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Manuel Coutinho Pereira

Lara Wemans
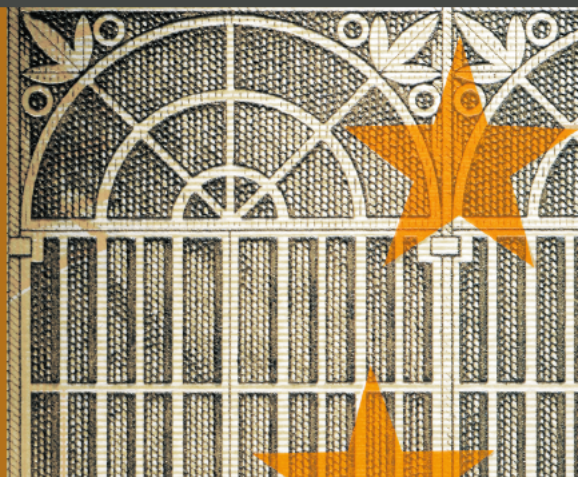
OUTPUT EFFECTS OF A MEASURE OF TAX SHOCKS BASED ON CHANGES IN LEGISLATION FOR PORTUGAL

Manuel Coutinho Pereira

Lara Wemans

Banco de Portugal
EUROSYSTEM

Output effects of a measure of tax shocks based on changes in legislation for Portugal[*]

Manuel Coutinho Pereira and Lara Wemans[†]

Banco de Portugal

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Abstract

This paper develops a new measure of quarterly discretionary tax shocks for Portugal that result from changes in legislation, following the narrative approach. It covers the years from 1996 to 2012 and was based on a comprehensive analysis of tax policy measures taken in the course of this period. The findings point to strongly negative and persistent effects of legislated tax increases on GDP and private consumption, matching the tendency of the narrative approach to yield comparatively high tax multipliers.

Keywords: fiscal policy, tax shocks, macroeconomic stabilization

JEL codes: E62, E43, E32

1 Introduction

The interaction between fiscal policy and economic activity is a recurrent topic of economic research. In a period when large fiscal policy shifts have been enacted both in Europe and in the US, in the aftermath of the financial and sovereign debt crisis, this topic remains fully relevant. This is particularly so for Portugal, as the country

is facing a significant fiscal tightening under the Economic and Financial Assistance Program while, at the same time, a consensus has been reached that economic growth is of paramount importance in facing the fiscal sustainability challenges ahead.

There is an open discussion about the size of tax multipliers, i.e. the impact on economic activity of each euro of shift in taxes. The difficulties in measuring these multiplier effects stem firstly from the two-folded character of the relationship between taxes and GDP, as not only changes in taxes have an impact on economic activity, but also GDP swings affect tax revenues. In addition, the two variables may be simultaneously influenced by many factors that when omitted cause biased estimations of the impact of taxation. Another problem relates to the uncertainty about the time of reaction to fiscal measures and horizons considered by economic agents.

There are mainly two empirical approaches to estimate the impact of fiscal shocks on output, the Structural Vector Autoregressive (SVAR) and the narrative. The SVAR approach, followed for example in Blanchard and Perotti (2002), uses fiscal (normally national accounts) data and relies on assumptions regarding their automatic contemporaneous reaction to movements in economic activity, in order to isolate the non-systematic component of fiscal policy. By contrast, the derivation of shocks in the narrative approach, followed in this paper and envisaged in Romer and Romer (2010), is more direct and intuitive, as tax policy shocks are dated and quantified according to legislation and contemporary budgetary analyses.[1] This approach does not depend on assumptions regarding the automatic response of fiscal variables to GDP. Furthermore, many factors that influence GDP are less likely to systematically influence the legislated component of taxes, which limits the room for endogeneity. A possible bias arises from the willingness of government to influence economic activity, establishing a link between discretionary fiscal policy and GDP. However, the analysis of the motivation behind fiscal policy actions makes it possible to isolate and exclude this kind of measures which, as discussed in the paper, have been anyway rather infrequent in Portugal during the period considered.

Another challenge when measuring the impact of fiscal policy is posed by the fiscal data available. The narrative approach has the advantage of being independent of accounting rules (and their widely known limitations), while having the disadvantage of depending on information that partly emanates from the political process and is subject to noise. Gathering comprehensive and consistent narrative information about

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[1]The identification of tax shocks in the narrative approach is thus fundamentally different from the standard method used to identify discretionary tax policy that consists in cyclically adjusting fiscal variables.

tax changes is very demanding and this has limited the number of studies in this vein. In fact, there are still few works in the wake of Romer and Romer, Cloyne (2010) for the UK being one of the exceptions. Other papers such as Devries et al. (2011) take a related approach that considers annual data and major fiscal policy shocks only, while covering a wide range of countries. There is an older strand of narrative studies started by Ramey and Shapiro (1998) that look into the effect on economic activity of military spending shocks. Note that this method is hard to extend to other types of expenditure shocks that are more difficult to track and quantify (see European Commission (2013), Part III, for a discussion of this issue).

The paper is organized as follows. Section 2 describes the sources, and presents a list of tax measures implemented in Portugal between 1996 and 2012 and the type of information gathered about them. The motivation behind these actions as a potential source of endogeneity is analyzed in section 3.

Section 4 explains the implementation details in converting the tax measures into a quarterly series of tax shocks. This procedure is not straightforward and depends, for example, on assumptions regarding economic agents' response to anticipated changes in income. Alternative series of shocks were derived on the basis of different underlying assumptions. This section ends with an analysis of the series of tax shocks.

Section 5 uses the constructed series of shocks to measure the effects of discretionary tax policy on output. The benchmark response of GDP to a positive tax shock is strongly negative with a multiplier that reaches -1.3 one year out. This response is statistically significant, but surrounded by sizeable uncertainty. As extensions to the main findings, this section assesses in particular the robustness of the results to the exclusion of significantly large measures from the sample and controlling for public expenditure. The effects of direct and indirect taxation are then separately analyzed: the GDP responses are negative in both cases but lack statistical significance. The end of section 5 compares these multipliers with the findings in Pereira and Wemans (2013), using the SVAR methodology.

Section 6 discusses evidence from considering alternative assumptions in the derivation of the shocks, while section 7 focuses on the response of some output components to changes in taxation. Finally, section 8 presents the concluding remarks.

2   Legislated tax changes

The estimation of the impact of tax policy on economic activity presented in this paper relies on a series of shocks especially constructed for the purpose. The starting point

in this work is a list of all major legislated tax changes enacted in Portugal since 1996, along with their approval and implementation dates[2], quantification and assignment to broad categories of revenue such as direct and indirect taxes and social contributions. Detailed information about tax policy measures in Portugal is very scarce as it was only recently, in the wake of the euro area sovereign debt crisis, that a systematic reporting of the expected effects of tax changes became entrenched in budgetary documents. Consequently, the series of shocks is confined to a relatively recent period, from 1996 to 2012, and even for this period its construction required gathering information from several sources. These sources primarily included budget reports, legislation documents and the annual reports of Banco de Portugal. Another important source of information about the revenue effect of tax measures was the data collected under the so-called disaggregated approach for the analysis of fiscal policy within the European System of Central Banks (see Kremer et al. (2006) for a description of the data that serve as an input to this approach). Finally, the treatment of particularly complex issues benefited from discussions with experts.

As far as quantification is concerned, conceptually we want an estimate of revenue effects holding GDP constant, that is the feedback of GDP on tax revenues should not be considered. Measures were generally quantified this way in the sources. This is particularly important for measures with a large potential influence on economic activity, such as changes in the value added tax rate, as a consideration of feedback effects would typically lead to an overestimation of the response of economic activity. Tax changes are quantified in nominal terms.

When different estimates for the magnitude of a particular tax change were available in the sources, information about the implementation details in the legislation and other documents was used in deciding what figure to take. The confrontation of several sources helped cross-checking estimates in order to reduce the noise that could be introduced by the political process. At the same time, inconsistencies can arise from the use of different methods for the quantification of revenue effects in different sources (or in the same source over time), but the fact that the sample is in practice restricted to recent years helps to mitigate this issue.

The legislated tax changes considered are confined to measures with an expected effect on economic activity. This criterion led in particular to the exclusion of the securitization of tax revenues, implemented by the Portuguese government in 2003.

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[2]Many of these changes were part of the State Budget, although there were several exceptions. In Portugal the State Budget for the next year is usually submitted to Parliament in October and, after approval, it comes into force in January.

This was a financial operation enacted in order to fulfill the budget deficit target and, although it affected tax revenues as recorded in national accounts, it did not impact the amounts actually paid by economic agents. Consequently, it is unlikely to have had directly affected economic activity.

For the purpose of deriving the quarterly shocks in the next sections, it is useful to distinguish between three types of measures according to the nature of their revenue effects. Firstly, there are measures with a permanent effect on receipts and for these the annualized long-term (i.e. on-going) figure is retained.[3] Occasionally some tax changes of this type, such as in the value added tax rates, are quantified in the sources for less than a full year and taking into consideration the seasonality of the relevant macroeconomic base. Such seasonal effects must be undone in the calculation of the annualized figure. Secondly, our sample comprises measures that affect revenue only temporarily, and these are quantified on the basis of the overall variation in receipts owing to the measure. Finally, a third category consists of measures that switch revenue from one year to the other: for instance, an increase in prepayments of the corporate income tax, or in the amounts withheld at source in the personal income tax, offset by an increase in refunds or a reduction in balances due in the following year. These measures while taking effect permanently have a yearly revenue profile akin to the one of measures with a temporary nature, in that revenue changes initially but goes back to the original level after some time.

Recent decades featured frequent modifications in tax legislation and this made it possible to compile a comprehensive list of around 70 measures with a potential effect on economic activity over the period 1996-2012. This list is summarized in Table 1 including the year of implementation, the tax concerned, a brief description of the measure and its quantification (as a percentage of nominal GDP). Moreover measures are classified according to their effects into permanent (p.e.), temporary (t.e.) and revenue-switching (r.s.e.).

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[3]Note that some of these measures may have additional temporary short-term revenue effects which have to be considered when a time of payment perspective is adopted in the compilation of shocks - see section 4.1.

Table 1: Tax policy measures implemented in Portugal from 1996 to 2012 (continues)

Year	Tax	Brief Description	Quantification (% GDP)
1996	IVA	Introduction of an intermediate rate (12%) in July (p.e.)	-0.32
1996	ISP	Change in the average tax rate (p.e.)	0.02
1997	IRC	Tax rate reduction from 36 to 34% (p.e.)	-0.17
1997	ISP	Change in the average tax rate (p.e.)	-0.12
1998	ISP	Change in the average tax rate (p.e.)	0.10
1999	ISP	Change in the average tax rate (p.e.)	-0.10
2000	IRC	Increase in the prepayment rate from 75 to 85% for high-profit firms (r.s.e.)	0 (+/-0.26)
2000	IRC	Introduction of lower rates for companies located on inland regions and for small companies plus a reduction in the tax rate from 34 to 32% (p.e.)	-0.22
2000	ISP	Change in the average tax rate (p.e.)	-0.52
2001	IRS	Reductions on the tax rates and inclusion of an additional bracket (p.e.)	-0.24
2001	ISP	Change in the average tax rate (p.e.)	0.27
2002	IRS	Especially strong update of bracket limits of withholding tables (r.s.e.)	0 (-/+0.25)
2002	IRS	Special scheme for the payment of tax arrears (t.e.)	0.17
2002	IRC	Special scheme for the payment of tax arrears (t.e.)	0.33
2002	IRC	Tax rate reduction from 32 to 30% (p.e.)	-0.14
2002	IVA	Standard tax rate increase from 17 to 19% in June (p.e.)	0.64
2002	IVA	Special scheme for the payment of tax arrears (t.e.)	0.23
2002	ISP	Change in the average tax rate (p.e.)	0.37
2002	Other Ind.	Special scheme for the payment of tax arrears (t.e.)	0.11
2002	Social cont.	Special scheme for the payment of tax arrears (t.e.)	0.13
2003	IRC	Increase in the special advanced payment rate (p.e.)	0.10
2003	ISP	Change in the average tax rate (p.e.)	-0.03
2004	IRC	Tax rate reduction from 30 to 25% (p.e.)	-0.45
2004	ISP	Change in the average tax rate (p.e.)	0.18
2005	IRS	Decline in tax rates compensated by a reduction of tax deductions (r.s.e.)	0 (-/+0.12)
2005	IVA	Standard tax rate increase from 19 to 21% in July (p.e.)	0.51
2005	ISP	Change in the average tax rate (p.e.)	0.03
2005	Social cont.	Increase of self employed social contributions in July (p.e.)	0.07
2006	IRS	Reintroduction of tax credits (p.e.)	-0.08
2006	IRS	Introduction of a new top bracket (p.e.)	0.02
2006	IRS	Gradual increase in the taxation of income from pensions (p.e.)	0.04
2006	ISP	Rise in the tax rate (p.e.)	0.13
2006	IT	Multi-year increase of the unitary tax component (p.e.)	0.09
2007	IRS	Elimination of the different treatment of married and single taxpayers (p.e.)	-0.02
2007	IRC	Changes in the taxation of dividends (p.e.)	0.02
2007	ISP	Rise in the tax rate (p.e.)	0.12
2007	Other ind.	Reform of the taxation of vehicles in July (p.e.)	-0.04
2007	Social cont.	Increase of the public employees and pensioners contribution to their health system (p.e.)	0.06
2008	IRS	Increase in tax credits (p.e.)	-0.04

Table 1: Tax policy measures implemented in Portugal from 1996 to 2012 (continued)

Year	Tax	Brief Description	Quantification (% GDP)
2008	IRC	Introduction of tax benefits (p.e.)	-0.01
2008	IRC	Change in the calculation of taxable income (p.e.)	0.04
2008	IMI	Reduction in top tax rates by mid-year (p.e.)	-0.04
2008	IVA	Decline in the standard tax rate from 21 to 20% in July (p.e.)	-0.28
2009	IRS	Raise in tax benefits to people with disabilities (p.e.)	-0.02
2009	IRC	Rate cut from 25 to 12.5% applied to low values of taxable income (p.e.)	-0.1
2009	IRC	Changes in the rules for prepayments (r.s.e.)	0 (+/-0.03)
2009	IRC	Reduction in the special prepayment limit (p.e.)	-0.03
2009	IT	Increase in the tax rate - ad valorem and unitary components (p.e.)	0.01
2010	IRS	Special surcharge on the income from pensions and labour of 1% for the 3rd and 4th income brackets and 1.5% for the higher brackets in July (p.e.)	0.39
2010	IRS	Increase of withholding rates on capital income in July (p.e.)	0.02
2010	IRS	Introduction of a new bracket with a marginal rate of 45% to be applied to taxable income exceeding 150.000 euros (p.e.)	0.01
2010	IRC	Increase of 2.5 p.p. in the rate applied to high taxable profits	0.12
2010	Other dir.	Special taxation scheme for undeclared income from capital held abroad (t.e.)	0.05
2010	IVA	Increase in all rates by 1 p.p. in July (p.e.)	0.61
2011	IRS	New ceilings for tax benefits; higher taxation of capital gains and reduction of the deduction applicable to pensions' income above 22.500 euros (p.e.)	0.11
2011	IRS	Extraordinary surcharge of 3.5% on 2011's taxable income (t.e.)	0.58
2011	IRC	Introduction of a ceiling to tax benefits (p.e.)	0.06
2011	Other dir.	Effect of the introduction of a new tax on the banking sector (p.e.)	0.09
2011	IVA	Increase in the standard rate from 21 to 23% (p.e.)	0.60
2011	IVA	Increase of the rate applied to electricity and natural gas in October (p.e.)	0.29
2011	ISP	Reduction of tax benefits (p.e.)	0.08
2011	Social cont.	Entry into force of the new contributory code; increase in the contributory rate for public employees from 10 to 11% (p.e.)	0.16
2012	IRS	Reduction of tax benefits (p.e.)	0.37
2012	IRS	Increase in the taxation of pensions (p.e.)	0.07
2012	IRS	Solidarity surcharge on highest pensions (p.e.)	0.01
2012	IRS	Increase of the taxation on capital income (p.e.)	0.00
2012	IRC	Surcharge initiated in 2010 extended to profits exceeding 1.5 million euros plus introduction of a surcharge on profits exceeding 10 million euros (p.e.)	0.11
2012	IMI	Increase of top and bottom tax rates and elimination of exemptions (p.e.)	0.03
2012	Other dir.	Special taxation scheme for undeclared income from capital held abroad (t.e.)	0.16
2012	IVA	Changes in the lists of goods and services subject to reduced rates (p.e.)	0.99
2012	IT	IABA	Increase in excise taxes (p.e.)	0.06
2012	ISV	Update of the tax (p.e.)	0.01

Note: IVA-Value Added Tax; ISP-Tax on Oil Products; IRC-Corporate Income Tax; IRS-Personal Income Tax; IT-Tax on Tobacco; IABA-Tax on Alcohol and Alcoholic Beverages; ISV-Tax on Vehicle Sales; IMI-Municipal Tax on Real Estate; p.e.-permanent effects; t.e.-temporary effects; r.s.e.-revenue switching effects.

3 The role of motivations behind tax changes and endogeneity concerns

The adequate estimation of the effects of tax changes on GDP growth requires a series of tax shocks that does not respond to current and future economic developments, in order to avoid the well-known simultaneity bias. Previous studies using the narrative method focused on the motivation behind tax measures as a way to isolate exogenous actions. Tax measures deemed endogenous in Romer and Romer (2008) are taken in response to information about current or prospective economic developments and include countercyclical policy and spending-driven tax changes. In contrast, measures classified as exogenous include namely those targeted at fostering long-term growth and reducing inherited fiscal imbalances. The relevance of these criteria in the Portuguese case is now discussed.

As to countercyclical policy, in the sample period there is only one episode that can be considered as a discretionary government action aimed at stabilizing the economy, comprising a few measures taken around the international financial crisis that erupted in 2008. The Portuguese action plan (*Iniciativa para o Investimento e o Emprego*) within the 2009 European Economic Recovery Plan, along with other measures already implemented in 2008 and described in the documents as having a countercyclical motivation (see, for example, Ministério das Finanças (2009), Chapter II.4), had nevertheless a rather modest size (annualized effect of around 0.1 percent of GDP). Note that the major fiscal measures enacted under this action plan were on the expenditure side. Other measures that brought down the tax burden in the same period, such as the reduction of the standard rate of the value added tax, were not part of the official documents related to the fiscal stimulus and thus cannot be classified as pursuing macroeconomic stabilization.

Such a lack of importance of the countercyclical motive, unlike previous studies using the narrative approach for the US and UK, is also related to the sample period. Those studies are based on extended samples that start shortly after WWII, and thus include the «golden age» of fiscal policy as a tool for demand management. Also in the US and the UK there were hardly any countercyclical tax measures after 1980 until recently.

Regarding spending-driven tax policy, there is no evidence in the documents analyzed for Portugal of changes in taxes responding to measures on the expenditure side. In fact, the conduct of fiscal policy in Portugal and the approach followed in setting-up the budget may not favor such a direct link between expenditure and revenue measures.

While some measures in Table 1 - for example, the reductions of the corporate income tax rate - can be seen as motivated by the desire to promote long-term growth, the major motivation behind tax changes in Portugal over the last decade has been the need to comply with the Stability and Growth Pact rules. Measures intending to curb deficits and enhance fiscal sustainability generally qualify as exogenous in the Romer and Romer (2008) typology. Nevertheless, the Portuguese and European contexts have specificities that follow from the emphasis on a target defined by reference to the actual deficit in the Stability and Growth Pact. This may establish a link between downturns in economic activity and the need to implement fiscal tightening.

There is evidence of procyclical discretionary fiscal policy in Portugal (Cunha and Braz (2009)) as the European Monetary Union integration process required keeping the deficit below the reference level in a period of low GDP growth. More generally, Agnello and Cimadomo (2009) find evidence of a procyclical behavior of legislated revenue changes prior to the recent financial crisis for European Union countries, indicating that this was not a peculiarity of the Portuguese fiscal policy. However, besides macroeconomic developments, many other factors may trigger episodes of budgetary slippage such as hikes in health- or age-related expenditure. In fact, a standard Granger causality test clearly speaks against that output lags help predict our shock measure of legislated changes in taxes (see section 5.2). Nevertheless, when measuring the effects of tax shocks, a specification controlling for past economic conditions is used and this accounts for the possibility of a response to them.

Finally, some of the tax changes considered were part of fiscal consolidation packages involving simultaneously measures on the expenditure side. This tends to bring about a contemporaneous correlation with spending shocks (Pereira and Wemans, 2013, find this kind of evidence for Portugal) and is taken into account in the robustness exercise.

4 Transforming the measures into a quarterly series of tax shocks

4.1 The benchmark approach: focusing on the time of payment

The construction of a quarterly series of tax shocks requires that the effect on revenue of each measure is assigned to a particular quarter (or quarters). This is far from a mechanical procedure and in many cases a deep knowledge of each measure's partic-

ularities is necessary. For instance, the way a change in personal income tax rates or deduction rules affects the behavior of economic agents may depend on whether such change modifies the amounts withheld at source or, instead, the refunds in the following year. The principle followed in deriving the benchmark shock measure was to date tax changes in accordance with the time taxes have to be paid.

This focus on the implementation date is also adopted by Romer and Romer (2010) and Cloyne (2013) for their benchmark analysis. In fact, there is strong microeconomic evidence mainly for the United States that anticipated changes in taxes influence the behavior of economic agents when they take effect (e.g. Johnston et al. (2006)), suggesting the impact on disposable income as a key channel of transmission of tax shocks to economic activity (see Jappelli and Pistaferri (2010) for a review of the literature on consumption responses to changes in income). In the Portuguese case this approach is further justified by the existence of a significant share of liquidity constrained income.[4] Moreover the importance of the implementation date may reflect other factors, such as a lack of detailed information on tax policy measures that would allow economic agents to accurately predict the change in future tax payments they entail.

The time of payment rule applies as follows (see also the Appendix A explaining in detail how several concrete measures are recorded). The most straightforward case consists of measures with permanent effects, affecting tax payments made in a continuous way, for example, concerning the value added tax rates or the personal income tax, if fully reflected on the withholding tables. Such actions are recorded once, in the quarter of implementation, by 1/4 of the annualized revenue change. Note that they represent a permanent level shift in revenues from that quarter onwards and our shock measure intends to capture *changes* in taxation. If measures of this kind are implemented step-wise, over several years, they are recorded in the quarter of implementation of each step, also by 1/4 of the annualized revenue change. In the case of measures implemented after the middle of a quarter, the change in revenue is split proportionally between the quarter of implementation and the next.

Some legislated tax changes affect revenue in a temporary way. These are recorded by the variation in the amounts raised in each quarter, and are cancelled by a symmetrical shock in the following quarter, reflecting the return of receipts to the original level.

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[4]Castro (2006) estimates a 40 per cent share of liquidity constrained income for Portugal between the mid-nineties and 2005. In addition, this study finds a positive relationship between this share and the unemployment rate, a fact that could support an increase of liquidity constrained income in recent years.

A more difficult case concerns permanent measures affecting intermittent tax payments in that they occur only in specific quarters of the year. This is especially the case of payments of the corporate income tax[5] and the annual refunds of the personal income tax. On the one hand, in order to adhere strictly to the time of payment principle, shocks should be recorded in the quarter of payment and cancelled in the next (given the absence of a payment). However, such a recording would have to go on forever. On the other hand, these tax payments generally concern previous year's income or wealth, and therefore a certain smoothing behavior by agents appears plausible. In particular, corporations are typically in a good position to forecast their tax liabilities and, in addition, face less liquidity constraints than households and adopt an extended horizon in their investment decisions. Therefore, for these measures the time of payment approach is applied taking the year, instead of the quarter, as a reference. We assume that economic agents consider the change in the payments for the year as a whole owing to the measure and incorporate this information in their behavior from the first quarter (for measures coming into force in January, which is usually the case).[6] Such change is thus spread uniformly over the four quarters, and 1/4 of it is recorded in the first quarter.

Measures switching revenue from one year to the other - see section 2 - are, in the first year, recorded following the rules for permanent measures. This typically leads to assigning to the first quarter 1/4 of the change in revenue for the year as a whole. In the next year (first quarter) there is a symmetrical cancellation recording, given the return of revenues to the original level.

We also consider a slight variation of the benchmark approach, featuring a strict time of payment recording of the measures that concern intermittent tax payments. In this alternative, the changes in those payments are assigned to the exact quarters in which they occur[7], recorded for the actual amounts, and cancelled in the following

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[5]The corporate income tax code foresees prepayments equal to between 70 and 90 per cent of the previous year's tax liability that take place in three installments in July, September and December. The settlement of the final tax liability occurs in May of the following year.

[6]In practice, for changes in the corporation income tax rates, we assume that in the first year a change takes effect (t), the only impact on revenue comes through the December prepayment, by 20 per cent of the amount, and that in $t+1$ companies pay the remainder of the tax liability of t and adapt their prepayments to the new tax rate. This intends to mimic the fact that tax changes taking effect in t translate into significant changes in revenue only from $t+1$ on.

[7]In doing this, besides the assumption concerning the prepayments of the corporate income tax described in the last footnote, it is further assumed that tax refunds of the personal income tax concentrate in the third quarter. This has mostly been the case, notwithstanding some changes in the procedures since 1996. Regarding the tax on real estate, we assumed that it has been paid fully in the second quarter, at the time of the first installment, ignoring the possibility of paying it in two installments in certain cases.

quarter. By convention, the recording of a measure stops when the quarterly profile of its revenue effect remains unchanged from one year to the other. This approach has the obvious shortcoming that permanent measures affecting intermittently paid taxes are treated similarly to measures with temporary effects, but it is useful to cross-check the impacts of intermittent tax payments vis-a-vis the benchmark shock measure.

4.2 An alternative approach: focusing on approval dates and cumulative liabilities

The idea behind the construction of the benchmark series of shocks is that the relevant moment for measuring the macroeconomic effects of taxation is when agents have to pay their taxes. However if the behavior of consumers was primarily influenced by their permanent income expectations, the relevant moment would instead be when they learned that their future disposable income would change. In this case, they would modify their behavior at the time of credible announcement of the measure. Similarly, firms may adopt a multi-year horizon for some of their investment decisions, particularly large scale ones[8], the relevant piece of information being in this case the long-run change in tax liabilities.

This approach brings the timing of the shock closer to the moment of announcement of the underlying measure, and in this sense is also more adequate to capture possible impacts on economic activity through the expectations channel (for instance, a positive impact of measures that enhance the soundness of the fiscal stance). The time of credible announcement of a measure is approximated by the date of approval of the respective legislation[9] (the exact date considered was that of publication in the *Diário da República*). In calculating the cumulative change in liabilities, short-term revenue effects related to pre-payments or refunds do not matter.

Table 2 compares the quarterly recording of shocks under the cumulative liabilities and the time of payment approaches (see also Appendix A). For permanent (one-step) measures affecting continuous tax payments, the two approaches differ only to the extent that there is a lag between approval and implementation. Note that, in this case, there are no short-run revenue effects that originate a difference vis-a-vis the long-run

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[8]In contrast, the recording of the tax shock taking as a reference the amount to be paid over the one-year horizon, in the time of payment approach, may provide a better basis for assessing the effects of taxes on small-scale investment decisions (such as acquisition of transportation equipment).

[9]It is very difficult to construct a shock measure that goes beyond this. Agents usually learn about a measure before approval, but the moment this happens is hard to establish. At the same time, many measures are dropped or strongly modified in the course of the legislative procedure, and one would need an assessment about the probability agents attach to the approval of each proposal.

figure. In the cumulative liabilities approach measures enacted step-wise are recorded only once, also at the time of approval, by 1/4 of the sum of all single (annualized) tax changes. In addition measures that affect taxes paid intermittently are recorded once, by 1/4 of the annualized long-run revenue change. For measures affecting receipts temporarily, the shock is assigned to the quarter the respective legislative change was approved, by the overall change in revenue, and cancelled in the following one. Finally, measures switching revenue from one year to the other are disregarded, as it is assumed that economic agents realize that these have no effect on their net tax liabilities.[10] In practice, whenever legislation is approved in the second half of a quarter, the shock is fully assigned to the following quarter.[11]

Table 2: Summary of recording of tax measures with permanent effects

Type of measure	Approach	Time of recording	Amount
Continuous tax payments, one-step	time of payment	quarter when payment begins[1]	1/4 change in annualized revenue
	cumulative liabilities	quarter of approval[2]	1/4 change in annualized revenue
Continuous tax payments, multi-step	time of payment	quarter when payment begins at each step	1/4 change in annualized revenue at each step
	cumulative liabilities	quarter of approval	1/4 sum of changes in annualized revenue at every step
Intermittent tax payments	time of payment	1st quarter of year when payment begins and, while applicable, of following years[3]	1/4 change in actual revenue during the year
	cumulative liabilities	quarter of approval	1/4 change in annualized long-run revenue

Notes: (1) Measures implemented in the second half of the quarter are proportionally split between the quarter of implementation and the next. (2) Measures approved in the second half of the quarter are recorded in the next. (3) If the measure is passed already in the course of the year, the shock is assigned to the first quarter of the period thereafter.

4.3   An overview of the series of tax shocks

The series obtained in the time of payment approach are illustrated in Figure 1 for shocks to direct taxes (including social security contributions), and in Figure 2 for shocks to indirect taxes. The shaded areas signal the periods when GDP contracted for at least two consecutive quarters.

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[10]Strictly speaking this kind of treatment should also be applied to temporary measures under a recording that cumulates the changes in liabilities. However, it was felt that temporary measures ought to have a different treatment than measures that merely switch revenue between time periods.

[11]This deviates from the rule followed in the time of payment approach as the spreading by two quarters makes no sense in a liabilities-focused analysis. We thus adopted this more simplified assumption borrowed from Romer and Romer (2010).

Figure 1: Shocks to direct taxes (as a percentage of GDP)
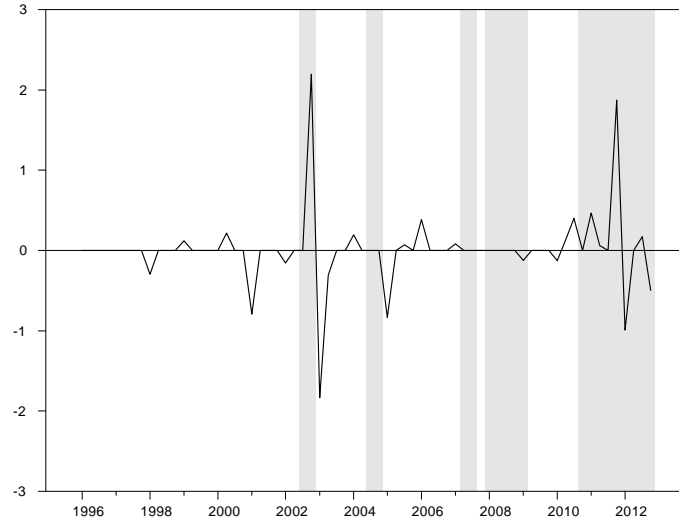
Figure 2: Shocks to indirect taxes (as a percentage of GDP)
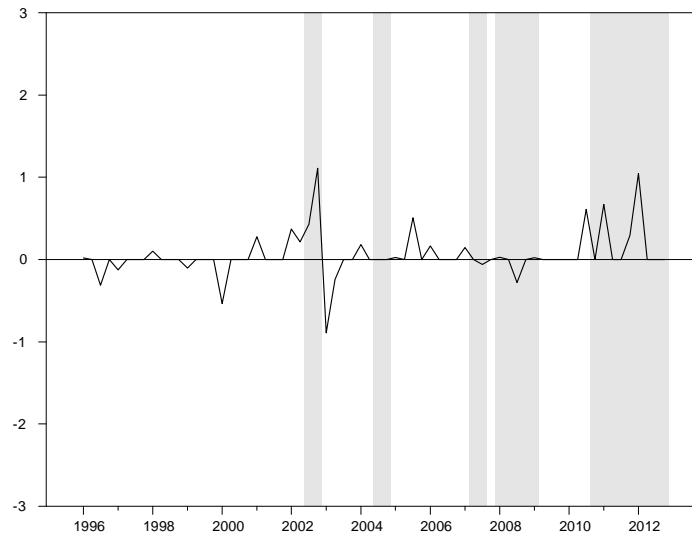
In the case of direct taxes, there is a first major negative shock in the initial quarter of 2001, resulting from the combination of a reduction in the corporate income tax rate and the reform of the personal income tax coming into force in 2001 (the shock measure also reflects the cancellation of the temporary effect of the increase in the corporate income tax prepayments in 2000). The special scheme for the payment of tax arrears («perdão fiscal»), in the last quarter of 2002, gave rise to a particularly noticeable shock affecting both direct and indirect taxes, matched by a negative one in the following quarter. This program allowed tax arrears with a legal collection date until 31 December 2002 to be settled without paying interest or fines.[12] After that, there is a significant negative shock in 2005 that reflects the lagged effects of the corporate income tax rate reduction of 2004. In the later sample years, several measures led to a series of positive shocks to direct taxes, the largest one being the 2011 personal income tax surcharge, impacting chiefly the last quarter of that year and, given its temporary nature, originating a cancellation in the subsequent quarter.

Regarding indirect taxes, besides the special scheme for the payment of tax arrears, already mentioned, several increases in the value added tax rates translated into significant positive shocks. The change in the average rate of the tax on oil products in 2000 was the most significant tax reduction in the sample period. More recently, in 2012, there is another large positive shock, brought about by the application of the standard value added tax rate to goods previously subject to the reduced or intermediate rates.

To conclude, the special scheme for the payment of taxes in 2002 clearly stands out as the most significant shock in the sample. Moreover, the measures taken in the period before and in the course of the Economic and Financial Assistance Program also give rise to a prominent sequence of shocks. Note further that there is a positive contemporaneous correlation between direct and indirect tax shocks (the correlation coefficient is about 0.45). This mirrors the fact that many tax policy measures were aimed at fiscal tightening, and were not, in particular, shifts between different types of taxation. This is in contrast with the evidence in Princen et al. (2013), who analyze discretionary tax measures between 2001 and 2012 in several EU countries and find evidence of increases in indirect taxes, matched by cuts in direct taxes, targeting a shift to growth-friendlier tax bases.

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[12]This shock has a specific nature in that it does not concern taxes to be paid but instead taxes that ought to have been paid. Still it captures a unique episode of a very large change in the amount of tax payments mostly concentrated in one quarter. Therefore it was considered in the estimation, but in a robustness section we show how results change when this episode is excluded.

5   Effects of discretionary exogenous tax policy on output

5.1   Benchmark results

The macroeconomic impacts of the tax shocks derived in the previous section can be assessed on the basis of reduced-form specifications, under the assumption that the shocks do not respond to contemporaneous or prospective changes in economic activity. As explained in section 3, within our set of legislated tax changes only very few have a countercyclical motivation: these are identified and can be easily excluded from the estimation. We come back to this issue below.

The specification we use regresses output growth $(\Delta \ln y_t)$ on the contemporaneous value and on 4 lags of the shock measure (ΔT_{t-i}) and 4 own lags:

$$\Delta \ln y_t = \alpha + \sum_{i=0}^{4} \beta_i \Delta T_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta \ln y_{t-i} + e_{t.} \tag{1}$$

This specification is in first differences because the shock measure captures changes in taxation. It controls for lagged output which is likely to be the single most important control variable in this context (see Romer and Romer (2010)). Note that it accounts in particular for a possible lagged pro-cyclical response of some legislated changes in taxes, induced by the functioning of the Stability and Growth Pact (see section 3), although the econometric evidence presented in the next section strongly suggests that this is not needed. Studies such as Mertens and Ravn (2011) and Cloyne (2013) have plugged narrative shock measures into a reduced-form VAR including other macroeconomic variables, besides output.[13]   This is not feasible here owing to the lack of degrees of freedom. Perotti (2012) raises the possibility of a bias in using a specification like equation (1). If GDP (y_t) responds to x_t, x_{t-1}, ... and these are omitted in the equation, e_t will not be orthogonal to them. Given that y_{t-i} will also respond to x_{t-i} and lags, e_t will not be orthogonal to y_{t-i} as well. Perotti considers the case where x_t is changes in government revenue that are not legislated actions nor an endogenous reaction to GDP, but this line of reasoning could apply to many other macroeconomic variables affecting GDP, say interest rates, and thus is an issue difficult to overcome. Below we address another possibility of bias stemming from the correlation of tax shocks with shocks on the expenditure side.

The shock series starts in 1996:1. Given that 4 lags of the variables are included,

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[13]In a related paper, Favero and Giavazzi (2012) suggest to measure the effects of the narrative tax shocks inside a fiscal SVAR.

the estimation, by OLS, is based on a sample starting in 1997:1 and ending in 2012:4. GDP and all the other macroeconomic variables considered are seasonally adjusted prior to estimation. As it is plausible that some components of GDP, notably private investment, react to tax shocks with a lag greater than 1 year, we also report the results considering 8 lags of the shock measure. The effect of the shocks is determined as a cumulative dynamic multiplier.

Figure 3 presents the effects on output of an increase in taxes of 1 percentage point of GDP and one-standard-deviation confidence bands[14] for the benchmark tax shock measure. The response of GDP is negative and builds up steadily, attaining -1.3 percent after 1 year, and -2.7 percent after 3 years. In the subsequent period it strengthens a bit further, to around -3.0 percent, and remains thereafter at this level, being thus highly persistent. This effect on output is statistically significant, although the confidence bands are wide. These findings indicate that legislated tax increases (decreases) have a powerful recessive (expansionary) impact on economic activity. Excluding from the shock series the few tax changes that have a countercyclical motivation, the output response remains virtually the same. Therefore in the remainder of the paper the full set of legislated changes is considered. Furthermore, if the lag length of the shock measure is increased to 8 in equation (1), the trajectory of output deviates only slightly from that presented in Figure 3, decreasing by 1.2 percent 1 year out and 2.9 percent 3 years out.

Figure 3: Output response to discretionary tax policy (1% of GDP shocks)
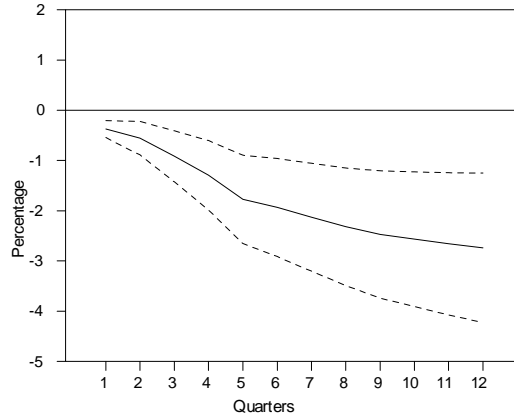
Comparing with previous studies using the narrative approach, Romer and Romer

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[14]The bands for this and the other dynamic multipliers throughout the paper were obtained by a standard Monte-Carlo procedure, drawing 1000 vectors of coefficients from a multivariate normal with mean and variance-covariance given by the least squares point estimates. An output response for each draw was computed; the standard deviation across all responses is presented.

(2010) and Cloyne (2013) report negative impacts on output which take between 2 to 3 years to build up and reach maxima, respectively, around -3 and -2.5 percent of GDP. Moreover, the first of these studies also finds a rather persistent output response. Such magnitudes for the impact of taxes are much in line with the ones for Portugal.[15]

5.2 Output response allowing non-permanent shocks

Regression (1) above embodies the most relevant experiment: a permanent change in taxes. Nevertheless it may be also interesting to estimate an alternative specification in the form of a bivariate VAR including the shock measure and output growth. The impulse-responses yield the trajectory of GDP following a *typical* legislated tax shock during the sample period in that the shock is allowed to decay over time through the inclusion of its own lags in the respective equation. Similarly to regression (1) above, GDP is allowed to respond contemporaneously to taxes, meaning that it is ordered in the second place after the shock series.

Figure 4 shows the GDP response from the bivariate VAR. The profile is similar to the one in Figure 3, but the impact is now a bit smaller: around -1 percent after 1 year and -2 percent after 3 years, and the maximum stands at -2.4 percent. Such result is caused by a reversion in the second quarter after impact of slightly more than 20 percent of the shock (not shown), which remains at this level thereafter. A separate analysis of direct and indirect taxes shows that the partial decay of the shock happens only for the former, matching a larger share of legislated changes affecting direct taxes with a temporary effect on revenues. In comparison to the regression-based analysis this tends to weaken the GDP response.

In this setting one can also examine the abovementioned possibility that legislated changes react indirectly to the cycle through a response to past deficits. A way of doing this is through a Granger causality test of joint significance of output lags in the tax shock equation. The null hypothesis is clearly not rejected with a p-value of 0.71, indicating that output does not Granger cause the tax changes. Looking at the point response of legislated changes in taxes following shocks to output (not shown), this is negative, which would be in line with pro-cyclicity, but it is quite small and statistically not significant. Note finally that pro-cyclicity would tend to amplify the shock over time given its strong recessionary impact, while one observes the opposite

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[15]Cloyne notes that the similarity of the results for the UK and for the US is surprising, given the very different tax systems in the two countries, as well as sources used and procedures followed to obtain the shock series. It is interesting to note that we have reached the same type of findings for Portugal.

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Figure 4: Output response to discretionary tax policy (1% of GDP shocks) allowing non-permanent shocks
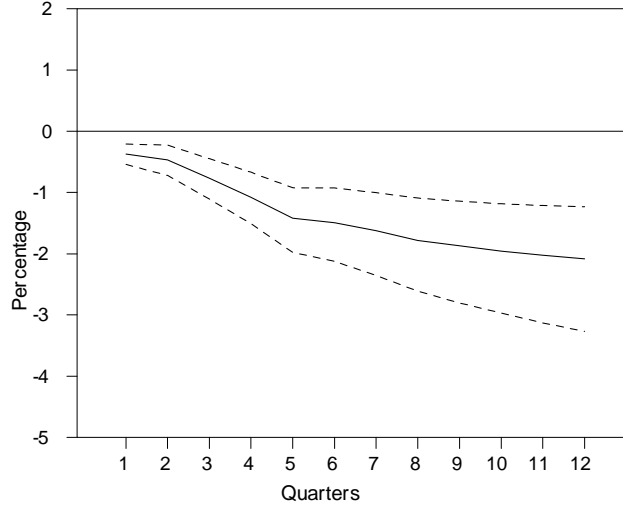
- a reversion of the shock (stemming from its non-permanent nature).

5.3   Robustness: outliers and controlling for expenditure

As seen in section 4.3 a number of tax policy actions stand out for their size, notably the special scheme for the payment of tax arrears in 2002 («perdão fiscal») and several measures taken during the recent period of fiscal consolidation, from 2010 to 2012. Such large tax changes are legitimate observations to consider. Nevertheless one may ask whether they are driving the large negative effects of taxation on GDP documented above, given that our sample is small and the mentioned tax increases - albeit partly temporary - coincided with periods of contraction in economic activity (see Figures 1 and 2).

In order to address this issue, we (i) dropped the amounts related to the special scheme for the payment of tax arrears from the shock series, and (ii) considered a sample ending in the 2010:2. Note that this last exercise implies the loss of about 1/5 of the degrees of freedom available. The GDP responses are shown, respectively, in Figures 5 and 6 (the benchmark response from Figure 3 is also shown - dashed line - for comparison). As far as the point estimates are concerned, the impact on GDP remains virtually unchanged when the special scheme for the payment of tax arrears is dropped, and weakens but only to a small extent when the last two and a half years are excluded from the sample. The most visible change consists in the widening of the confidence bands, particularly in the second case, which is not surprising given the reduction in

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Figure 5: Output response to discretionary tax policy (1% of GDP shocks) dropping the «perdão fiscal»
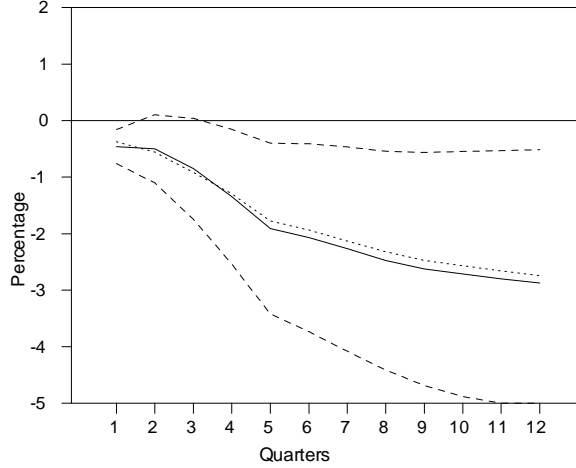
the number of degrees of freedom. Overall these robustness exercises indicate that the benchmark results are not being driven by particular episodes of legislated increases in taxes, although they also underline the great uncertainty surrounding a precise quantification of the impact they have on output.

Some of the changes in taxation showing up in our shock series were part of consolidation packages including, at the same time, measures on the expenditure side. Therefore there is room for (negative) correlation between tax shocks and contemporaneous expenditure shocks - and indeed Pereira and Wemans (2013) found evidence of this kind for Portugal. Assuming a conventional depressing effect on GDP of government expenditure reductions, such correlation would tend to overstate the measured negative impact of tax increases on output. A possible way to assess whether this is causing a substantial bias is to include government expenditure and its lags in equation (1) above.

The response of output to changes in taxes controlling for spending[16] (not shown) is indeed less negative than the benchmark response, but without making much of a difference (they almost coincide for the first four quarters and three years out the fall in GDP is now 2.3 instead of 2.7 percent). It is worth noting that the inclusion of expenditure in equation (1) allows controlling for shocks to this variable but has the unwanted consequence of holding fixed the trajectory of the variable following tax shocks (expenditure may react to them both directly or indirectly, following the GDP

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[16]Government expenditure is defined as the sum of government consumption and investment plus social transfers. Moreover, like GDP, it enters the equation in growth rates.

Figure 6: Output response to discretionary tax policy (1% of GDP shocks), sample ending in 2010:Q2
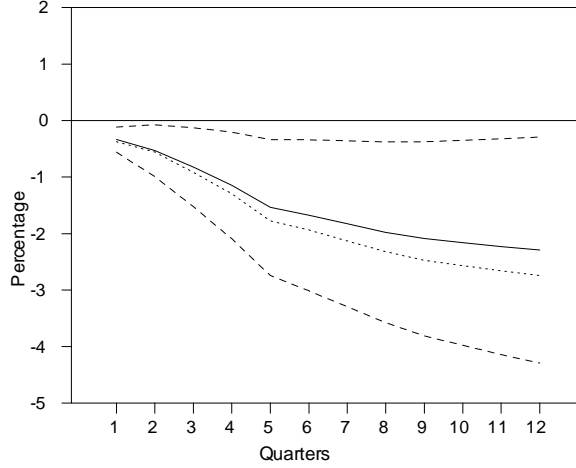
response). This may exaggerate the reduction in the recessive effect of tax shocks when expenditure is taken on board, given the pro-cyclical behavior of important expenditure categories (see Pereira and Wemans) which is likely to override the countercyclical response of some others, like unemployment benefits. In any case, our findings clearly indicate that the inclusion of expenditure is relatively unimportant for the measured effects of discretionary exogenous taxation on GDP.

5.4   Separating the effects of direct and indirect taxes

This section distinguishes between the effects of direct and indirect taxes on output (note that our listing contains a reasonable number of measures for each category). In doing so, it is necessary to take into account that shocks to the two types of taxes are contemporaneously correlated (see section 4) and thus each series has to be included in the equation used to measure the other's effect on output. Otherwise the measured response of output, say to direct tax shocks, would reflect to some extent the effects of shocks to indirect taxes, and vice-versa. The specification now used is:

$$\Delta \ln y_t = \alpha + \sum_{i=0}^{4} \beta_i \Delta DT_{t-i} + \sum_{i=0}^{4} \varphi_i \Delta IT_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta \ln y_{t-i} + e_t, \qquad (2)$$

where, as before, $\Delta \ln y_t$ is the growth rate of output and ΔDT_t and ΔIT_t are, respectively, the shocks to direct and indirect taxes. The point estimates indicate a fall in output by 0.7 percent after one year and 2.2 percent after three years, following a 1 percent of GDP change in direct taxes (Figure 7), and by, respectively, 2.3 and 3.0

percent, following an identical change in indirect taxes (Figure 8).

Figure 7: Output responses to discretionary changes in direct taxes (1% of GDP shocks)
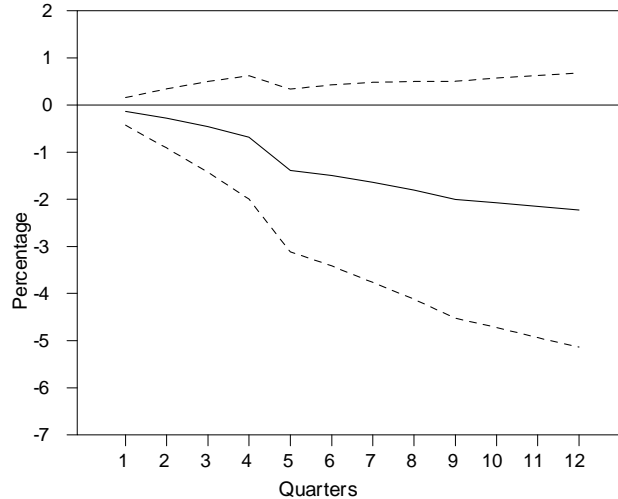
Therefore, as far as point estimates are concerned, a sizeable negative impact on economic activity is observed for both categories of taxes. However the confidence bands widen noticeably in comparison to total taxes and, albeit still clearly indicating a negative sign, encompass a zero response. This added uncertainty possibly reflects the lower density of shocks when each tax category is taken separately, and the smaller number of degrees of freedom in regression (2). In fact the bands largely overlap in Figures 7 and 8, so that it is not possible to come to a conclusion as to different effects of direct and indirect taxation. These results are in contrast with the evidence in Pereira and Wemans (2013) who found a stronger effect of direct taxes on output (see next section).[17]

5.5   A comparison with SVAR results

The narrative approach has most commonly led to larger tax multipliers than the SVAR approach. For example, the multiplier estimated for the US post-war economy by Romer and Romer (2010) reaches -3, while SVARs multipliers for the US usually do not come much beyond -1.[18] The findings of Cloyne (2010) indicate a GDP response

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[17]Previous studies for other countries using the narrative approach did not present evidence on this issue.

[18]This is the general trend although in each of the two methodologies the measured impact on economic activity depends on the precise specification used. In addition there is subsample sensitivity,

Figure 8: Output responses to discretionary changes in indirect taxes (1% of GDP shocks)
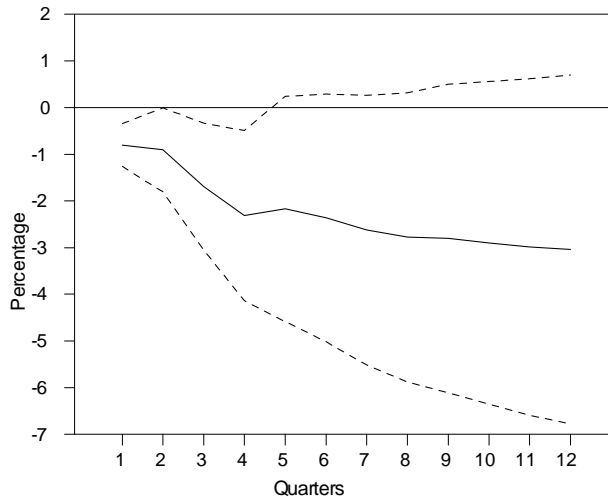
similar to the one in Romer and Romer, associating the narrative approach with high negative tax multipliers. Such a tendency is confirmed by the results obtained for Portugal. In fact, the effects of tax shocks presented above are much stronger than the ones estimated in Pereira and Wemans (2013) using an SVAR.

Figure 9 compares the GDP response in the SVAR presented in Pereira and Wemans (but extending the sample to the last quarter of 2012, in order to eliminate the gap in the sample period)[19] with the results in Figure 4 above where shocks are allowed to be non-permanent and thus more comparable with those in SVARs. Although both methodologies yield negative effects on GDP, the difference between the results is statistically significant, with the GDP response in the SVAR reaching a maximum of -0.3 percent against -2.4 percent in this study. When taxes are broken down, the point GDP responses differ both for direct and indirect tax shocks. However, more so in the second case as the response hovers around zero in the SVAR, while the point estimates are always strongly negative in the narrative approach (though also lacking statistical significance).

Some possible reasons for the different findings in the two methodologies for expenditure shocks have been put forward in the literature. Ramey (2011), focusing on the impact of military spending on GDP and private consumption, has blamed the failure of SVARs to capture the anticipation of fiscal policy measures by economic agents for

which further complicates the comparison.

[19]Note that the results presented here are very similar with the ones obtained in the original paper with a sample ending in the last quarter of 2011.

Figure 9: GDP response to tax shocks (1% of GDP): narrative (full line) and SVAR (dashed line) results
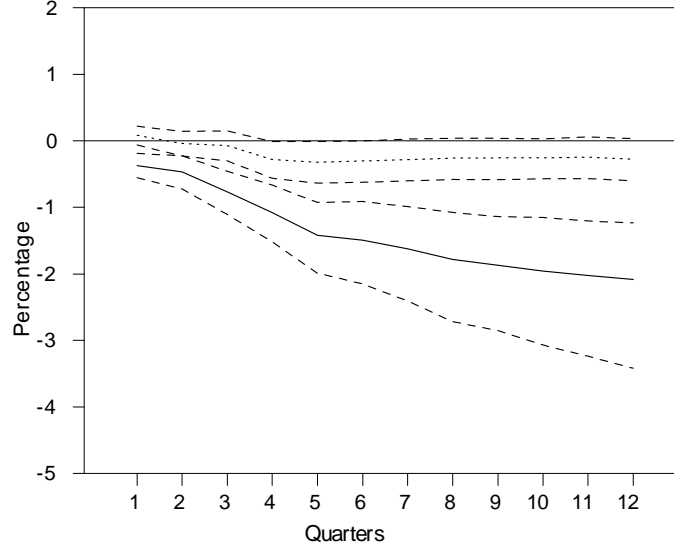
the differences vis-a-vis the narrative approach. Recall that SVARs generally date tax shocks when revenue is affected, while in the narrative approach, for the reasons given in section 4.1, the benchmark analyses have been based on a time of payment rule. The latter rule corresponds approximately (though not exactly - this point is further discussed below) to the moment revenue changes, taken in the SVARs. Therefore the gap between the GDP responses to tax shocks presented in the empirical work under each methodology cannot be ascribed to anticipation effects.

Naturally tax shocks in the two methodologies differ in many other ways. In particular, in SVARs they are extracted from the series of total tax revenues, assuming a given elasticity to GDP in order to isolate automatic contemporaneous movements in taxation. The elasticity calibrated into the SVAR model - being only an approximation - is a first reason for the divergence in the findings. Indeed some studies have stressed the sensitivity of SVAR results to changes in calibrated elasticities. For Portugal, however, Pereira and Wemans show that their main findings are quite robust to the elasticities assumed, which does not support this particular hypothesis.

The content of shocks is also intrinsically different, as SVAR shocks capture all deviations from systematic policy, while the narrative approach concentrates on discretionary legislated policy (not responding to economic activity), i.e. usually significant and clearly acknowledged actions. Thus SVAR shocks include many changes in revenue that may not be perceived as changes in taxation by economic agents, or at least be

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perceived as relatively less important ones, such as improvements in the efficiency of tax collection. Moreover, the dating of the shocks in the SVAR approach will depend on accounting rules that can deviate from the date taxes have to be paid, relevant for the narrative approach. This can happen especially in the case of the value added tax as there is a significant lag (albeit partly corrected in national accounts) between the time consumers pay the tax and when companies pass on the amounts collected to the tax authorities. Furthermore, fluctuations in refunds of this tax bring about an important variation in revenues that is irrelevant for consumers. This could help justify the particularly big discrepancy in the findings for the indirect tax multiplier.

The quantitative importance of changes in tax revenues not explained by the business cycle nor legislative actions can be large. Kremer et al. (2006) estimate that for Portugal in the period 1998-2004 such changes, in absolute average and annual terms, stood at 0.4 percent of GDP, above the figure for the legislated changes (0.3 percent). This phenomenon is likely to be even more pronounced when quarterly data are used as they are more affected by short-run volatility in revenues. Consequently the differences in the content of shocks might be the most important single explanatory factor for the larger tax multipliers found in the narrative approach vis-a-vis SVARs.

6   Output response in the cumulative liabilities and strict time of payment approaches

The benchmark results are based on a shock measure derived assuming that the time of payment is the correct timing for the transmission of discretionary fiscal policy to economic activity. This emphasis on the implementation date is justified by the evidence that consumers respond to changes in current disposable income. Nevertheless, alternative assumptions cannot be ruled out, in particular, that economic agents modify their behavior at the time a given measure is passed and consider at once the cumulative change in liabilities for the future. The approach put forward in section 4.2 brings the shock measure closer to these assumptions.

As it turns out the output response for the cumulative liabilities series comes rather close to the one for the time of payment series, both in terms of level and profile (Figure 10). The same holds as regards statistical significance (not shown). This is likely to stem from an important correlation between the shocks in the two approaches. In particular, these coincide for most permanent measures affecting revenues collected continuously over the year. Furthermore, in Portugal the approval of tax changes often

Figure 10: Output response to discretionary tax shocks for different shock measures (1% of GDP)
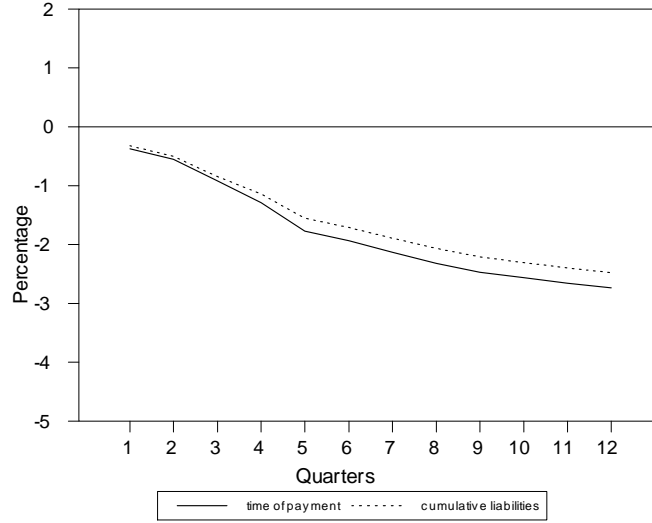
does not take place much before implementation, and there are almost no examples of important multi-year tax plans, factors that could amplify the differences between the shocks in the two approaches. Lastly, owing to the inclusion of a number of lags of the shock measure in equation (1), this specification may in some cases still capture the effect of shocks on economic activity reasonably well, as a lagged impact, even if the right timing is missed.

Given the limited variability in terms of characteristics of tax measures in our dataset, a more interesting experiment is to consider the GDP response in a regression where one includes the two alternative measures at the same time. This regression captures *only* the effects on economic activity of those parts of the shocks which do not overlap (as the other shock measure is held constant in the regression). Figure 11 presents the GDP response in each one of the approaches, controlling for the other. The respective confidence bands (not shown) become rather wide, in such a way that they comprise a zero response in both cases. This is likely to reflect the fact that one is now looking at the effects of portions of the full shocks. Taking into account such lack of statistical significance, the conclusions that follow must be essentially read as hints.

The trajectory of output following shocks dated in accordance to the time of payment, controlling for the cumulative liabilities series, comes close to the one observed for the shock measure as a whole. This provides support to the assumption that output responds to tax changes at the time of implementation. The response of output

Figure 11: Output response to discretionary tax policy controlling for the alternative shock measure (1% of GDP shocks)
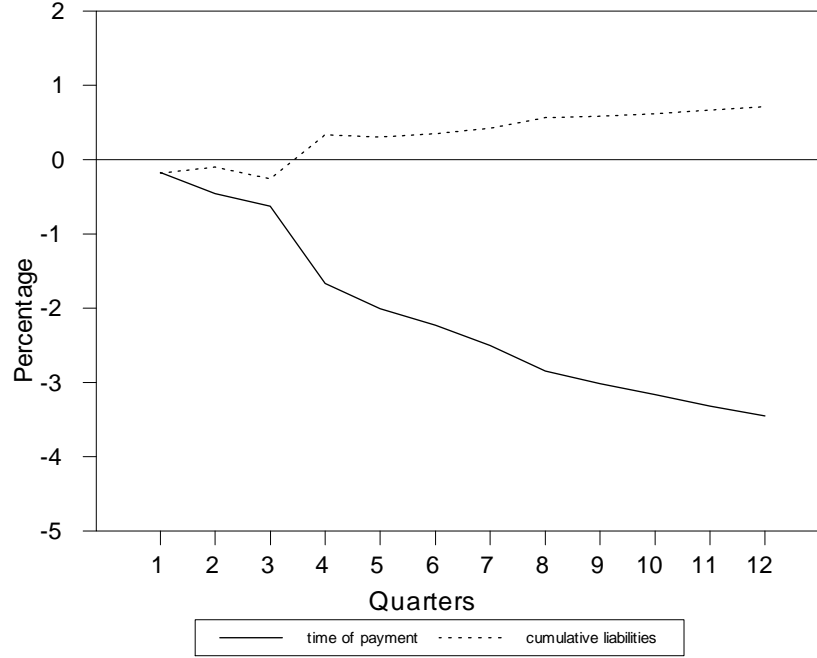
for the cumulative liabilities measure, holding constant the time of payment series, is initially nil and after about one year it becomes *positive* albeit small. As said the cumulative liabilities approach is comparatively more suitable for measuring the effects on the economy operating through expectations. Such evidence goes thus against the permanent income theory, but it would be compatible, among other hypotheses, with a positive impact on the confidence of economic agents of tax increases reflecting a prospective improvement in the fiscal stance. Romer and Romer (2010) also document a positive - statistically non-significant - relationship with economic activity for their present-value measure (which bears similarity to our cumulative liabilities measure) when controlling for their benchmark series. Consistently Mertens and Ravn (2011) find that the tax changes in the Romer and Romer dataset that could be anticipated (in the sense that were announced at least one quarter prior to implementation) have *before implementation* a positive relationship with output (reversed after implementation).[20]

As an additional experiment, we have assessed the effects on output of a third

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[20]Note however that the experiment in Mertens and Ravn is not fully comparable with what is done in our study and Romer and Romer. In fact Mertens and Ravn take the Romers' benchmark series and split it into two subsets: anticipated and non-anticipated shocks. But note that the Romers' benchmark measure differs from their present-value measure not only as regards timing but also the amounts recorded (similarly to the two alternative shock measures in our study).

shock measure in which all tax changes are dated on a strict time of payment basis (see the end of section 4.1). The distinctive feature of this third measure is to capture, in particular, the possibility that refunds of the personal income tax have an impact on output concentrated in the quarter they occur - say, because some consumers face strong liquidity constraints. In a regression including both this modified measure and the benchmark one, the responses of output were negative and equal three years out, respectively, to -0.7 percent and -2.1 percent (non-significant in both cases). Bearing in mind that one is looking at the effects of those portions of the shocks which do not overlap, a larger impact of the benchmark shock measure may indicate that a smoothing behavior by consumers in face of tax refunds predominates.

7   Response of output components to tax shocks

This section studies the trajectory of some GDP components, namely private consumption and private investment, following legislated tax changes, for the benchmark shock measure. The specification used in doing so is similar to (1), but replacing GDP by the relevant demand component. Following a rise of 1 percent of GDP in taxes private consumption falls by about 2.0 percent after one year, and 3.5 percent after three years (Figure 12). This is slightly more than the fall in GDP, but overall the responses of the two variables are very much in line with each other. The responses of consumption of non-durables and durables (Figure 13) differ, as expected, by showing a much more pronounced fall for the latter, which stands at 8.3 and 10.6 percent, respectively, one and three years out. In contrast, the corresponding reductions in the consumption of non-durables are 1.2 and 2.8 percent. The confidence bands (not shown) indicate that both responses are statistically significant.

Tax policy may have distinct impacts on corporate investment depending on the transmission channel. While the traditional interest rate channel implies a rise in investment following a tax increase, negative effects are also possible, e.g. indirectly through the recessionary impact on output or, in the case of the corporation income tax, the reduction in prospective profitability. Unfortunately the response of private investment to the measure of tax shocks developed in this paper does not shed light on this issue for Portugal. In fact, except for the quarter of impact, in which the response (not shown) is positive, from the second quarter on the confidence bands are approximately symmetrical around a zero response. We increased the number of lags of the shock series up to 8, and used the shock measure based on cumulative liabilities, which could be more adequate in this context, but without coming to very

Figure 12: Private consumption response to discretionary tax policy (1% of GDP shocks)
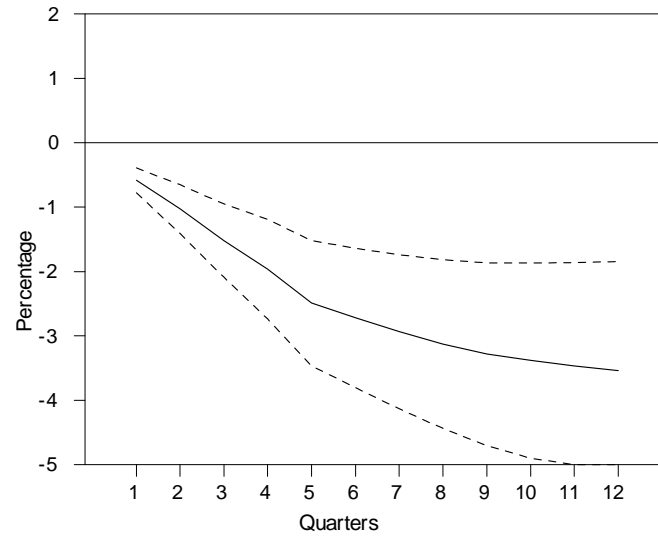
Figure 13: Consumption of durables and non-durables response to discretionary tax policy (1% of GDP shocks)
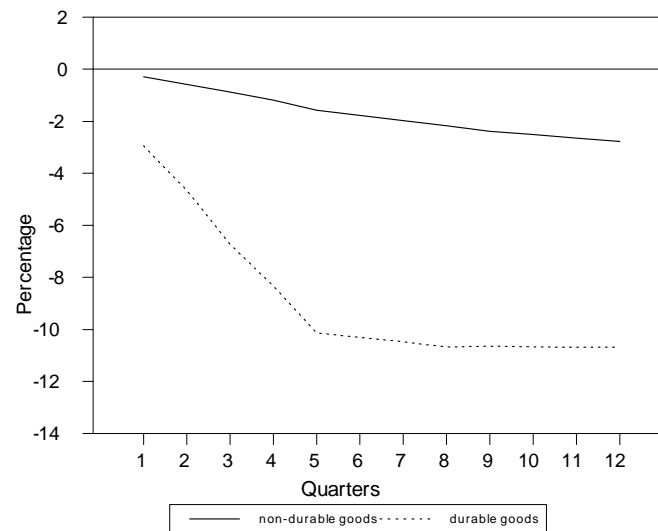
different conclusions. When investment is broken down by investment of households and corporations, the responses remain statistically non-significant. For the latter variable, there is a sign change from positive to negative after about two years but, given the degree of uncertainty, it is difficult to assess whether this is meaningful in any way.

While for Portugal the depressing effect of tax shocks appears essentially linked to private consumption, the abovementioned studies for the US and the UK also report a strong recessionary impact on private investment.

8 Concluding remarks

This study develops a quarterly series of discretionary tax policy shocks for Portugal, based on the legislation and contemporary budgetary analyses. It covers the period from 1996 to 2012. Moreover the sample period is characterized by a high density of measures that have been mostly exogenous, in the sense that they were independent from current and prospective macroeconomic conditions. The benchmark analysis is based on the assumption that economic agents respond to changes in taxes when their current income is affected.

The estimated multiplier effects of tax shocks on economic activity are negative and high, in line with the results of other studies belonging to the same strand of the literature. Legislated tax changes of 1 percent of GDP reduce output by 1.3 percent one year out. These estimates are statistically significant, although surrounded by a reasonable degree of uncertainty, and are robust to a number of variations in the specification used to measure the impacts and to the exclusion of abnormally large measures. The evidence thus suggests that legislated increases (decreases) in taxes have considerable recessionary (expansionary) effects. A shock of the same magnitude has an effect on consumption of around -2.0 percent after one year. Consumption of durables responds particularly strongly to changes in taxation.

This paper also considers an alternative shock measure better suited for capturing a possible role of expectations in the transmission of fiscal policy. Note that the conduct and implementation of tax policy in Portugal does not provide a good setting for studying the issue, as most measures affect income close to the date of approval. With this caveat, there is a hint of a positive relationship between the expectations component of tax changes and economic activity. This could theoretically stem from beneficial effects on economic growth coming from the prospective of fiscal consolidation.

The estimated impact of changes in taxation on economic activity for Portugal is

much stronger in this paper than in previous work using the SVAR methodology, as it has been the case for other countries. This gap can be ascribed to many differences in the two methodologies, where the content of the shock figures prominently. While in the narrative approach shocks come strictly from discretionary exogenous government policy, in SVAR they reflect many other factors to which economic agents may respond differently. In fact the two methodologies embody exercises that are not exactly equivalent.

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9 Appendix

A Detailed treatment of some examples of tax measures

This section illustrates the detailed treatment of concrete tax measures under the different assumptions regarding the timing of impact on economic activity.

1 - Permanent measures affecting continuous tax payments, implemented in the middle of a quarter

[Example: Standard Value Added Tax (IVA) rate increase from 17 to 19% implemented in June 2002 (approved on May 31) - Annualized effect: €904 million]

- TIME OF PAYMENT APPROACH: 1/4 of the annualized effect is divided between the quarter of implementation and the following quarter, in proportional terms.

  [recording of example above - 2002:2 €75 million | 2002:3 €151 million]

- CUMULATIVE LIABILITIES APPROACH: 1/4 of the annualized effect is assigned to the quarter the law was approved, unless the approval date falls in the second half of the quarter - in this case, it is assigned to the following quarter.

  [recording of example above - 2002:3 €226 million]

2 - Permanent measures, continuous tax payments, multi-step implementation

[Example: Multi-year increase of the unitary component of the Tax on Tobacco (IT) in 2006 - Annualized effect: €150 million (implemented in 3 steps, €50 million at each of them]

- TIME OF PAYMENT APPROACH: 1/4 of the annualized effect is assigned to the quarter of implementation of each step.

  [recording of example above - 2006:1 €13 million | 2007:1 €13 million | 2008:1 €13 million]

- CUMULATIVE LIABILITIES APPROACH: 1/4 of the sum of the annualized effects at every step is assigned to the quarter the law was approved.

  [recording of example above - 2006:1 €38 million]

3 - Permanent measures affecting intermittent tax payments - IMI and IRS refunds

[Example: Increase of top and bottom rates of the municipal tax on real estate (IMI) rates in 2012 - Annualized effect: €50 million]

- TIME OF PAYMENT APPROACH: 1/4 of the annualized effect is assigned to the first quarter of the first year of payment/refund.

  [recording of example above - 2012:1 €13 million]

  - STRICT TIME OF PAYMENT APPROACH: annualized effect is assigned to the quarter of payment/refund and cancelled in the following quarter.

    [recording of example above - 2012:2 €50 million | 2012:3 -€50 million]

- CUMULATIVE LIABILITIES APPROACH: 1/4 of the annualized effect is assigned to the quarter the law was approved.

  [recording of example above - 2012:1 €13 million]

4 - Permanent measures affecting intermittent tax payments - IRC

[Example: Corporate Income Tax (IRC) rate reduction from 32 to 30% in 2002 - Annualized effect: -€200 million]

- TIME OF PAYMENT APPROACH:

  - * 1/4 of 20% of the annualized effect is recorded in the first quarter of the first year of implementation (t), as a temporary effect on prepayments (this is reverted in the first quarter of the second year of implementation (t+1));
    * 1/4 of 80% of the annualized effect is recorded in the first quarter of t+1, as a temporary effect on the final tax liability (this is reverted in the first quarter of the third year of implementation (t+2));
    * 1/4 of 80% of the annualized effect is recorded in the first quarter of t+1, as a permanent effect on prepayments;
    * 1/4 of 20% of the annualized effect is recorded in the first quarter of t+2, as a permanent effect on the final tax liability.

    [recording of example above - 2002:1 -€10 million | 2003:1 -€70 million | 2004:1 €30 million]

  - STRICT TIME OF PAYMENT APPROACH:
    * 20% of the annualized effect is recorded in the last quarter of the t, as the effect on the last prepayment of the year, and cancelled in the following quarter;
    * 80% of the annualized effect is recorded in the second quarter of t+1, as the effect on the final tax liability, and cancelled in the following quarter;

    ∗ 2/3 of 80% of the annualized effect is recorded in the third quarter of t+1, as the effect on the first and second prepayments of the year, and cancelled in the following quarter;

    ∗ 1/3 of 80% of the annualized effect is recorded in the fourth quarter of t+1, as the effect on the last prepayment of the year, and cancelled in the following quarter;

    ∗ 20% of the annualized effect is recorded in the second quarter of t+2, as the effect on the final tax liability, and cancelled in the following quarter.

[recording of example above - 2002:4 -€40 million | 2003:1 €40 million | 2003:2 -€160 million | 2003:3 €53 million | 2003:4 €53 million | 2004:1 €53 million | 2004:2 -€40 million | 2004:3 €40 million]

- CUMULATIVE LIABILITIES APPROACH: 1/4 of the annualized effect is assigned to the quarter the law was approved.

  [recording of example above - 2002:1 -€50 million]

5 - Measures with temporary effects

[Example: Special scheme for the payment of Value Added Tax (IVA) arrears in 2002 - Overall effect: €329 million (of which €86 million paid in 2003)]

- TIME OF PAYMENT APPROACH: effects recorded in the quarter the amounts are paid and cancelled in the following quarter.

  [recording of example above - 2002:4 €243 million | 2003:1 -€157 million | 2003:2 -€86 million]

- CUMULATIVE LIABILITIES APPROACH: overall effect is recorded in the quarter the law was approved and cancelled in the following quarter.

  [recording of example above - 2002:4 €329 million | 2003:1 -€329 million]

6 - Measures with revenue switching effects affecting intermittent tax payments - IRC, passed in the course of the year

[Example: Increase in the prepayment rate of the Corporate Income Tax (IRC) from 75 to 85% for high-profit firms in 2000 (approved on April 4) - Annualized effect: +€328/-€328 million (0)]

- TIME OF PAYMENT APPROACH: recorded by 1/4 of the change in actual revenue in the first quarter of the year of implementation (except for measures passed in the course of the year, which are recorded in the first quarter of the period thereafter) and cancelled in the first quarter of the following year.

  [recording of example above - 2000:2 €82 million | 2001:1 -€82 million]

- STRICT TIME OF PAYMENT APPROACH:

    * 2/3 of the annualized effect is recorded in the third quarter of t, as the effect on the first and second prepayments of the year, and cancelled in the following quarter;

    * 1/3 of the annualized effect is recorded in the fourth quarter of t, as the effect on the third prepayment of the year, and cancelled in the following quarter;

    * annualized effect is recorded in the second quarter of t+1, as the effect on the final tax liability, and cancelled in the following quarter.

    [recording of example above - 2000:3 €219 million | 2000:4 -€109 million | 2001:1 -€109 million | 2001:2 -€328 million | 2001:3 €328 million]

- CUMULATIVE LIABILITIES APPROACH: these measures are not recorded.

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