determinants of FDI

#### 4.1. The role of the overall institutional performance

We first summarize the indicators from the Index of Economic Freedom, the Political Risk Rating, and the Doing Business into a smaller set of components, which are then used in (1) to capture the overall institutional framework of a country. For each institutional database, the newly created institutional components reflects the simple average of those indicators that have the highest correlation amongst themselves.

For the Index of Economic Freedom, two components were computed. The first component – hereinafter "firms' freedom" – is related with elements that influence the regular activity of business firms, potentially impacting their profitability. This component reflects: property rights, business freedom, corruption freedom, financial freedom, investment freedom, monetary freedom, labor freedom, and trade freedom. The second component – which we term "public sector freedom" – measures the public sector effects on economic freedom, *viz* fiscal freedom and government freedom.

For the Political Risk Rating, we identified three components. The first component is interpreted as "political risk", and relates to political risk factors directly affecting firms: the quality of bureaucracy,

<sup>7</sup> Estimation is done through the Poisson Pseudo-Maximum-Likelihood estimator. For further details on the estimation methodology, see our *Working Paper* "Foreign Direct Investment and Institutional Reform: Evidence and an Application to Portugal."

<sup>8</sup> For instance, the "investment freedom" indicator aggregates information on the degree of transparency and bureaucracy associated with the foreign investment code, restrictions on land ownership, sectoral restrictions on investment, or expropriation of investments without fair compensation, among others. It is not possible to evaluate which of these specific restrictions play the most important role in inward FDI. The same argument can be applied to most indicators used herein.

investment profile, socioeconomic conditions, corruption, the presence of the military in politics, democratic accountability, law and order, and the occurrence of internal and external conflicts. The second component reflects religious and ethnic tensions, and is simply termed "political tensions". The last component relates to government stability.

For Doing Business data, we opted to compute only one component, interpreted as representing an overall measure of the cost of doing business imposed by regulations, since there was no clear alternative decomposition. This component is the simple average of the nine constructed indicators for the Doing Business: starting a business, dealing with construction permits, registering property, getting credit, protecting investors, paying taxes, trading across borders, enforcing contracts, and closing a business.

The results are presented in Table 1. As firms' freedom, political risk, and the doing business components are highly correlated, sharing similar base indicators, we opted not to include them simultaneously in the regressions. Recall that higher index values indicate better performances. Columns (1) and (2) identify an effect on inward FDI of 31 ( $e^{0.273} - 1$ ) percent for each point increase in firms' freedom component, and of 59 ( $e^{0.463} - 1$ ) percent for each point increase in the political risk component.<sup>9</sup> On the opposite direction, the results in column (3) do not support the hypothesis that the ease of doing business *per se* is an important attractor of FDI.

Public sector freedom comes out with a negligible effect on FDI in all specifications. This component includes fiscal freedom and government freedom. Fiscal freedom assesses the fiscal burden of a society, more freedom being associated with lower taxes. As it includes the top tax rate on corporate income, *ceteris paribus*, one should expect higher values in fiscal freedom to be associated with more FDI. Government freedom measures the level of government expenditures as a percentage of GDP, with more freedom being associated with lower expenditures. Theoretically, it is not clear whether this indicator should attract or repel FDI, as higher public expenditures may be associated with better infrastructure, more stable socioeconomic conditions, or greater incentives for FDI, as well as with a higher future fiscal burden and fiscal uncertainty. Political tensions are also insignificant. Government stability affects inward FDI positively.

Results for geographic and economic factors are in line with the expected impacts. Geography plays an important role in bilateral inward FDI, with Table 1 suggesting the presence of both a border effect and a distance effect. The level of GDP also comes out as statistically significant in all specifications, giving support to the market size hypothesis. Economic growth and the degree of openness play a positive role, but the effect is not robust to different specifications. Labor costs impact FDI negatively when firms' freedom or political risk are included in the regression, but the effect is positive if doing business is included instead. Labor costs are highly correlated with institutional quality, as better institutional quality is more appropriately captured through the firms' freedom or political risk components, the results in columns (1)–(2) should be more robust *vis-à-vis* the results in column (3), where the doing business indicator is considered instead. Hence, evidence seems to corroborate the fact that higher labor costs retract inward FDI, *ceteris paribus*, though only the effect in column (2) is statistically significant. Finally, the effects of education and the effective average tax rate are non-significant.

An important point worth mentioning is that, albeit education does not seem to influence the total amount of FDI, it should play a key role in the type of FDI. Naturally, countries with higher education levels are more likely to attract FDI in high tech industries, whereas countries where the educational performance is lower might attract mostly investments in low tech industries.

**<sup>9</sup>** We report marginal effects for non-logarithmic regressors using the formula  $e^{\hat{\sigma}} - 1$ , where  $\hat{\beta}$  is the estimated parameter.

#### Table 1

THE DETERMINANTS OF FOREIGN DIRECT INVESTMENT								
	(1)	(2)	(3)					
Geographic factors								
border	0.598***	0.626***	0.538***					
	(0.119)	(0.117)	(0.120)					
log distance	-0.591***	-0.539***	-0.676***					
	(0.113)	(0.114)	(0.100)					
Economic factors								
log GDP	0.865***	0.989***	1.006***					
	(0.089)	(0.098)	(0.095)					
GDP growth	0.111	0.113	0.210**					
	(0.077)	(0.072)	(0.085)					
log labor costs	-0.264	-0.459**	0.098					
	(0.164)	(0.186)	(0.170)					
openness	0.003	0.004**	0.011***					
	(0.002)	(0.002)	(0.003)					
education	0.023	-0.069	-0.089					
	(0.051)	(0.061)	(0.061)					
effective average tax rate	0.013	0.001	0.015					
	(0.015)	(0.014)	(0.014)					
Institutional factors								
firms' freedom	0.273**							
	(0.107)							
public sector freedom	0.017	-0.000	0.016					
	(0.037)	(0.037)	(0.042)					
political risk		0.463***						
		(0.140)						
political tensions	-0.032	-0.103*	0.092					
	(0.055)	(0.061)	(0.059)					
government stability	0.189**	0.163**	0.132*					
	(0.079)	(0.077)	(0.080)					
doing business			-0.003					
			(0.121)					
Observations	1832	1832	1768					
Pseudo-R2	0.910	0.912	0.911					

Source: Authors' calculations.

**Notes:** White-robust standard errors in parentheses. \*, \*\*, and \*\*\* represent rejections at 10, 5, and 1 percent significance levels, respectively. Source country dummies were included, but are not displayed.

All in all, our results hint that better institutions and lower political risk attract FDI. The quantitative magnitude of the effects is very important, and suggests an active role to be played by local governments, as institutional improvements providing better business environments to multinational firms are able to raise incoming FDI in large amounts. In addition, investors seem to pay more attention to the country's overall institutional framework than to business regulations specifically. Below we identify which institutions are more conducent to incoming FDI and should therefore be considered as potential targets for reform by local governments.

#### 4.2. Institutional breakdown

The analysis above focused on the effects of institutions on FDI at an aggregate level. It was silent as to the effects of specific institutions on FDI. We now re-estimate equation (1) by adding each institutional variable individually to the baseline model, controlling for geographic and economic variables. That is, we estimate 31 equations, one for each institutional indicator.

The results for the coefficients of institutional regressors are presented in Table 2. All indicators range from 0 to 10, with higher index values always indicating better performances. For reasons of parsimony,

#### Quadro 2

THE DETERMINANTS OF FOREIGN DIRECT INVESTMENT   INSTITUTIONAL BREAKDOWN									
		coeff.	st. dev.		coeff.	st. dev.			
	corruption freedom	0.174***	0.051	financial freedom	0.144***	0.037			
anic Mic	investment freedom	0.168***	0.052	property rights	0.131**	0.064			
dex nor	government freedom	0.046*	0.028	labor freedom	-0.011	0.048			
Eco Fre	business freedom	0.023	0.079	monetary freedom	-0.040	0.139			
	trade freedom	-0.038	0.166	fiscal freedom	-0.004	0.055			
b	democratic accountability	0.453***	0.099	socioeconomic conditions	0.252***	0.079			
Satii	government stability	0.218***	0.074	law and order	0.167***	0.056			
Political Risk F	bureaucracy quality	0.118**	0.048	corruption	0.092**	0.037			
	investment profile	0.138	0.136	external conflicts	0.093	0.091			
	military in politics	-0.011	0.091	internal conflicts	-0.045	0.099			
	religious tensions	0.032	0.041	ethnic tensions	0.015	0.049			
siness	paying taxes	0.146**	0.074	trading across borders	0.111**	0.054			
	registering property	0.073**	0.031	getting credit	-0.089**	0.041			
Bu	starting a business	-0.135*	0.077	closing a business	0.089	0.057			
oing	construction permits	0.024	0.052	enforcing contracts	0.018	0.041			
ă	protecting investors	-0.018	0.045						

Source: Authors' calculations.

Notes: White-robust standard errors are presented. \*, \*\*, and \*\*\* represent rejections at 10, 5, and 1 percent significance levels, respectively.

we do not report the coefficients for the control variables (geographic and economic variables), although these are considered in all regressions.

Among the indicators for the Index of Economic Freedom, corruption freedom, financial freedom, investment freedom, and property rights emerge as the main drivers of inward FDI. Corruption freedom assesses how the prevalence of corruption affects the perceived degree of uncertainty in the economy, as well as the pecuniary and non-pecuniary costs of operating a business associated with corruption. Lower corruption, corresponding to a 1 point increase in the indicator, raises incoming FDI by 19 ( $e^{0.174} - 1$ ) percent. A 1 point increase in the financial freedom indicator – which assesses the degree of independence of financial institutions from state control – raises the stock of FDI by 15 ( $e^{0.144} - 1$ ) percent. Investment freedom assesses the constraints on the flow of investment capital. A 1 point increase in this indicator raises the stock of FDI by around 18 ( $e^{0.168} - 1$ ) percent. Finally, a 1 point increase in the property rights indicator – which evaluates the ability of individuals to secure private property, the extent to which laws protect property, and the efficiency with which the judiciary system enforces those same laws – raises inward FDI by around 14 ( $e^{0.131} - 1$ ) percent. The remaining indicators from the Index of Economic Freedom have a negligible estimated effect on incoming FDI.

As to the Political Risk Rating indicators, our results hint at an important effect of low political risk and good institutions on inbound FDI. The most important indicators are: democratic accountability, measuring the extent to which governments respond to citizens, with an effect of approximately 57 ( $e^{0.453} - 1$ ) percent in FDI for each point increase; socioeconomic conditions, which evaluate the extent to which social dissatisfaction constrains government action, with an impact of 29 ( $e^{0.252} - 1$ ) percent; government stability, which assesses the government's ability to stay in office, with an impact of 24 ( $e^{0.217} - 1$ ) percent; law and order, which measures the strength and impartiality of the legal system and whether laws are widely respected, with an impact of 18 ( $e^{0.167} - 1$ ) percent; bureaucracy quality, which measures the strength, quality, and autonomy of the bureaucracy, with an impact of 13 ( $e^{0.118} - 1$ ) percent; and corruption, with an impact of 10 ( $e^{0.092} - 1$ ) percent. Doing Business indicators have a lesser impact on inward FDI. Table 2 puts into evidence that only some business regulations, namely those related with paying taxes, export and import activities, and property registration, affect FDI positively.

The empirical results suggest that multinational firms direct their investments to stable and well-functioning democracies, with lean bureaucracies, lower corruption levels, and impartial legal systems.

#### 5. Institutional Reform in Portugal: Some Policy Directions

We now strive to understand how an institutional reform in Portugal may impact the country's ability to attract larger amounts of FDI. For this exercise, one needs some benchmark against which to evaluate the impact of reform options. A potential choice could consider the best possible institutional performance, as indicated by a value of 10 in the institutional index. This is however a naive approach, since not even the most institutionally advanced countries have institutional indexes near the top of the scale for all indicators. A more realistic alternative compares the Portuguese institutional performance with that of a reference set of countries. Since, in our perspective, Portugal should aim at improving institutions to the highest institutional standards, we take as benchmark the EU's three most institutionally advanced countries.

Since we are using three distinct databases, there is no uniform criteria that can be used to select the three most institutionally advanced countries. We therefore proceeded as follows. For the indicators of the component of Economic Freedom, we selected the countries with the best performance in the firms' freedom component – Denmark, Sweden, and the United Kingdom. For the Political Risk Rating indicators, the selection of the best performing countries – Finland, Luxembourg, and Sweden – was based on the political risk index. The most institutionally advanced countries regarding business regulations, which are used as benchmark for Doing Business indicators, are Denmark, the United Kingdom, and Ireland.

We examine and compare the impact of specific, item by item, reforms. Our analysis is based on the latest institutional data we had access to, namely the 2013 Index of Economic Freedom, the 2013 Doing Business, and the Political Risk Rating for 2006. Our exercise closely follows Tavares (2004), who proposed three measures of institutional reform: the first assessing the benefits of reform in terms of a dependent variable of choice, the second the reform effort, given by some measure of distance between current institutions and the desired institutional status, and finally the ratio of the first by the second indicator, a measure of the efficiency of the reform effort.<sup>10</sup>

We examine separately each institutional indicator for which Portugal is lagging behind the standard of the EU's most institutionally advanced countries. The impact of reforming institution k to the benchmark level is given by the exponential of the estimated coefficient for each institutional indicator, as computed in the previous section, multiplied by the institutional difference between Portugal and the average indicator of benchmark countries. That is

Impact on FDI<sub>k</sub> = exp
$$\left(\beta_{3k}\left(INST_{Rk} - INST_{Pk}\right)\right) - 1$$
 (2)

where  $INST_{l,k}$  denotes the institutional index of institution k in country l, l = B, P (where B stands for benchmark countries, *i.e.*, the EU's three most institutionally advanced countries, and P for Portugal) and  $\beta_{3,k}$  is the respective coefficient. Obviously, the higher the value of (2), the more promising are the prospects for reform in that area. This may occur for different reasons: either that institution has a large impact on inbound FDI, or Portuguese institutions have a lot of leeway for betterment, or both.

The "cost of reform", *i.e.*, the required effort to bring the Portuguese institutional index closer to the benchmark level, can be proxied, albeit imperfectly, by

**<sup>10</sup>** Another application can be found in Cavalcanti *et al.* (2008), where the potential of institutional reforms in Brazil is assessed.

Required reform 
$$\operatorname{effort}_{k} = \frac{INST_{B,k} - INST_{P,k}}{INST_{P,k}}$$
(3)

Equation (3) measures the distance of the Portuguese institutional index relative to the benchmark, *i.e.*, the required institutional change needed for Portugal to bring itself onto a par with benchmark countries. Higher values suggest that more effort has to be exerted in order for the reform to be successful, as the relative distance is greater.

The third measure of institutional reform evaluates the efficiency of the reform, *i.e.*, the impact on FDI of each unit of effort put into the reform. In a sense, it gives the "bang for the buck" for each specific reform, computed as the ratio of (2) over (3)

$$\text{Efficiency of reform}_{k} = \frac{\text{Impact on FDI}_{k}}{\text{Required reform effort}_{k}}$$
(4)

A value of 1 indicates a one-to-one relationship between inbound FDI and the reform effort. That is, any reform requiring a given percentage increase in the institutional indicator for convergence with benchmark countries would give rise to exactly the same percentage increase on inward FDI. The higher the value of (4), the more promising is the reform in that area in terms of efficiency, that is, the higher the increase in FDI for each unit of effort put into the reform.

As it only makes sense to evaluate the benefits of potential reforms for areas in which Portugal lags behind the average level of benchmark countries, we ignore any indicators where the opposite holds. Any area whose coefficient in the above estimates is not statistically significant is ignored in the following exercise.

Table 3 and Chart 1 stress that the Portuguese institutional performance is well below that of the EU's most institutionally advanced countries, and that institutional improvements can have large impacts on

#### Table 3

REFORMING PORTUGUESE INSTITUTIONS. IMPACT ON FDI, REQUIRED REFORM EFFORT, AND EFFICIENCY OF REFORM VERSUS THE EU'S THREE MOST INSTITUTIONALLY ADVANCED COUNTRIES							
	(1)	(2)	(3)=(2)-(1)	(4)	(5)=exp((4)(3))-1	(6)=(3)/(1)	(7)=(5)/(6)
	index portugal	index top 3	difference	coefficient	Impact on FDI (%)	Required effort (%)	Efficiency
Agg. Institutional indicators							
firms' freedom**	6.76	8.53	1.77	0.27	62.0	26.1	2.4
political risk***	8.38	9.51	1.13	0.46	68.5	13.4	5.1
Index of Economic Freedom (IEF)							
corruption freedom***	6.10	8.83	2.73	0.17	60.9	44.8	1.4
financial freedom***	6.00	8.33	2.33	0.14	39.9	38.9	1.0
investment freedom***	7.00	8.83	1.83	0.17	36.1	26.2	1.4
property rights**	7.00	9.00	2.00	0.13	30.0	28.6	1.0
government freedom*	2.83	1.82	-1.01	0.05			
Political Risk Rating (PRR)							
democratic accountability***	10.00	10.00	0.00	0.45			
socioeconomic conditions***	6.70	7.78	1.08	0.25	31.2	16.1	1.9
law and order***	8.33	10.00	1.67	0.17	32.1	20.0	1.6
bureaucracy quality**	7.50	10.00	2.50	0.12	34.3	33.3	1.0
corruption**	6.67	8.89	2.22	0.09	22.7	33.3	0.7
government stability***	7.12	7.63	0.51	0.22	11.7	7.2	1.6
Doing Business (DB)							
paying taxes***	6.87	8.31	1.43	0.15	23.3	20.9	1.1
trading across borders**	8.23	8.63	0.40	0.11	4.5	4.9	0.9
registering property*	8.49	7.73	-0.76	0.07			

Source: Authors' calculations.

**Notes:** \*, \*\*, and \*\*\* represent the variables which are significant at the 10, 5, and 1 percent significance levels, respectively. The reform measures are only computed for the statistical significant variables in which Portugal has an inferior performance relative to the three most institutionally advanced countries.



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Source: Authors' calculations.

Notes: IEF stands for Index of Economic Freedom, PRR for Political Risk Rating, and DB for Doing Business.

FDI in Portugal. For instance, closing the gap of 2.73 points in the corruption freedom indicator, which assesses the prevalence of corruption, has an estimated effect of around 60 percent on Portugal's inward FDI – a very important impact for a small open economy, particularly vulnerable to changes in FDI flows for both structural and cyclical reasons, and seeking to attract larger amounts of foreign investments. Reforms that lessen the constraints on the flow of investment capital, evaluated by the investment

Chart 1

freedom indicator, have an estimated effect on FDI that is targeted to Portugal of around 36 percent. The impact–effort ratios associated with these reforms are also comparatively high. Improving the degree of independence of financial institutions from state control and the level of protection of property rights to the best European standards boost inward FDI by around 40 and 30 percent respectively, though reforms in these areas are associated with lower impact–effort ratios. The financial freedom indicator has, however, a doubtful applicability in the Portuguese case.

Important impacts can be also achieved through reforms in Political Risk indicators, namely in the quality and transparency of the bureaucracy (impact of 34 percent) and in the strength and impartiality of the legal system (32 percent). The latter requires however a lower effort and is more efficient. A reform aimed at reducing corruption within the political system has an estimated impact on Portugal's inward FDI of around 23 percent, naturally below that of a reform which addresses the degree of corruption within the society (evaluated through the corruption freedom indicator from the Index of Economic Freedom). Among business regulations, reforming the administrative burden associated with tax payments has an estimated impact on FDI that is targeted to Portugal of around 23 percent.

Notice that, though the results suggest also that socioeconomic conditions should be a main target for reform, these are endogenous to the economy and harder to change through government effort alone. We have therefore not considered this area as a prime reform target.

All in all, our results suggest that the Portuguese institutional performance is well below that of the EU's most institutionally advanced countries, and there is therefore a lot of leeway for betterment. Improvements in the institutional performance, corresponding to a convergence with the best European practices, have a very important impact on incoming FDI. Reforms impacting the overall institutional performance and lowering political risk – assessed though the firms' freedom and the political risk indicators, respectively – are estimated to boost FDI into Portugal by around 60 to 70 percent.<sup>11</sup>

#### 6. Concluding Remarks and Policy Implications

More than identifying institutional gaps, this article aims at fostering the debate, within the society and amongst policy-makers, for the potential gains of reforming Portuguese institutions on inward Foreign Direct Investment. It must be stressed, that, although our analysis identifies the institutional areas that should be considered as prime targets in a potential institutional reform, designing specific reform proposals requires a deeper investigation on the current institutional framework.

This article identifies those institutional areas with larger effects on incoming Foreign Direct Investment and investigates, for those areas, the relative institutional position of Portugal and the effects of an institutional reform in Portugal implying a convergence with the best European practices. Reform options are evaluated using the most recent available institutional data we had access to, namely the 2013 Index of Economic Freedom, the 2006 Political Risk Rating of the International Country Risk Guide, and the 2013 Doing Business.

We find that countries with better institutions are able to attract considerably larger amounts of Foreign Direct Investment. The most important institutional factors affecting foreign investments are associated with the legal and bureaucratic environment, the prevalence of corruption and the degree of protection

**<sup>11</sup>** Using the six most institutionally advanced countries instead does not yield substantial differences in the results. In this case, the impact on Portugal's FDI associated with a convergence in the firms' freedom indicator is around 55 percent. For the political risk indicator, the effect is around 60 percent. Additionally, observe that the impacts of individual institutional reforms do not add up to the effects of an encompassing institutional reform, since reforms are not disjoint sets (they are correlated). That is, improvements in some institutional area are mechanically associated with improvements in others, and thus the global effect is smaller than the simple addition of individual effects. For instance, lower corruption levels are associated with better protection of property rights and lower investment restrictions.

of property rights, the independence of financial institutions from state control, and restrictions on the flow of investment capital. Business friendly regulations, taken alone, do not seem to play an important role in the attractiveness of foreign investments.

Our results show that Portugal has still a lot of leeway for betterment in the most important institutional areas affecting Foreign Direct Investment. Closing the Portuguese institutional gap *vis-à-vis* the EU's most institutionally advanced countries has an estimated effect on incoming foreign investments of around 60 percent. Our analysis of reform possibilities in Portugal indicate that the country should focus on decreasing corruption, lessening restrictions on investment, and strengthening and improving the legal system, since these areas have the largest impacts on Foreign Direct Investment and the better impact–effort ratios.

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# **BUSINESS CYCLE ACCOUNTING FOR PORTUGAL\***

Nikolay Iskrev\*\*

#### ABSTRACT

This article analyzes the sources of business cycle fluctuations in Portugal using the business cycle accounting methodology developed by Chari *et al.*, (2007). In this approach, various types of distortions are represented as "wedges" in standard equilibrium relationships. This allows a quantitative assessment of the relative importance of those wedges. It is found that distortions affecting total factor productivity play a key role in explaining the behavior of output from 1998 through 2012.

### 1. Introduction

In this article I apply the business cycle accounting methodology developed by Chari et al., (2007) to Portuguese data from 1998 through 2012. The objective of the analysis is to determine the type of distortions that are necessary for models of the Portuguese economy to be able to generate business cycle fluctuations similar to those observed in the data. In a nutshell, the methodology consists of introducing several time-varying wedges to a standard real business cycle model and analyzing their contributions to observed fluctuations in aggregate macroeconomic variables. As Chari et al., (2007) show, many dynamic economic models, with various types of frictions and structural shocks, are equivalent to a prototype model with four wedges that enter in the model as time-varying productivity, labor income taxes, investment taxes and government consumption. For example, the effects of investment-financing frictions, taxes on consumption or capital income are captured by the investment wedge. The efficiency wedge may reflect variations in total factor productivity or input-financing frictions. Also, a monetary model with sticky wedges or labor unions is observationally equivalent to a real business cycle model with a labor wedge. These equivalence results imply that the effects of shocks and frictions in a detailed model can be replicated in the prototype model as movements in one or more of the wedges. By construction, the combined effect of the four wedges accounts for all of the observed movements in the data. Applying the accounting procedure shows the importance of each wedge and thus of the underlying types of frictions that are captured by it. Hence, this approach can be used to identify the classes of models and mechanisms that are promising venues for future research and those that are not.

Applying the business cycle accounting methodology to Portuguese data shows that while three of the wedges - efficiency, labor and investment, play a role during different business cycle episodes, the efficiency wedge is consistently the main factor driving output during the period from 1998 through 2012. Interestingly, very similar conclusions were reached by Cavalcanti (2007) who also applied the business cycle accounting procedure to the Portuguese economy. The difference between this article and Cavalcanti (2007) is that he studies an earlier period, from 1979 until 2000, and uses annual instead of quarterly data as in this paper.



<sup>\*</sup> The opinions expressed in the article are those of the author and do not necessarily coincide with those of Banco de Portugal or the Eurosystem. Any errors and omissions are his sole responsibility.

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#### 2. Methodology

The business cycle accounting approach consists of three steps. First, a prototype model economy perturbed by various distortions, or wedges, is introduced. Second, the model is estimated and the realized processes for the wedges are recovered. Third, the marginal importance of each wedge is evaluated by decomposing the observed fluctuations in data into movements due to each wedge. These steps are described in detail next.

#### 2.1. The model

The model economy consists of a representative consumer, a representative producer and a government. In each period t the economy experiences one of finitely many events  $s_t$ . At time t the history of events is denoted by  $s^t = (s_0, ..., s_t)$ . The probability at time 0 of history  $s^t$  is  $\pi_t(s^t)$  with the initial realization of event  $s_0$  being exogenously given. The economy has four exogenous stochastic variables, all of which are functions of the history of events  $s^t$ : an efficiency wedge  $A_t(s^t)$ , a labor wedge  $1 - \tau_{lt}(s^t)$ , an investment wedge  $1 / (1 + \tau_{st}(s^t))$  and a government consumption wedge  $g_t(s^t)$ .<sup>1</sup>

The representative consumer chooses per capita consumption  $(c_t)$  and labor  $(l_t)$  to maximize her discounted lifetime utility

$$\sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi_t \left( s^t \right) \left( \log\left(c_t\right) + \psi \log\left(1 - l_t\right) \right) N_t$$

$$\tag{1.1}$$

subject to the budget constraint

$$c_t(s^t) + (1 + \tau_{xt}(s^t))x_t(s^t) = (1 - \tau_{lt}(s^t))w_t(s^t)l_t(s^t) + r_t(s^t)k_t(s^{t-1}) + T_t(s^t)$$
(1.2)

and the capital accumulation equation

$$N_{t+1}k_{t+1}(s^{t}) = (x_{t}(s^{t}) + (1-\delta)k_{t}(s^{t-1}))N_{t}$$

$$(1.3)$$

where  $x_t$  is per capita investment,  $k_t$  is per capita capital,  $T_t$  is per capita lump-sum taxes or transfers,  $w_t$  is the wage rate,  $r_t$  is the rental rate of capital, and  $N_t$  is the working age population.

The representative firm chooses per capital capital  $k_t(s^{t-1})$  and labor  $l_t(s^t)$  to maximize its profits

$$y_t(s^t) - r_t(s^t)k_t(s^{t-1}) - w_t(s^t)l_t(s^t)$$
(1.4)

where  $y_t(s^t)$  is per capita output produced by a constant returns to scale production function

$$y_t(s^t) = A_t(s^t)k_t(s^{t-1})^{\alpha}l(s^t)^{1-\alpha}$$
(1.5)

and the efficiency wedge  $A_t$  captures the fluctuations of productivity.

The equilibrium of this economy is characterized by the resource constraint

$$c(s^{t}) + x_{t}(s^{t}) + g_{t}(s^{t}) = y_{t}(s^{t})$$
(1.6)

and the first order conditions for labor and capital

$$\frac{\psi c_t(s^t)}{1 - l_t(s^t)} = (1 - \tau_{lt}(s^t))(1 - \alpha) \frac{y_t(s^t)}{l_t(s^t)}$$
(1.7)

<sup>1</sup> Defining the labor and investment wedges as  $1 - \tau_l$  and  $1 / (1 + \tau_x)$  aims at facilitating their visual inspection and make them comparable to the efficiency wedge in that an increase is beneficial for growth.

$$\begin{aligned} \frac{(1+\tau_{xt}(s^{t}))}{c_{t}(s^{t})} &= \\ \beta \sum_{s^{t+1}} \pi_{t}(s^{t+1} \mid s^{t}) \frac{1}{c_{t+1}(s^{t+1})} \left( A_{t+1}(s^{t+1}) \alpha \frac{y_{t+1}(s^{t+1})}{k_{t+1}(s^{t+1})} + (1-\delta)(1+\tau_{xt+1}(s^{t+1})) \right) \end{aligned} \tag{1.8}$$

Equation (1.7) says that the marginal rate of substitution between consumption and leisure equals the marginal product of labor, distorted by the wedge  $1- au_{\mu}$  . Equation (1.8) states that the intertemporal marginal rate of substitution in consumption equals the marginal product of capital, distorted by the wedge  $1/(1+ au_{xt})$  . Even though  $au_{tt}$  and  $au_{xt}$  resemble taxes on labor and investment income, they represent all distortions affecting the respective equilibrium conditions. The labor wedge captures frictions that affect both the supply side and demand side, *i.e.*, consumers as well as firms. For example, the effects of monetary policy shocks in a model with sticky wages will show up in the prototype model as fluctuations in the labor wedge. The investment wedge also represents frictions affecting the intertemporal conditions of both the consumers and the firms. More detailed models with taxes on consumption or investment as well as liquidity constraints on consumers or investment-financing frictions on firms are equivalent to the prototype model with an investment wedge. The efficiency wedge  $A(s^{t})$  represents the effects of a wide range of institutions and policies that affect the efficiency with which the factors of productions are used. For example, a model with frictions which distort the allocation of inputs towards less efficient firms would have the same equilibrium allocations as the prototype model with an efficiency wedge. Finally, the government consumption wedge  $g(s^t)$  in the prototype closed-economy model can be regarded as an income accounting wedge in an open economy setup. Therefore, it captures fluctuations in both government consumption and net exports.<sup>2</sup>

Following CKM, I assume that the mapping between the event  $s_t$  and the vector of wedges is one to one and onto. This means that the agents in the economy can uniquely infer  $s_t$  from observing the values of  $A(s^t)$ ,  $\tau_{tt}(s^t)$ ,  $\tau_{rt}(s^t)$  and  $g_t(s^t)$ . Furthermore, I assume that  $s_t$  follows a stationary VAR(1) process

$$s_t = P_0 + Ps_{t-1} + Q\epsilon_t, \quad \epsilon_t \sim N(0, I)$$

$$(1.9)$$

where QQ' is a positive definite matrix.

#### 2.2. Estimation

To estimate the model, the equilibrium conditions are linearized around the steady state of the economy, and the endogenous variables are expressed as linear functions of the state variables  $k_t$  and  $s_t$ . This results in a linear state space system for a vector of observables given by  $[log(y_t), log(x_t), log(l_t), log(g_t)]$ . Then, using data on output, investment, hours worked and government consumption<sup>3</sup> and the fact that the system is Gaussian, the likelihood function is constructed using the Kalman filter and maximized with respect to the unknown parameters. The estimated model together with the data is then used to construct the four wedges. Specifically, the efficiency wedge  $A_t$  is constructed from the production function; the labor wedge  $1 - \tau_t$  is derived from the intratemporal first order condition and the investment wedge on the estimated model. The government consumption wedge  $g_t$  is obtained directly using data on government spending and net exports.

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<sup>2</sup> In another extension to an open economy setup, time variations in the tariffs on imports of intermediate inputs, or fluctuations in the world price of these inputs, would be captured by the efficiency wedge in the prototype closed economy model (see Ahearne *et al.*, (2006).)

**<sup>3</sup>** Note that we abstract from growth in the model and assume that a deterministic steady state exists. To match the data with the definitions of the variables in the model, all variables are expressed in per capita terms and de-trended using the Hodrick-Prescott filter.

#### 2.3. Evaluating the importance of the wedges

The measured wedges by construction account for the observed movements of all variables in the model. The purpose of the business cycle accounting procedure is to investigate the importance of a given wedge, or a combination of wedges, for the dynamics of the macroeconomic variables, such as output, investment and hours worked. This is done by feeding the estimated wedges to the model and estimating its responses to the wedges individually or in combinations. In particular, to measure the separate distortionary effect of a given wedge, the original model is solved holding all other wedges constant at their steady state values. Note that the agents in the economy still form expectations using the full multivariate process for wedges in (1.9) and therefore the predicted dynamics of the active wedge is the same as in the economy with all wedges. This results in obtaining the dynamics of the model variables due to a given wedge. Similarly, the effect of combinations of wedges is obtained by holding the other wedges fixed. A combination of all wedges produces the same behavior of the variables as observed in the data.

#### 3. Business cycle accounting for Portugal

The model from Section 2 is estimated using quarterly data for Portugal for the period from 1998:Q1 through 2012:Q3. The estimation results are then used to compute the equilibrium of the model and to measure the realizations of the wedges implied by the data. Chart 1 gives a visual presentation of these wedges<sup>4</sup> while Table 1 summarizes their business cycle properties by showing their correlations with output at several leads and lags. The table also shows the standard deviation of each wedge relative to that of output which is 1.12. The efficiency, labor and government consumption wedges are positively correlated with output, contemporaneously as well as at several leads and lags. The investment wedge, on the other hand, is negatively correlated with output at all lags and becomes positively correlated at leads beyond the second one. The efficiency wedge is the most strongly correlated with output in the data, with contemporaneous correlation of 0.84, and tends to lead the cycle as it is more strongly and positively correlated with future output than past output.

Chart 2 plots output in the data together with the predictions of the model for output when a single wedge is included. As we can see, the component of output due to the efficiency wedge alone is strongly correlated with output in the data and somewhat more volatile than it. The other three components of output, due to either the labor, investment or government consumption wedges are much less volatile and not very strongly correlated with the observed output.

In fact, as can be seen from Table 2, which shows the cyclical properties of the output components, ouput due to investment and government consumption wedges are negatively correlated with output in the data, and much less volatile than it. Output due to the labor wedge alone is more strongly and positively correlated with output in the data and fluctuates 60% as much as it. Finally, as the first panel in Chart 2 suggests, output due to the efficiency wedge alone fluctuates 13% more than output in the data and is strongly and positively correlated with it, especially with future output.

The importance of each wedge for accounting in the behaviour of output can be assessed by holding that wedge fixed while keeping the other three wedges moving. The results are presented in Chart 3 and show that without the efficiency wedge, and to a lesser extent the labor wedge, the model fails to reproduce the observed fluctuations in output. In contrast, without the other two wedges, and in particular without the government spending wedge, output in the model matches very closely the data.

Next, I focus on two particular episodes: the period from 1998 through 2003 and the period from 2008 through 2012. For the first period, panel (a) of Chart 4 shows observed output together with the predictions of the model when only one of the wedges is present – the efficiency, the labor or the

<sup>4</sup> The wedges are normalized to equal 1 in 1998.
# Chart 1

## OUTPUT AND MEASURED WEDGES



Source: Author's calculations.

## Table 1

BUSINESS CYCLE PROPERTIES OF WEDGES, 1998 Q1-2012 Q3											
Wedges	Rel.	Correlation of output in <i>t</i> with wedges in <i>t</i> + <i>j</i>									
	Std	-3	-2	-1	0	1	2	3			
Efficiency	1.05	0.58	0.78	0.88	0.84	0.65	0.37	0.09			
Labor	1.24	0.21	0.28	0.38	0.47	0.47	0.33	0.08			
Investment	1.35	-0.47	-0.42	-0.35	-024	-0.09	0.10	0.29			
Government	2.99	0.17	0.24	0.29	0.30	0.25	0.13	-0.04			

Source: Author's calculations

### Chart 2

# OUTPUT IN THE DATA AND PREDICTIONS OF THE MODEL WITH A SINGLE WEDGE (1998-2012)



Source: Author's calculations.



## Table 2

BUSINESS CYCLE PROPERTIES OF OUTPUT COMPONENTS, 1998 Q1-2012 Q3											
Output	Rel.	Correlation of output in t with wedges in t + j									
components	Std	-3	-2	-1	0	1	2	3			
Efficiency	1.13	0.58	0.78	0.90	0.86	0.67	0.39	0.10			
Labor	0.60	0.21	0.29	0.37	0.46	0.46	0.31	0.06			
Investment	0.45	-0.50	-0.48	-0.42	-0.32	-0.15	0.07	0.29			
Government	0.41	-0.18	-0.25	-0.29	-0.30	-0.25	-0.14	0.04			

Source: Author's calculations

#### Chart 3



Source: Author's calculations.

investment wedge.<sup>5</sup> All of them are normalized to equal 100 in 1998. Between 1998 Q1 and 2000 Q3 output grew by 4% relative to trend and by 2003 fell back to trend. In the model with efficiency wedge alone output follows a broadly similar pattern, increasing faster in the first 3 quarters, and starting to fall sooner. With only the investment wedge output in the model grows by less than 3% relative to trend and remains 2% above trend in the end of 2003. The model with the labor wedge alone predicts a decline in output to about 3% below trend in 2003. These results indicate that the faster growth in the first half of the period is primarily driven by the efficiency wedge, while the decline in the second half would have started sooner and would have been steeper without the investment wedge.

**<sup>5</sup>** As the earlier results show that the government consumption wedge accounts for very little of the fluctuations in output, it will not be discussed further.

#### OUTPUT IN THE DATA AND PREDICTIONS OF THE MODEL WITH A SINGLE WEDGE 108 104 (a) (b) 103 106 investment 102 efficiency data 104 101 100 102 labor 99 investment 100 98 data labor 97 98 96 96 95 efficiency

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2008

2009

2011

2012

2010

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Source: Author's calculations

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1998 1999 2000 2001 2002 2003

Chart 4

Panel (b) of Chart 4 shows the dynamics of output and the separate effects of the three wedges during the period from 2008 through the third quarter of 2012. During that period output first falls 4% relative to trend, recovers for a while and then starts to fall again ending more than 5% below trend at the end of the period. As before, the efficiency wedge does the best job in predicting the fluctuations in output in this period. With it alone output in the model falls more than in the data and the temporary recovery in 2010 is less pronounced. Apart from this, the prediction of the model parallels the movements in the data. The labor wedge helps the efficiency wedge in accounting for the observed dynamics of output during the period. However, with it alone the fall in output starts a year later and is smaller than in the data, especially during 2009 and 2010. Also, it predicts a counterfactual recovery of output at the end of the period. With the investment wedge alone the model predicts a modest increase in output relative to the data. By 2009 predicted output increases about 2% while in the data output falls about 4%. By 2012 predicted output is about 1% above trend while in the data output is 5.5% below trend.

The necessity of each one of the three wedges for reproducing the observed output movements during the two business cycle episodes can be evaluated using Chart 5. For the 1998-2003 period, panel (a) show that without the efficiency wedge output in the model initially drops about 2% below trend, before starting to grow, reaching around 3% above trend in 2002. Without the labor or investment wedges, output in the model matches the general pattern of output in the data, but either overpredicts, in the first case, or underpredicts, in the second, the increase in output before it starts slowing down. The same observation can be made for the period between 2008 and 2012, as shown in panel (b) of Chart 6. Without labor and especially the investment wedge, output in the model matches quite closely output in the data. Without the efficiency wedge, however, instead of falling it grows 2% by 2011 and remains above trend throughout the whole period.



**Source:** Author's calculations.

#### 4. Concluding remarks

The analysis in the previous section suggests that the efficiency wedge plays a dominant role in explaining the output fluctuations in Portugal throughout the 1998-2012 period. Thus, research on more detailed models should focus on frictions and shocks that show up as an efficiency wedge in the prototype model. However, although the labor and investment wedges are relatively less important for the analyzed period as a whole, they play an important role during particular business cycle episodes, such as 2001-2004 and after 2009. The labor wedge in particular has a strong negative impact on output during these periods. Therefore, the evidence suggests that policy discussions should focus on improving the functioning of the labor market institutions and strengthening the overall competitiveness of the economy.

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