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THE SHORT-TERM IMPACT OF GOVERNMENT BUDGETS ON PRICES: EVIDENCE FROM MACROECONOMETRIC MODELS[1]

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ABSTRACT

This paper recalls the existing empirical evidence on the (short-term) impact on prices of fiscal variables and compares it with the results of a new set of harmonised simulations, conducted with eight well-established econometric models used by the ECB, five National Central Banks of the Eurosystem, the European Commission and the OECD. Overall, a broad consensus appears on the impact on prices of changes in individual government budget items. In all the models examined, changes in government demand and in direct taxes on households have a very limited impact on prices, while in contrast changes in indirect taxes and employers' social security contributions have a relatively large impact. The results obtained for the year following the shock show that the effect on prices usually takes some time to materialise fully. This is particularly relevant when analysing the effects of shocks to public consumption, as those tend to become large when considering the second year after the shock. These results are in line with model comparisons of this kind conducted with US and UK models and they are also broadly consistent with VAR results.

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1. Introduction

In a recent paper (Perotti, 2001) the author proposes to summarise "what we know about the effects of fiscal policy on output". His findings, based on a review of the recent theoretical and empirical economic literature, are rather disappointing, and he concludes that "there is clearly no consensus on the basic effects of government spending on output".[2]

In this document we address a similar question, but we focus instead on the effects of fiscal policy on prices and extend the analysis to other types of fiscal shocks. On the other hand, we restrict the analysis to the short-term effects of different budget items on price movements and examine this issue mainly from an empirical perspective. In particular, using several macroeconometric models currently used in a number of central banks and other institutions, we report and discuss simulation results for four different fiscal shocks and we contrast them with those from previous model comparison exercises as well as with the available evidence from VAR studies.

The empirical evidence concerning the impact on prices of fiscal variables is not fully satisfactory. Large attention has been devoted to the relation between inflation and fiscal balances, which appears to exist only in extreme circumstances. Until recently, a more disaggregated approach, distinguishing between budget items, has typically involved model simulations. The drawback of this approach rests on the dependency of the results on the modellers' choices. However, studies which compare the results of simulations across different models are not available for most euro area countries. A literature which uses VAR methods and focuses on individual budget items is slowly emerging, but data problems limit it to a few countries and ask for caution in interpreting its results.

Our comparison involves simulations carried out with eight large or medium-size econometric models. Five refer to individual countries and belong to Central Banks within the ESCB (National Bank of Belgium, Deutsche Bundesbank, Banco de España Banca d'Italia and Banco de Portugal)[3]. One model refers to the whole euro area (Area Wide model) and is used by the ECB.[4] The last two models (INTERLINK[5] and QUEST[6]) have been developed, respectively, within the OECD and the European Commission. They are multi-country models, allowing the users to examine shocks which concern either individual countries or the whole area. While the models differ considerably in several aspects, they share the characteristics common to many other macroeconomic models of combining short-term "Keynesian" features with long-term neo-classical properties[7].

We examine the effects of shocks to the following four budget items: 1) government purchases of goods and services, 2) personal income tax, 3) indirect taxes and 4) social security contributions. As it can be expected that the short-term effects on prices of changes in personal income taxation should not be significantly different from those concerning monetary transfers to households (pensions, wages, etc.), the categories we singled out for our experiment can be viewed as representative of most budget items.

In the first exercise the main issue addressed is the evidence embodied in these econometric models on the impact on prices through the aggregate demand channel. In the second, we also examine the aggregate demand channel, triggered by the change in disposable income, discussing the role of alternative specifications of the consumption and the investment functions. We expected that wage bargaining would have also played a role in this experiment, as according to standard labour market theory workers negotiate their compensation taking into account their after tax wage. However, the participating models do not include the tax wedge among the short-run determinants of wages. In the third exercise one of the key issues is whether the econometric models we examine embody an immediate and full adjustment of final prices to the change in indirect taxes or, alternatively, include some partially offsetting temporary reaction of net prices. Finally, in the last exercise we find out what the models say about firms' reactions to a fiscally induced increase in labour costs (see chart 1 for a summary of the main channels through which fiscal policy affect prices).

As already mentioned, we restrict our analysis to the short term impact of fiscal shocks, i.e. to the effects in the year of the shock and in the following one, although in some cases results for longer horizons are reported for illustration. While it could have been very interesting to extend our simulation horizon systematically further, we refrained from doing so for three main reasons. First, extending the period would have necessarily called for specifying appropriate reaction functions for monetary, exchange rate and fiscal policies (which are instead left exogenous in our simulations). While doing so would have somewhat increased realism, the results would not have shown any longer the pure effects of fiscal shocks, becoming less useful for policy advice, which is very often based on such counterfactual simulation results. Second, allowing policy reactions would have made it extremely complex to relate differences in the results across models to the specific linkages they embody between the fiscal block and the other parts of the models. Third, it should be emphasised that the specification of the policy reactions, together with the large number of other *ceteris paribus* assumptions that are needed to run the simulations necessarily involves a number of arbitrary simplifying assumptions – on e.g. demographics, labour supply, pension schemes, etc – which render the long-run analysis from a fiscal standpoint less relevant. While simulations carefully designed using fully closed models can address these issues (e.g. as those reported in Wallis, 2003), we preferred to focus on short-run results, which allowed us to circumvent those methodological difficulties. As a result, the issue of steady-state implications of such policy changes is beyond the scope of this paper.

Overall, our findings on the effects on prices seem less disappointing than those of Perotti (2001) on output. While the differences are non-negligible, the overall pattern of responses to the shocks reviewed is relatively similar across models. This may possibly be owing to the relative homogeneity of the models we include in our comparison. In the recent years, a number of model comparison exercises, some of them also conducted with fully-closed models (i.e. supplemented with fiscal and monetary policy modelling and exchange rate equations), have presumably contributed to this observed convergence.

The results, while subject to a number of caveats, point to a number of useful, and hopefully not trivial, conclusions for understanding the connection between fiscal policy and prices in the short-term. In particular, the range spanned by our results for each exercise is often sufficiently contained to allow us to draw some conclusions on the relative importance for price developments of changes in the various individual budget items. For instance, for all models examined, changes in government demand and in direct taxes on households have a negligible impact on prices, while changes in indirect taxes and employers' social security contributions have a relatively large impact.

The rest of the paper is structured as follows. In section 2 we provide a brief survey of the relevant theoretical and empirical (VAR) literature studying the relationship between fiscal policy and inflation. In section 3 we discuss the design of the simulations, a number of comparability problems and some additional caveats. In Section 4 we analyse each of the individual simulations, comparing the results, when possible, with those of other similar projects and of some VAR studies. Section 5 concludes the paper.

2. An overview of the theoretical and empirical literature

The theoretical literature has identified three main channels through which fiscal policy affects prices: seignorage, aggregate demand and aggregate supply. The first channel comes from the obvious link between fiscal policy and inflation when deficits are financed by printing money. This, however, is not currently a realistic alternative for countries where there is a fully independent central bank, like in the European Union, with moreover a legal prohibition to finance government deficits (Article 101, formerly 104, of the Maastricht Treaty)[8]. Second, fiscal policy can affect prices through its impact on aggregate demand, with a magnitude depending on a number of key factors[9].Third, prices can be affected through the impact of fiscal policy on aggregate supply. Although this channel is generally discussed with reference to long-term issues - with lower private saving leading to lower investment and thereafter output, its short-term impact may also be substantial, e.g. if changes in indirect taxes are promptly shifted to consumers. Significant supply-side effects may also stem from changes in labour income taxes in the presence of labour market rigidities (Alesina and Perotti, 1997).

In addition to these traditionally mentioned channels, the so-called Fiscal Theory of the Price Level (FTPL) has recently emphasised a direct link between the budget balance and the price level in a setting characterised by full employment of resources (Woodford, 2001; Christiano and Fitzgerald, 2000). According to this theory, which applies to a non-Ricardian policy regime - i.e. with no government commitment to adjusting fiscal policy if debt explodes - an increase in the deficit results in a net increase in the permanent income of the private sector. Given that the total available resources of the economy has not changed, the new equilibrium requires an increase in the price level. The internal consistency of this approach is highly disputed (Buiter, 1999 and Niepelt, 2002). Even some of its proponents point out that, while possibly useful as an explanation of some past inflationary episodes, the FTPL does not seem particularly relevant for current policy analysis in Europe, because of institutional constraints, and in the US, where the evidence of the last two

decades suggests that governments were ready to adjust fiscal policy when the debt got large (Christiano and Fitzgerald, 2000).

The empirical literature studying the relationship between fiscal policy and inflation has traditionally focused on the aggregate fiscal balance, without generally distinguishing between different budget items, and on specific and extreme circumstances (episodes of hyperinflation, government insolvency and monetisation of the debt[10]). Unsurprisingly, outside these episodes only limited evidence of a relationship between fiscal deficits and inflation has been found, moreover restricted to emerging countries only at the long-run horizon. King and Plosser (1985), for example, found no significant causality from fiscal deficits to changes in base money and inflation in the US and in another 12 countries. These results are similar to those obtained by Montiel (1989) and Dornbush, Sturzenegger and Wolf (1990) in the case of some high-inflation emerging countries. More recently, Catao and Terrones (2001) found a statistically significant long-run relationship between the ratio of government deficits to narrow money and inflation for a panel of emerging market economies. Also Fischer, Sahay and Végh (2000) found fiscal deficits causing high inflation but detected no evidence of a relationship between inflation and fiscal balances for low inflation countries, or during low inflation periods in the high inflation countries.

A more disaggregated approach than that focusing on the budget balance can however be found in econometric macromodels documentation, which typically includes simulation involving shocks to specific fiscal variables, such as various expenditures items or different tax rates. The drawback of this source of information rests on the dependency of the results not only on the specific model used but also on the various ancillary assumptions included in the experiments. Efforts to implement comparable simulations across different econometric models have been undertaken in the US, with the well-known NBER/NSF model comparison seminars held in the mid-seventies (Fromm and Klein, 1976) which resumed at the end of the eighties (Klein, 1991) and the Brookings Institutions conference in the late eighties (Bryant et al., 1988). Similar exercises were conducted in the UK, where, following the establishment in 1983 of the ESRC Macroeconomic Modelling Bureau and across almost two decades, surveys dedicated to specific issues were published on a regular basis (Church et al., 2000).[11] To our knowledge, such extensive and well documented effort cannot be found for most euro area countries as regards fiscal policy experiments – contrary to what is available for e.g. monetary policy simulations (e.g. BIS 1995, WGEM 2003).

A disaggregated approach is also followed by the recent strand of the literature that has applied VAR methods to the analysis of the effects of fiscal policy on macroeconomic variables (see Table 1). The studies included in this literature are not homogeneous, especially with reference to the approaches used to identify fiscal policy shocks (a survey of the different approaches can be found in Perotti, 2002). The studies also differ as for the variables included in the VAR models. As shown by Favero (2002) for the case of not modelling monetary policies, omitting variables from the specification of the models may lead to misleading results. The lack of reliable quarterly data for fiscal variables has so far limited the application of these methods to a few countries and moreover calls for caution in interpreting its results.

The evidence from this literature on the effect of government spending shocks on prices or inflation appears mixed. For the US, Fatás and Mihov (2001) and Mounford and Uhlig (2002) show negative effects on prices after a positive government spending shock[12]. Perotti (2002) finds an initial positive impact and negative effects thereafter on CPI over the period 1961-2000; for the sub-period starting in 1980, the effects (albeit not significant) are instead positive after 1, 12 and 20 quarters and negative after 4 quarters. Edelberg, Eichenbaum and Fisher (1999) find a negative effect after an initial positive effect, Neri (2001) reports no significant effects and Canzoneri, Cumby and Diba (2002) find a temporary rise in inflation after a brief decline. For other OECD countries, Perotti (2002) finds positive effects of government spending on prices in Germany, the UK and Australia, and negative, albeit small, in Canada. Marcellino (2002) reports minor and not statistically significant effects on inflation in Germany, Italy and Spain[13] and a positive and significant effect in France in the short-run. Finally, Canova and Pappa (2002), which study the effect of fiscal shocks on price dispersion in the US and in the EU countries, find that, on average, expansionary expenditure shocks (identified as those that produce contemporaneous positive comovements in output and deficit) increase relative prices (the effects are significant for the first two years in the case of the US states and for the first four quarters in the case of the EU countries). However, large differences exist in the shape and sign of the price responses across states and countries. In particular, for 14 out of 45 US states, relative price responses are negative.

As regards tax shocks[14], Mountford and Uhlig (2002) find that a net revenue shock has a negligible effect on prices in the US when controlling for the business cycle and for monetary policy shocks[15], while in Canzoneri, Cumby and Diba (2002) the inflation response to a net tax increase is negative, although very small, after an initial and also minor positive effect. Marcellino (2002) reports non-significant effects on inflation of positive tax shocks in France, Germany and Spain, while inflation significantly increases in Italy in the short-run[16]. Perotti (2002) finds that, in particular in the post-1980 period, the impact of a tax shocks on prices is very small, typically negative or zero, while after 3 years there is evidence of a positive effect in UK and Australia, although only in the latter the effect is large. Finally, Canova and Pappa (2002) find that, on average, positive revenue shocks (identified as those that produce contemporaneous negative comovements in output and deficit) decrease relative prices in US states and EU countries (with the effects being significant for the first two years in the case of the US states and after the seventh quarter in the case of the EU countries). Again, however, there are large differences in the shape and sign of the responses across states and countries. The results also suggest that expenditure and revenue shocks matter as a source of price dispersion, the magnitude of the effects being larger in the US than in the euro area countries.

Overall, there are in view of this type of literature (relatively) unambiguous effects on the real side of the economy – unless horizons beyond one year are considered – whereas, on the other hand, the picture appears quite unclear as regards the impact on prices.

Table 1: **EFFECTS ON PRICES AND GDP OF GOVERNMENT DEMAND AND EXPENDITURE SHOCKS IN SELECTED VAR STUDIES**

Quarters	Prices				GDP			
	1st qrt	4th qrt	12th qrt	20th qrt	1st qrt	4th qrt	12th qrt	20th qrt
Demand shock - US								
Perotti (2002) 1961-2000	+*	-	-*	-*	+*	+	+*	+*
Perotti (2002) 1980-2000	+	-	+	+	+	+	-	-*
Neri (2001) 1965-1996	+*	+*	+*	+*	+*	+*	-	-
Fatás and Mihov (2001) 1960-1996	-*	-*	-*	-*	+*	+*	+*	+*
Edelberg, Eichenbaum and Fisher (1998) 1948-1996	-*	-*	-		+*	+*	+*	
Mountford and Uhlig (2002) 1955-2000	-	-*	-*	-	+	+	-	-
Canzoneri, Cumby and Diba (2002)	-	+	+		+*	+*	+	
Demand shock - Germany								
Perotti (2002) 1961-2000	+*	+*	+*	+*	+*	+*	-	*
Perotti (2002) 1980-2000	+	+*	+*	+	+	-*	-	-
Marcellino (2002) 1981-2001	-	-			+*	+*		
Revenue shock - US								
Perotti (2002) 1961-2000	+	-	-*	-*	-*	-*	-*	-*
Perotti (2002) 1980-2000	-	-*	-*	-	-*	-	*	-
Neri (2001) 1965-1996	-*	-*	-*	-*	-*	-*	-*	-*
Mountford and Uhlig (2002)	+	+	-	-	-*	-*	-*	-
Canzoneri, Cumby and Diba (2002)	+	-	-		-*	-*	-*	
Revenue shock - Germany								
Perotti (2002) 1961-2000	-	+*	+	-	-*	-*	-*	-
Perotti (2002) 1980-2000	-*	-	-*	-	+	-*	-	-*
Marcellino (2002) 1981-2001	+	+			-	-		

* *The value 0 is outside the region between the two one-standard error bands.*

3. Main features of the econometric models under review

Our comparison exercise covers the results of simulations with eight econometric models. Five are used in national central banks within the ESCB - National Bank of Belgium (denoted BE), Deutsche Bundesbank (DE), Banca d'Italia (IT), Banco de Portugal (PT) and Banco de España (ES) - one model (Area Wide model, AWM) at the ECB, and the last two models (INTERLINK and QUEST) have been developed at the OECD and the European Commission respectively. Although the theoretical underpinnings of these models and their purposes are very different, they also share some common features. These common features are described below, and the main differences are also highlighted.

Four of the models are single-country models of their respective country (BE, IT, PT and ES) while the other four are multi-country models, allowing shocks to individual countries or the whole area to be examined, except in the case of the AWM, which treats the euro area as a single economy. Single-country models, except that of IT, are relatively small, with between 15 and 30 estimated behavioural equations, while the multi-country models and the IT model all have a much larger number of estimated equations. Moreover, all models use quarterly data, except that of PT, which is based on annual data.

In all these models, the short-run behaviour is demand-determined, while a vertical supply curve determines long-run output. The latter is driven in all cases by a Cobb-Douglas production function[17] with two productive factors (labour and capital) and exogenous technological progress or a total factor productivity term, the measure of labour supply including a definition of the NAIRU. In the short run, with sluggish prices and wages, the level of demand (and, therefore, output) may differ from its long-run level, which sets in train a process of price and wage adjustments that drives the models back to their long-run equilibrium.

One of the key differences among the models, with possibly important consequences on the results of model simulations, refers to the treatment of expectations. The ES and PT models do not include any forward-looking element, while such an element does play a role in the determination of exchange rates in the IT model and the AWM. In addition to this variable, forward-looking elements play a role in the determination of long-term interest rates (AWM, BE and DE models) and of short-term interest rates (DE). Finally, the BE, OECD and QUEST models include further forward-looking elements in a wide number of other variables, including private consumption, labour market, prices and wealth. In most cases, however, the impact of such differences is expected to be limited, given the simulation environment used in the current exercise.

As regards the government sector, the fiscal variables typically include 6-7 expenditure categories (2-4 of them exogenous) and 4-8 revenue items (1-2 exogenous). Exceptions are the IT and PT models, which offer a higher degree of disaggregation (13 and 22 expenditure categories and 11 and 26 revenue items, respectively). All models, except that of PT, include a fiscal rule to ensure fiscal solvency in the long run. Once again, this is of limited importance given the simulation design.

Monetary aggregates play no role in the determination of prices and output, except in the case of the DE model where M3 influences the determination of the long-run price level. Short-term interest rates are exogenously determined in the BE, ES, PT and IT models, while a Taylor rule is used in the case of the DE, QUEST and AWM models. This is again neutral to most of our results.

As regards the main determinants of the various domestic demand components, private consumption is mainly determined by disposable income and wealth in all the models, except in the case of the PT model, which does not include wealth. Most models also include interest rates as a determinant of consumption (AWM, ES, DE, IT, PT and QUEST) while only a few of them incorporate the unemployment rate as an additional determinant (AWM, BE). Finally, the BE and the QUEST models incorporate a human wealth variable as a long-term determinant and explicitly allow for liquidity constrained consumers. Investment demand, meanwhile, is mainly determined by output and the user cost of capital, although most of the models distinguish between different types of investment, including public investment.

As regards external demand, world demand and competitiveness are included as long-run determinants of export volumes in all the models, while final demand and competitiveness are the main determinants of import volumes. In addition, the BE and IT models include the output gap or capacity utilisation as an additional short-run determinant of import and export volumes.

As far as the labour market is concerned, output is the main long-term determinant of employment in all models[18], while prices, productivity and unemployment are included in all models as determinants of wages. Two main frameworks are behind the determination of wages, either a Phillips curve (AWM, BE, PT, IT) or a wage-bargaining framework (BE, ES, OECD). In the case of the QUEST, Belgian and Spanish models the tax wedge also has an impact on wages as a long-run determinant thereof. Wages are further determined by the reservation wage and vacancy cost in the QUEST model.

Finally, the GDP (or Value Added) deflator is the main price measure in all models, its equation driving the price system. Prices are usually set as a mark-up over marginal costs, which correspond to unit labour costs. Other determinants include foreign prices and capacity utilisation or the output gap. In addition, prices depend, explicitly, on the frequency of price adjustment in the QUEST, making inflation forward-looking.

4. Design of simulations and caveats

This section provides a brief description of the simulation design, also discussing some problems of comparability across the various models' results and some other methodological caveats.

4.1. The common simulation design

The four simulation exercises take the form of unanticipated shocks affecting the following budget items:

1) Purchases of goods and services
2) Personal income tax
3) Indirect taxes
4) Employers' social security contributions.

Participants in the project were asked to construct the shocks so as to deliver an ex-ante (i.e. excluding the feedback on the budget component arising from changes in the macroeconomic variables) increase in the budget component of 1 % of GDP in each of the year's quarters.

A number of additional simulation guidelines were provided. Since e.g. a few models include some fiscal rules, it was requested that such rules be suspended in the experiments. Also interest rates and exchanges rates were supposed to remain equal to their baseline values over the simulation horizon. As we are mainly interested in fiscal shocks affecting an individual country, this assumption seems reasonable, since shocks reviewed tend to have a one-off impact on inflation and affect individual countries, while in the case at hand - the euro-area -monetary policy responds to the entire area aggregate developments. In addition, this setup can be viewed as reflecting the standard counterfactual 'projection' environment of the Eurosystem. Finally the simulation horizon could be limited to two years - to the extent that the focus of the exercise was clearly put on the short-run impact with unchanged policies and unchanged exchange rates.[19]

4.2. Model-specific simulation design and potential implications

Although modellers largely adhered to the suggested guidelines, a number of differences remained which may affect comparability across results, in particular with respect to the assumptions on the nature of the shock or on interest rates and exchange rates, and therefore to be mentioned.

Temporary shocks: As mentioned above we focus our analysis on the short-term impact of fiscal shocks, thus on the effects in the year the shock occur. However, in order to provide some insight about the impact of fiscal shocks at further horizon, we discuss the results of the simulations in the year following the shock for some econometric models (without reverting the shock). For most participating models (those which are backward-looking) the design of the simulation in the following years is irrelevant. However, for e.g. QUEST, this aspect is important, and the following scheme [(+1 (t), +1 (t+1), 0 (t+2), 0 (t+3), -1 (t+4), -1 (t+5), 0 (t+i with i=6,n)] was adopted, whereby the shock lasts for two years and is then fully offset by an opposite shock in the fifth and sixth year of the simulation.[20] This profile renders the shock transitory, which in the context of a highly forward-looking model such as QUEST is key, to the extent that dealing with permanent shocks would otherwise necessarily imply an exhaustive discussion on the resulting steady-state, which is again beyond the scope of this paper.

Exchange rates: the only exception to the common rule is in the QUEST model, where the dollar-euro exchange rate is endogenous, via a Uncovered Interest Parity condition.

Interest rates: In two models, nominal short-term interest rates were not kept equal to the baseline values. Short-term interest rates were kept as in the baseline in real terms for the OECD. In QUEST, the monetary policy assumption employed was similar to a Taylor rule (inflation forecast based) with a smaller weight on the output gap (0.25) and a larger weight on expected inflation (1.0).

To assess the consequences of the first source of heterogeneity in monetary policy modelling, an alternative set of simulation exercises was performed, using the AWM along with the ES and IT models, with constant real, instead of nominal, interest rates (as done by the OECD). For these models, the results do not significantly change in terms of effects on prices. There are no significant effects on GDP in the case of exercises 1, 2 and, with respect to the first year results, of exercise 4. For exercise 3, assuming exogenous real interest rates determines a lower impact on the GDP by 0.2 percentage points in the first year, and by 0.5 percentage points in the second, on average. For exercise 4, the effect in the second year on the GDP is lower by 0.2 percentage points.

With respect to the Taylor rule used in QUEST, the fact that the determinants of monetary policy refer to the entire area suggests that this may not have had a significant impact on the results. At the same time this is combined with a UIP condition. Turning to such a design can indeed significantly alter the results, as seen e.g. for the AWM (cf. Dieppe and Henry, 2003). The same would presumably apply to results for largest euro area countries, to the extent that their own domestic developments have a big weight, by construction, in the euro area aggregates, which then may trigger some policy and exchange rate responses. In both cases, the results would then however be derived from 'closed' models, i.e. also comprising mechanisms bringing the system back to its steady-state. In such a configuration, results come closer to a fully-fledged medium-term analysis rather than being simply consistent with a conditional forecast / short-term setup.

4.3. Additional caveats

Beyond simple assumptions such as those just discussed, a number of other elements can have a bearing on the results and therefore render the comparison harder to achieve. They have to do with the details of the fiscal modelling, or more generally of other behavioural equations in the model. There is also the issue of possibly non-linear effects at work in the economies modelled.

Comparability across models could e.g. have been increased further by adopting more detailed guidelines on the fiscal side. One area where such step could have been particularly useful concerns the implications of switching off the fiscal rules, i.e. whether the budget item used as an instrument – in most cases direct taxes – should be kept at its baseline levels in real, in nominal or in GDP terms. Another similar issue relates to government expenditure items. In some models these items are endogenous and in other they are exogenous, in nominal or in real terms – as seen from the VAR survey (the elasticity issue, cf. Perotti, 2002), this may be the origin of some discrepancies across models.

An additional key issue regarding inflationary impacts of fiscal measures is how indirect tax rate hikes are passed through to consumer prices, and models differ substantially in this respect.

Either a full and immediate pass-through is assumed – as a simple accounting effect, prices being modelled in pre-tax terms – or some partial pass-through is estimated / calibrated. In this latter case, a limited set of illustrative simulations has been conducted to assess the impact of such divergences.

There is also the connected issue of how the economy specifically react to VAT-only shocks, in comparison with indirect tax shocks. Simulation experiments involving only a shock to VAT were also conducted, with the aim of assessing whether models point to a non-homogeneous impact of other indirect taxes with respect to VAT. However, only three models (BE, DE and IT) were sufficiently disaggregated to permit such a comparison – which is therefore not reported in detail. In the DE model, there is no significant difference between the results of the two exercises; in the IT and BE models, the other components of indirect taxes have a more limited impact on prices.

However, these specification problems should not be seen as a fundamental drawback of our exercise. It should be remembered that uniformity and consistency cannot be fully achieved, as recognised in other comparisons of this kind (e.g. Klein, 1976 or Church et al., 2000)[21]. Moreover, many aspects on which assumptions are not fully comparable do not seem to affect the results significantly, especially in view of the short-term focus of the analysis.

Other sources of heterogeneity may however be more difficult to assess, such as those stemming from fundamental 'behaviour' differences across models. As is often pointed out in the context of such cross-country model comparison exercises (see e.g. Locarno et al., 2003), some of these differences may be due to actual diversity across countries, while others clearly reflect modellers' choices or even the availability of data. Moreover, while the size of the models is not very different, the different level of disaggregation can lead to serious comparability problems for specific shocks. This is certainly the case of results for indirect taxes, where the number of individual deflators and their matching with the individual indirect tax rates is crucial.

Finally, the models employed in the analysis in most cases do not control for the cyclical situation of the economy and the results should therefore be interpreted as the effect of fiscal policy on prices under 'normal' cyclical circumstances. This latter caveat is particularly noteworthy since the cyclical position of the economy is often seen as a crucial element when analysing the impact of fiscal policy on economic activity (Hemming, Kell and Mafouz, 2000). In general, the models employed are however close to being linear, so that such elements are arguably not significantly bearing on the results – especially if shocks are of small magnitude.

Regardless of those necessary caveats, it should be noted that the aim of the study is not that of comparing the models per se, but to find out if there is a relative consensus on the channels through which budget items affect prices in the short run and on the likely quantitative effects. In this respect, the adoption of different ancillary assumptions in the design of the experiments or in the model structure may be a way, albeit obviously not systematic, of documenting the robustness of the conclusions reached.

5. Simulation results

5.1. Increase in government demand for goods and services

There is a broad consensus in economic theory that, except in special circumstances, an increase in government demand expands output in the short-run, with in particular stronger households income and therefore consumption, with in turn some accelerator response of investment. There is, however, great uncertainty over the magnitude of this impact (Perotti, 2001), to the extent e.g. that consumers may not always consume the implied additional income, or will rather consume imported goods. As to consumers, the following three factors are crucial: the importance of liquidity contraints; whether agents are forward-looking and maximising; agents' expectations about the implication for future government policy. Likewise, there is also uncertainty over the second part of the relationship which relates government demand to prices. While it is often considered that an increase in demand positively affects price developments, it should be pointed out that it is an open empirical issue whether prices are procyclical or not (e.g. Kydland and Prescott, 1990; Marchetti, 2001). These mixed results may indeed result from the difficulty to distinguish between supply and demand shocks in practice. In addition, a number of theoretical reasons for mark-ups being counter-cyclical have been put forth in the literature on the pricing policies of firms operating in oligopolistic markets (e.g. Rotemberg and Saloner, 1986; Stiglitz, 1984), which, combined with the stylised fact of countercyclical ULC, may explain a negative impact of public spending on prices. The lack of consensus on both the size and sign of the latter is confirmed by the contradictory results obtained by the VAR based studies in this area (see Table 1).

Exercise 1 represents a standard macromodel simulation experiment, very often conducted in the context of comparison exercises. Usually, the main focus of the analysis is the measurement of the multiplier of government demand, i.e. its impact on GDP. However, results for the impact on prices are often also reported, which allows us to compare our results with four similar exercises carried out in the US, in two different decades, and in the UK.

The impact on prices. For the first year (year t), the results of this experiment indicate an almost negligible impact on prices, with a small dispersion of estimated values. We calculate an unweighted mean of the results for the 5 NCBs, INTERLINK and QUEST. The mean reflects only 7 values as we (in this and in the discussion in all other following paragraphs) exclude the AWM, from the computation. The latter model should in principle be characterised by smaller leakages than its implicit individual country components, comparatively smaller and more open, by construction. In addition, the AWM mechanically incorporates the assumption of a joint shock affecting in all countries, which due to (implicit) trade spillover mechanisms should increase the multiplier with respect to single-(euro area) country simulations. Similarly we include for INTERLINK and QUEST only the average of the results for the individual countries', in order not to give too much weight to the modellers' choices embodied in these multi-country models.

Table2: Exercise 1

EFFECTS IN THE FIRST AND SECOND YEAR OF AN INCREASE IN PURCHASES OF GOODS AND SERVICES AMOUNTING TO 1 % OF GDP (percentage points)

	Prices*		GDP	
Year	**T**	**t+1**	**T**	**t+1**
Individual countries				
Belgium (National Bank of Belgium model)	0.10	0.29	0.87	0.50
Belgium (QUEST)	0.10		0.47	
France (INTERLINK)	*0.2*		*0.6*	
France (QUEST)	*0.14*		*0.66*	
Germany (Deutsche Bundesbank model)	0.04	0.17	1.18	1.07
Germany (INTERLINK)	*0.2*		*0.9*	
Germany (QUEST)	*0.16*		*0.65*	
Italy (Banca d'Italia model)	0.08	0.52	1.37	1.29
Italy (INTERLINK)	*0.2*		*0.7*	
Italy (QUEST)	*0.12*		*0.66*	
Portugal (Banco de Portugal model)	0.07	0.18	1.23	1.49
Portugal (QUEST)	0.16		0.48	
Spain (Banco de España model)	0.2	0.62	1.22	1.46
Spain (QUEST)	*0.08*		*0.67*	
Average	***0.12***[1]	***0.36***[2]	***1.03***[1]	***1.16***[2]
Extreme values	*(0.04 ; 0.2)*[1]	*(0.17 ; 0.62)*[2]	*(0.47;1.37)*[1]	*(0.50;1.49)*[2]
Euro Area				
Area Wide Model	*0.16*	*0.56*	*1.05*	*1.62*
INTERLINK	*0.20*		*1.00*	
Results of other studies				
Year	**t**		**t**	
UK models (Church et al., 2000)	*Ave:* ***0.08*** *(-0.6 ; 0.9)*[3]		*Ave* ***0.8*** *(0.4 ; 1.1)*[3]	
US models (Fromm and Klein, 1976)	*Ave:* ***0.03*** *(-0.2 ; 0.2)*[4,5]		*Ave* ***1.6*** *(0.8 ; 2.4)*[5]	
US models (Bryant et al., 1988)	*Ave:* ***0.04*** *Range: 0.6*[6]		*Ave* ***1.3*** *Range: 2.0*[6]	
US models (Adams and Klein, 1991)	*Ave:* ***0.07*** *(-0.1 ; 0.4)*[4,7]		*Ave* ***1.4*** *(0.2 ; 2.0)*[7]	

** Consumer price index*

1) Simple average of 7 results: 5 results from the NCBs models; for QUEST and INTERLINK models, simple mean of the results respectively reported for the individual countries. Extreme values of all results concerning individual countries.

2) Simple mean and extreme values of the results from the NCBs models.

3) Range spanned by the reported results for the 5 examined models. Monetary policy: Inflation targeting with interest rates as instrument.

4) Impact on GNP deflator

5) Range spanned by the reported results for the 8 examined quarterly models (for the Wharton model the standard specification is used). Monetary policy: non accommodating.

6) Range spanned by 12 examined models. Monetary policy: Money aggregates unchanged.

7) Range spanned by the reported results for the 10 examined models. Monetary policy: M1 kept on its base path.

The mean value of the impact on prices is 0.12%, a value very close to the averages of US and UK comparisons and to the results of the models referring to the whole euro area. The range of results across models is also strikingly small and lower than that observed in the other reported model comparisons[22]. The lowest value is 0.04%, for Germany on the basis of the DE model, and the highest 0.2%, on the basis of the INTERLINK for any of the three countries considered (Italy, France, Germany), and for Spain on the basis of the ES model. The results indicate that the large uncertainty over the size of the impact on output (see below) does not carry over to prices. In view of these, models we reviewed tend to embody the standard assumption of procyclicality, generally obtained via output gap terms. On the other hand, results also show a consensus on the small quantitative relevance of this channel in the first year. As already mentioned, in a context of significant overheating with sufficiently non-linear models, the effects of an increase in government demand could nonetheless be stronger.

The results that are available for the second year show a significant increase of the impact on prices. The impact is particularly large in the case of ES, IT and the AWM. For these models, the effects reach 0.62%, 0.52% and 0.56%, respectively. In the case of ES and the AWM, this is consistent with a larger-than-average impact on output. Overall, the results show that the impact on prices takes some time to materialise fully and is characterised by longer lags and/or by less important offsetting mechanisms than those relative to the impact on GDP. Chart 2 provides some illustration of how the extension of the simulation horizon can result in substantial price hikes in the example of ES, which is contrasted with that for Be where, overall, the modelled economy appears more stable.

The impact on GDP. The mean value result for the first year – slightly above 1 - is higher than that (0.8%) obtained in the 2000 UK model comparison. The difference could partly be explained by the fact that, in the latter, the underlying monetary policy assumption is more contractionary. The average impact multiplier is, instead, lower than older results for US models. This difference may be partly due to the greater openness of the individual European countries. It may also reflect changes in the parameter estimates, in line with empirical findings that show that the effects of fiscal policy on GDP have become weaker in recent decades (see e.g. Perotti, 2002). Finally, it should be borne in mind that modellers also presumably adjust their own tools to 'common knowledge' and recognised stylised facts, which in the case at hand may simply reflect increasing doubts on Keynesian (vs. Ricardian) effects of fiscal expansion policies.

In our comparisons, there is nonetheless a significant dispersion of the values of the impact multiplier, ranging from 0.6-0.9% in case of the models that allow for the presence of forward-looking agents (BE, INTERLINK and QUEST models – the latter also employing a Taylor rule), to 1.37% in the case of Italy (IT model), where import content is assumed to be limited in the case of government purchases, the accelerator effect on investment is relatively strong and consumers are assumed to be non-Ricardian (this is the case also for ES). The size of the range again tends to be slightly lower than that observed in previous model comparisons. The results of INTERLINK for the whole area are, as expected, above those for individual countries, reflecting the reduction in the import leakages. Taking into account this element, the results for the AWM seem in line with the

average of the individual models. The results for the second year indicate a slight increase of the multiplier to 1.2, with there as well, quite varied results across models, reflecting similar differences as those mentioned in the first simulation discussion – the lowest impact being for BE. See again Chart 2 for longer run simulations also involving the ES model.

All models, interestingly enough, including those reviewed in the US and UK comparisons, agree on the sign of the impact multiplier. This uniformity should not be considered a rejection of the results of the literature on non-Keynesian effects (Giavazzi and Pagano, 1990; Alesina and Perotti, 1997). In this literature a crucial role is played by expectations, interest rate risk premia and credibility, factors which do not play a fundamental role in most of the models examined in this paper and are further limited by the simulation set-up.

The results can be affected by a number of specification choices, as can be seen by looking at the results of alternative simulations carried out using the same model, for illustration the AWM. The latter has been simulated under different environments reflecting a range of possible specifications for key behavioural decisions, such as for consumption, investment or interest rates. Table 3 presents the results for the following configurations of the AWM: Basic Forecast Version (as used elsewhere in this paper), Ricardian Consumers (public deficit and debt are entirely removed from income and wealth), Forward-Looking Investment (50% of the accelerator term is based on model-consistent one-year ahead GDP) and Forward-Looking Consumers (50% of income and total wealth are model-consistent one-year ahead). In addition, results are also provided for a model where short-term interest rates are endogenously determined according to the so-called Taylor rule and the nominal exchange rate by the Uncovered Interest Parity (UIP) condition – which is very close to the QUEST simulation environment. Another more trivial element (not reported in the Table) with however non-negligible implications is the extent to which corporate sector profits are distributed to consumers. With all profits going each quarter to households – instead of only 40% – the corresponding multipliers and price effects would be about 10% and 20% stronger in years one and two.

Regardless of the specific aspects of each of the illustrative simulations reported, the following points can be made. First, unless monetary policy is active, results on prices for the first two years are not very much affected whereas, on the other hand, the Keynesian multiplier can vary a lot across specifications. Second, the strongest impact on the multiplier is seen when consumers do not consider public deficit nor debt as income or wealth, respectively ('proxied' Ricardian case). Third, the multiplier remains under unity over the whole simulation horizon when Ricardian and Forward-looking features are jointly introduced, even in the absence of monetary policy response. Fourth, with monetary policy reacting to the output and the inflation gaps, the price effect can be virtually zero. This does not exclude however some further negative impact on activity in the longer run because of a likely increase in long-term real interest rates, due to the additional spending by consumers, in e.g. an OLG environment with generations rather than dynasties, which then reduces savings and investment (as documented in model simulations reported in Faruqee et al., 1997). Channels involving asset prices and wealth valuation have not been investigated.

Table 3: AWM SIMULATIONS OF A PUBLIC EXPENDITURE SHOCK UNDER A VARIETY OF SIMULATION ENVIRONMENTS

Alternative specifications	Prices Year 1	Prices Year 2	Prices Year 3	GDP Year 1	GDP Year 2	GDP Year 3
BFV: basic forecast version	0.16	0.55	1.04	1.04	1.53	1.57
RC: Ricardian consumers	0.15	0.46	0.81	0.93	1.17	1.09
FLI: Forward-looking Investment	0.15	0.51	0.96	0.97	1.39	1.42
FLC: Forward-looking consumption	0.15	0.48	0.92	0.95	1.32	1.41
RC+FLC+FLI	0.13	0.38	0.67	0.78	0.94	0.85
RC+FLC+FLI +Monetary policy +UIP	-0.08	-0.04	0.10	0.66	0.57	0.33

NB: All results are in deviation from baseline levels, all simulations with exogenous real interest rates, to facilitate comparison with the case with monetary policy modelled as a Taylor rule (last simulation reported).

5.2. Exercise 2: An increase in the personal income tax.

There are two main theoretical channels linking an increase in personal income tax to price developments. The first channel focuses on changes in demand determined by variations in the household income. The rise in the personal income tax leads to lower household disposable income and to a reduction in real private consumption – with again great uncertainty as to the impact. In determining the latter, assumptions on households are crucial, even more than in the first exercise, to the extent that the shock this time affects directly income rather than domestic demand globally. As expected from textbook macroeconomic analysis, the values of the estimated effects of the direct tax changes are lower than the spending multipliers, so that the simulation results are expected to be similar – with an opposite sign – to the ones just reported, albeit of lower magnitude. As already discussed in the previous section, the quantitative relevance of the final impact on prices via the demand channel may be even more limited, at least in the short-run.

The second channel reflects the process of wage bargaining. An increase in direct taxes expands the wedge between the cost of labour for firms (which is unaffected) and the workers' take-home wage (which is reduced). Workers may react by demanding higher wages, leading to higher costs and to a reduction in the demand for labour.[23] Higher costs would then lead to higher prices. The relevance of this channel depends on the extent to which direct taxes hikes are shifted into real labour costs, which is in turn closely related to labour market flexibility. In particular, institutional factors of the labour market, such as the employment protection legislation, unions and the wage negotiation mechanisms, are usually found to be empirically relevant in explaining tax shifting. The models employed in this paper do not include the tax wedge among the short-run determinants of wages[24]. It may be noted that the almost complete absence of this channel is in line with the well-known empirical analysis of Daveri and Tabellini (2000). This study provides evidence of the existence of a partial shifting of labour taxes on wages in the medium term, using five-year averages of the variables, and it is therefore compatible with the absence of significant short-term effects.

The impact on prices. As regards the first year, the results show a negligible impact on prices, with a small dispersion of estimated values. The mean value of the impact on prices is almost zero and negative, very close to the results of the comparisons for UK and US models. The results we obtain are not surprising, as the impact through the demand channel is necessarily only a fraction of that, already small, caused by a public expenditure shock, and the second above mentioned channel, at least in the short-run, is not embodied in the models reviewed.

The results for the second year are mixed, with two models (the ES one and the AWM) showing a non-negligible negative impact on prices (about -0.3%), associated with a particularly large contraction of GDP. This can be explained for ES by the relatively high elasticity of private consumption to disposable income and for the AWM by the relative closeness of the economy. Other impacts are very small (between -0.09% and -0.04%), albeit larger than that in the first year.

Table4: Exercise 2

EFFECTS IN THE FIRST AND SECOND YEAR OF AN INCREASE IN THE PERSONAL INCOME TAX AMOUNTING TO 1 % OF GDP (percentage points)

	Prices*		GDP	
Year	**T**	**T+1**	**T**	**t+1**
Individual countries				
Belgium (National Bank of Belgium model)	-0.01	-0.07	-0.15	-0.23
Belgium (QUEST)	0.0		-0.14	
France (INTERLINK)	0.0		-0.2	
France (QUEST)	0.00		-0.22	
Germany (Deutsche Bundesbank model)	-0.04	-0.09	-0.62	-0.91
Germany (INTERLINK)	-0.10		-0.5	
Germany (QUEST)	0.00		-0.22	
Italy (Banca d'Italia model)	-0.01	-0.04	-0.11	-0.36
Italy (INTERLINK)	0.0		-0.2	
Italy (QUEST)	-0.01		-0.21	
Portugal (Banco de Portugal model)	-0.02	-0.07	-0.39	-0.67
Portugal (QUEST)	-0.02		-0.15	
Spain (Banco de España model)	-0.07	-0.31	-0.50	-1.02
Spain (QUEST)	-0.01		-0.19	
Average	***-0.03*** [1]	***-0.12*** [2]	***-0.32*** [1]	***-0.64*** [2]
Extreme values	*(-0.1 ; 0.0)* [1]	*(-0.31 ;-0.04)* [2]	*(-0.62;-0.11)* [1]	*(-1,02;-0.23)* [2]
Euro Area				
Area Wide Model	-0.08	-0.32	-0.56	-1.04
INTERLINK	*-0.1*		*-0.5*	
Results of other studies				
Year	**t**		**t**	
UK models (Church et al., 2000)	*Ave -0.04 (-0.04 ; 0.10)* [3]		*Ave: -0.17 (-0.32 ; 0.01)* [3]	
US models (Fromm and Klein, 1976)	*Ave: -0.01 (-0.10 ; 0.10)* [4,5]		*Ave: -1.00 (-1.30 ; -0.80)* [5]	

* *Consumer price index*

1) Simple average of 7 results: 5 results from the NCBs models; for QUEST and INTERLINK models, simple mean of the results respectively reported for the individual countries. Extreme values of all results concerning individual countries.

2) Simple mean and extreme values of the results from the NCBs models.

3) Simple mean of the results reported for the individual countries.

4) The results reported in Church et al (2000), which referred to a 2 % increase in the "basic income tax rate", have been rescaled to ensure comparability. Range spanned by the reported results for the 5 examined models. Monetary policy: Inflation targeting with interest rates as instrument.

5) Impact on GNP deflator

6) Range spanned by the reported results for the 8 examined quarterly models (for the Wharton model the standard specification is used). Monetary policy: non accomodating.

7) Range spanned by 12 examined models. Monetary policy: Money aggregates unchanged.

8) *Range spanned by the reported results for the 10 examined models. Monetary policy: M1 kept on its base path.*

The impact on GDP. The mean of the values of the impact on output in our comparison is -0.32% in the first year, which is close to the average of the UK results but much lower than that for the US, and -0.64% in the second year. As in the previous experiment, the dispersion of the impact on output across models is larger than that of the impact on prices and has a similar profile.

5.3. Exercise 3: An increase in indirect taxes.

Reflecting the widespread practice to bargain on the basis of prices net of VAT and of other indirect taxes, the assumption of an immediate pass-through to prices of changes in indirect taxes rates is common among forecasters but is not embodied in all models we employ. In particular, for the AWM, ES, IT, PT, and Interlink Italy models, the pricing policies of firms temporarily reduce the mechanical impact of indirect taxes on prices, which do not increase by the full amount of the change in VAT and excises rates.[25] This may have in turn an impact on GDP, to the extent that firms will possibly invest less, having to share with consumers the burden of increased taxes and being therefore more liquidity constrained.

Wage bargaining or indexation mechanisms may reinforce the direct impact of a change in indirect taxes[26]. According to standard labour market analyses, workers care about their real wage, and assess it using the consumer price index, while firms focus on real labour costs, deflated using the price of production index. A positive change in indirect taxes therefore reduces the value of the wage for workers but not the labour costs, as perceived by firms. This may lead to a higher level of equilibrium for wages. However, as already mentioned, the models participating in the comparison do not include the tax wedge among the short run determinants of wages.

The impact on prices. For the first year, the mean value of the impact on price developments is 1.19%. While there is a certain dispersion of results, it almost entirely reflects the different treatment of the pass-through of indirect taxes. Most of the remaining differences seem to reflect the dispersion across countries in the value of the ratio between consumption (government and private) and GDP and in the amount of VAT and other indirect taxes which do not apply to consumption goods (VAT does not in principle apply to capital goods, it is usually levied on private construction investment).

Table 5: Exercise 3

EFFECTS IN THE FIRST AND SECOND YEAR OF AN INCREASE IN INDIRECT TAXES AMOUNTING TO 1 % OF GDP (percentage points)

	Prices*		GDP	
Year	**t**	**T+1**	**T**	**t+1**
Individual countries				
Belgium (National Bank of Belgium model)	1.60	1.99	0.02	0.00
Belgium (QUEST)	1.66		-0.32	
France (INTERLINK)	1.40		-0.50	
France (QUEST)	1.50		-0.55	
Germany (Deutsche Bundesbank model)	1.17	1.2	-0.55	-0.53
Germany (INTERLINK)	1.30		-1.40	
Germany (QUEST)	1.49		-0.54	
Italy (Banca d'Italia model)	0.73 (1.16) [1]	1.28	-0.09 (-0.10) [1]	-0.45
Italy (INTERLINK)	0.8		-0.30	
Italy (QUEST)	1.38		-0.54	
Portugal (Banco de Portugal model)	1.10	1.59	-0.17	-0.41
Portugal (QUEST)	1.24		-0.36	
Spain (Banco de España model)	1.05	1.46	-0.20	-0.65
Spain (QUEST)	1.44		-0.54	
Average	***1.18*** [2]	***1.50*** [3]	***-0.31*** [2]	***-0.41*** [3]
Extreme values	*(0.73 ;1.66)* [2]	*(1.28 ; 1.99)* [3]	*(-0.55;0.02)* [2]	*(-0.65;0.0)* [3]
Euro Area				
Area Wide Model	0.76	0.94	-0.31	-0.88
INTERLINK	1.2		-0.9	

* *Consumer price index*

1) In brackets, results obtained excluding lags in the transmission of the tax burden on final prices.

2) Simple average of 7 results: 5 results from the NCBs models; for QUEST and INTERLINK models, simple mean of the results respectively reported for the individual countries. Extreme values of all results concerning individual countries.

3) Simple mean and extreme values of the results from the NCBs models.

The key pass-through point is illustrated by two additional experiments. The first, performed with the IT model, is one in which the temporary reaction of net prices is excluded and the full pass-through re-established. With this assumption, the impact on prices increases from 0.73 (the lowest across the results) to 1.16%, close to the average. Conversely, using in the AWM a specification for consumer prices where indirect taxes are assumed in the short-run to have an impact differing from that of pre-tax GDP deflator, the estimated parameters are consistent with a pass-through of 60% after one year. This reduction in the estimates lead to a similar decrease in the impact on prices, i.e. also of about a third.

The indexation of wages to prices in Belgium also explain the high value of the impact in that country, which is consistently shown in both QUEST and the BE model. The results for the second year of the simulations show a significant increase in the impact on prices. The increase is particularly strong for models which embody a temporary mechanism partially offsetting the full pass-through. As the impact of this mechanism vanishes, the dispersion across models reduces. The only large outlier is the result for Belgium (where only the results for BE model are available), where a wage-price spiral is fuelled by the wage indexation.

The impact on GDP. The mean value of the impact on outputs in our comparison is -0.31% in the first year, with a significant dispersion of values across countries and models, even if the results of the INTERLINK model for Germany are excluded. All simulations show a negative impact on output except that conducted using the BE model, which has a nil impact both in the first and in the second year. This counter-intuitive result is e.g., not confirmed by the results of QUEST for Belgium which are in line with those of the other countries. In the BE model, the standard demand channels are relatively weak (the decline in consumption is less than 0.1%) and moreover offset in the first two years by the increase in the investment of forward-looking firms, which react to the upward shift in relative labour costs. The impact on GDP for models without a full pass-through is relatively modest, ranging between 0.1 and 0.2, presumably because of less liquidity-constrained firms. In the second year, as for prices, the differences between the two types of models significantly diminish. Excluding the results of INTERLINK for Germany, the dispersion of the results concerning the impact of output seems comparable to that regarding the impact on prices.

Table 6: Exercise 4

EFFECTS IN THE FIRST AND SECOND YEARS OF AN INCREASE IN SOCIAL SECURITY CONTRIBUTIONS OF EMPLOYERS AMOUNTING TO 1 % OF GDP

(percentage points)

	Prices*		GDP	
Year	**t**	**t+1**	**t**	**t+1**
Individual countries				
Belgium (National Bank of Belgium model)	0.27	1.02	-0.01	-0.18
Belgium (QUEST)				
France (INTERLINK)	0.70		-0.20	
Germany (Deutsche Bundesbank model)	0.24	0.51	-0.51	-0.88
Germany (INTERLINK)	0.80		-1.20	
Italy (Banca d'Italia model)	0.34	1.15	-0.17	-0.47
Italy (INTERLINK)	0.20		-0.10	
Portugal (Banco de Portugal model)	0.67	0.90	-0.18	-0.44
Spain (Banco de España model)	0.10	0.62	-0.52	-1.03
Average	**0.36** [1]	**0.84** [2]	**-0.32** [1]	**-0.60** [2]
Extreme values	(0.1 ; 0.7) 1	(0.51; 1.15) 2	(-0.52; -.01) 1	(-1.03; -0.18)
Euro Area				
Area Wide Model	0.26	0.31	-0.50	-0.89
INTERLINK	0.7		-0.6	

* *Consumer price index*

1) Simple average of 6 results: 5 results from the NCBs models; for INTERLINK, simple mean of the results reported for the individual countries. Extreme values of all results concerning individual countries.

2) *Simple mean and extreme values of the results from the NCBs models.*

5.4. Exercise 4: An increase in employers' social security contributions.

An increase in the social security contributions of employers (SSCE) raises firm's labour costs, and should be leading to higher prices and, via the income/demand channel, lower output and employment. If part of the SSCE increase is passed however on to workers in the form of lower wages, firms' labour costs rise less and the previous price and output effects are expected to be lower (e.g. in the AWM this pass-through is of 50%). The lower wage income due to the fall in employment or wages has a negative impact on real disposable income and, through the demand channel, leads to a fall in prices, partly offsetting the impact of the increase in labour costs.

The impact on prices. The results show a considerable impact on prices, with a significant but moderate dispersion across countries. The mean value of the impact on price developments is 0.36% in the first year and 0.84% in the second year. The extreme values in the first year are shown by the ES model (0.1%) – where wages are mostly backward-looking – and INTERLINK for Germany (0.8%).

The impact on GDP. The mean value of the impact on output is -0.32% in the first year. Excluding the extremely large negative estimate for INTERLINK Germany (-1,2%), results range between -0.5% for the DE and ES models and -0.01% with the BE model. Excluding the outlier, therefore, the dispersion compares to that obtained for prices. The effect on the second year reaches -0.6% on average.

Summary and conclusions

We have conducted a comparative review of the short-run impact on prices of a number of fiscal policy shocks, using a variety of macroeconometric models for euro area countries as well as for the euro area as a whole. The main results from the exercise are the following, taking in turn each of the reported experiments:

First, the impact of *a change in government demand* on prices is negligible in the short-term. The result confirms those of similar model comparisons carried out in the UK and the US and is consistent with the small or non-significant effects found by most of the recent VAR based studies. From additional simulations we conducted, there is also evidence that model design would primarily impact on the results for activity - i.e. on the Keynesian multiplier - without major implications for price effects.

Second, the impact on prices of a *change in direct taxes on households* also appears to be negligible. This reflects the little quantitative relevance (see previous exercise) of the demand channel, activated by the effects of direct taxes on disposable income, and the absence of the tax wedge among the short-run determinants of wages in almost all models.

Third, *indirect taxes* have a relatively large impact on prices, but the results are relatively dispersed. This variability across models seems to mainly depend on the assumed or estimated degree of pass-through of indirect tax hikes to final prices, as have been documented by comparing results using the same models with different corresponding assumptions.

Fourth, *employers' social security contributions* should not be overlooked when assessing inflation, as all models agree that they have a significant impact on price developments. The latter seem to depend on the extent to which wage bargaining is affected by such measures.

More generally, the results obtained for the year following the shock show that the effect on prices usually takes some time to materialise fully. This is particularly relevant when analysing the effects of the shocks to public consumption for which in some countries, effects become large only in the second year after the shock. They also appear to be even larger at further horizons, which in turn raises the issue of monetary policy reaction, a feature not incorporated in most of the employed models in the context of this exercise, focused on short-term responses conditional on a no policy change assumption.

Regardless of this horizon issue, another contribution of this exercise is that we could illustrate how some (controlled) changes to the models explain why results sometimes substantially differed – in particular for the Government consumption and the indirect tax shocks – going therefore beyond a simple assessment of the multipliers associated with a given fiscal measure.

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Chart. 1

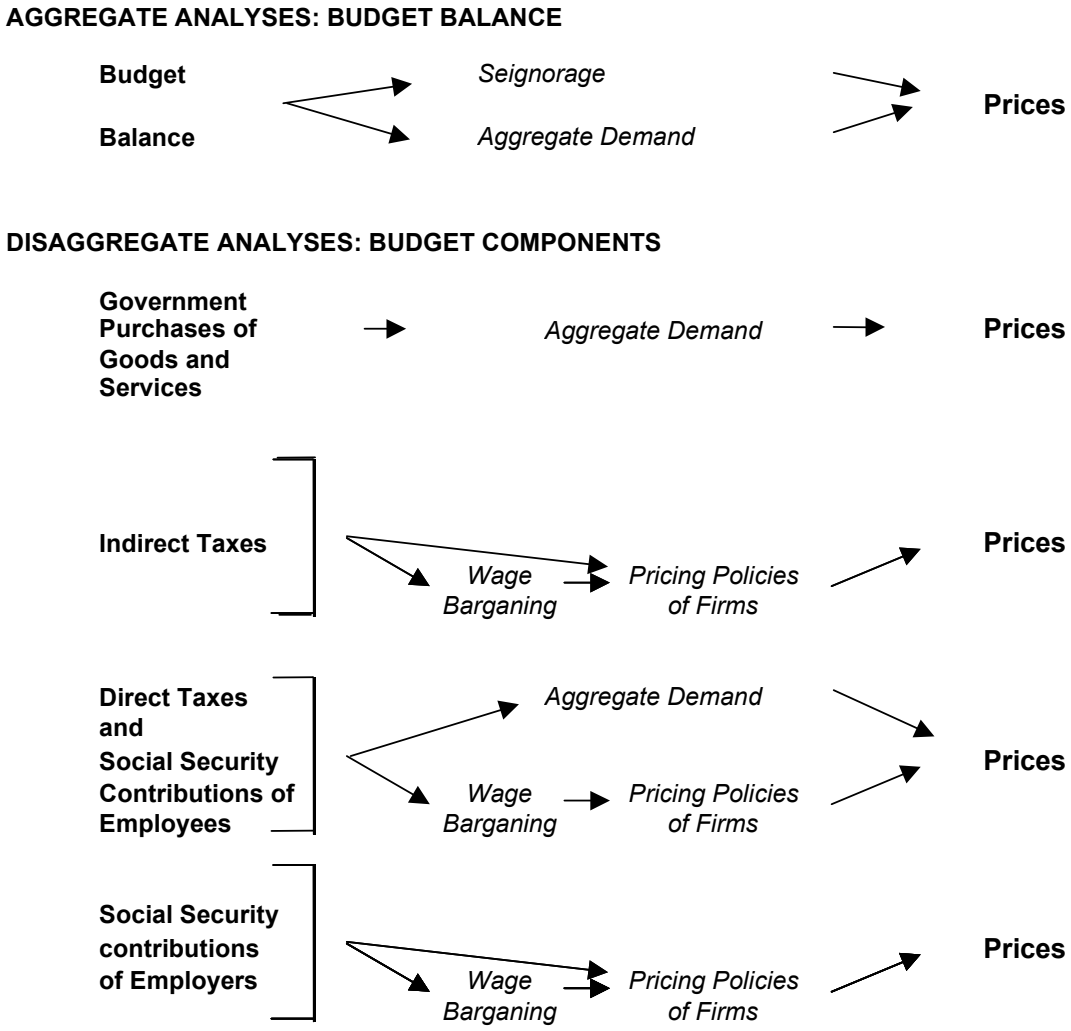
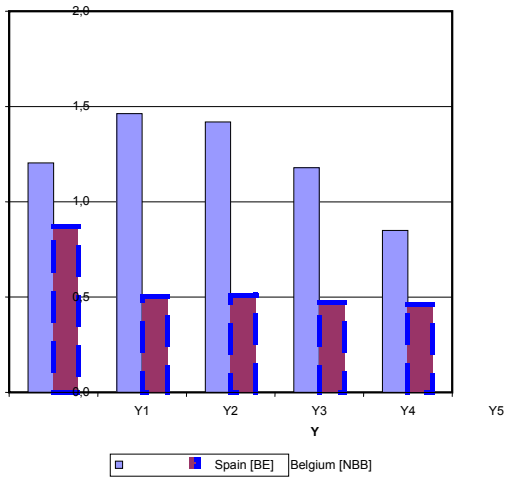
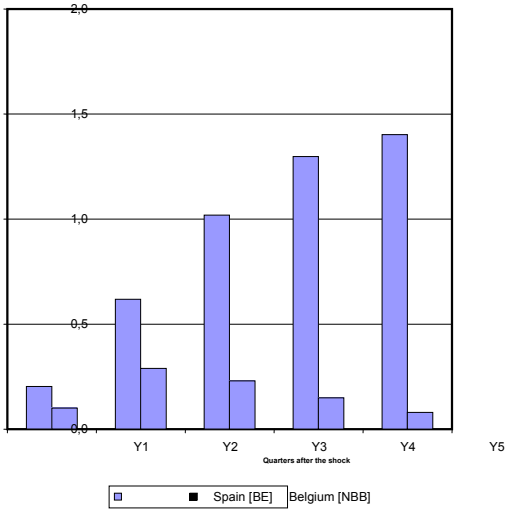

AGGREGATE ANALYSES: BUDGET BALANCE
Budget
Balance
Seignorage
Aggregate Demand
Prices
DISAGGREGATE ANALYSES: BUDGET COMPONENTS
Government Purchases of Goods and Services
Aggregate Demand
Prices
Indirect Taxes
Wage Barganing
Pricing Policies of Firms
Prices
Direct Taxes and Social Security Contributions of Employees
Aggregate Demand
Wage Barganing
Pricing Policies of Firms
Prices
Social Security contributions of Employers
Wage Barganing
Pricing Policies of Firms
Prices

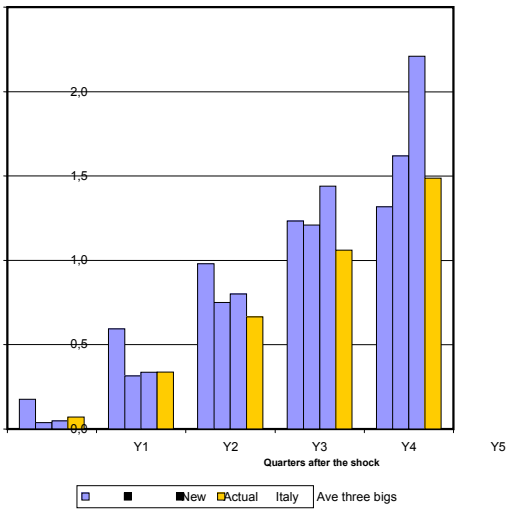
Chart 2. 1 p.pt GDP increase in Public consumption, 5 year horizon

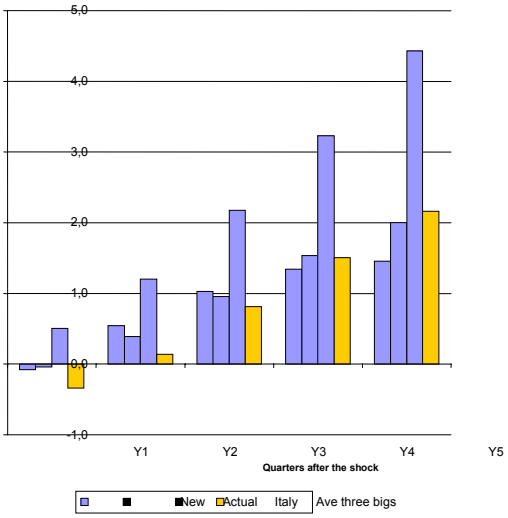
A. GDP



B. PRIVATE CONSUMPTION DEFLATOR







1 We would like to thank the following institutions for accepting to participate to the simulation experiments: European Commission, European Central Bank, OECD, National Bank of Belgium, Deutsche Bundesbank and Banco de Portugal. The document has greatly benefited from the explanations of the simulation results and useful comments provided by G. Langenus of the National Bank of Belgium, B. Hamburg and K. Wendorff of the Deutsche Bundesbank, P. Neves of the Banco de Portugal, J. in't Veld of the European Commission, P. Downes of the OECD, A. Dieppe of the ECB, A. Estrada and J. Vallés of the Banco de España as well as by ESCB MPC and WGF members. The opinions expressed in this paper are those of the authors and do not necessarily reflect those of the Banco de España, Banca d'Italia or the ECB.

2 In the model comparison recent exercise presented in Wallis (2003) the impact on output across models is less dispersed, perhaps reflecting greater convergence among models used by policy institutions.

3 Descriptions of the models and their main properties are available in Jeanfils (2000) for Belgium, Bundesbank (1999) for Germany, Estrada and Willman (2002) for Spain, and Banca d'Italia (1986), Terlizzese (1994), Altissimo and Siviero (2002) for Italy.

4 Documented in Fagan et al. (2001) and Dieppe and Henry (2003).

5 Some standard simulation results are reported in Dalsgaard et al. (2001).

6 The results presented for QUEST are from Brunila et al. (2002).

7 The relative homogeneity of the model specifications may be partly due to the fact that the institutions participating in the exercise have similar needs to be satisfied by an econometric model, with forecasting and policy analysis being high up on the list. Possibly also previous model comparison exercises have triggered some convergence process across modeling teams, both in terms of framework employed and results obtained.

8 Moreover, this channel does not seem particularly relevant for economies with sophisticated financial markets, in "which it is difficult for the government to raise large seignorage revenue, because of people's ability to substitute away from non-interest-earning assets." (Woodford, 2001, p.4).

9 Including, inter alia, the existence of nominal rigidities in the economy, the elasticity of supply, the interest-rate elasticity of investment, the interest rate and income elasticities of money demand, the degree of openness of the economy, the exchange rate regime, the magnitude of the wealth effects, the presence of forward-looking agents and more generally the role played by rational expectations.

10 See, for instance, Sargent (1982).

11 This article concluded the series of surveys, as the Bureau unfortunately closed on 30 September 1999.

12 According to Perotti (2002), these two studies implicitly assume a zero elasticity of real government spending to the price level. To assess the implications of this assumption the author considers two polar cases and a more plausible intermediate one (with the price elasticity equal, respectively to 0, -1 and -0.5). He shows that, under the assumption of price elasticity equal to 0, the effects of government spending on the GDP deflator after 4 quarters are negative in four out of the five countries he examines, though only in two cases they are significant. However, moving to the intermediate case the values of the estimated effects significantly increase and the negative sign remains only in the case of one country (US). All effects become positive when the elasticity of real government spending to the price level is assumed to be equal to –1. With few exceptions (and quantitatively minimal) the response at all horizons, periods examined and countries is larger when the elasticity is –0.5 than when it is 0. Results reported in the text are with the former value.

13 This non-significant effect appears also when considering separately three components of public expenditure: consumption, investment and social benefits.

14 In the VAR studies reviewed in this paper taxes are defined, except in the case of Marcellino (2002), as total taxes minus transfers. Thus the results are not directly comparable to those obtained in the simulation exercises presented below.

15 They also observe a reduction in the GDP deflator in the case of a balanced budget spending shock, defined as an increase in both government revenues and expenditures in such a way that the sum of the weighted increase in revenues and expenditure is zero for each period in the four-quarter window following the shock.

16 In addition, Marcellino (2002) provide the results for 4 revenue components (taxes on business, taxes on households, indirect taxes and social contributions). None of them appear to have a significant effect on prices in any country.

17 Private sector GDP is given through a nested CES and Cobb Douglas production function in the QUEST model.

18 Other factors include technological progress (ES and IT models), the stock of capital (AWM, ES) and real wages (AWM, DE, ES, PT)

19 In the case of the National Bank of Belgium, the fiscal rule is switched back on but only in the 7th year of the simulation.

20 The relevance for the results in the year of the shock of the design of the simulation in the following years depends on the presence of forward-looking elements and the way they are incorporated. There are forward-looking elements in the BE model in financial and goods markets, in the DE model for financial variables and in the IT model for inflation expectations. These elements tend to have a very limited impact, especially since short-term interest rates and the exchange rate are kept exogenous.

21 In the comparison of US models carried out in 1976, the rule explicitly adopted was "…to let model operators interpret a given set of directives as closely as possible, while recognizing that each model has some distinctive characteristics that do not always permit full compliance." (Klein, 1976, Page 8).

22 This may reflect the greater homogeneity of the models. The low dispersion of results can be appreciated comparing it, for instance, with the 1.2% confidence interval indicated in the June 2002 Eurosystem staff projections for the HICP of the following year (ECB, 2002). The range, which reflects the uncertainty when forecasting price developments, is based on the average absolute difference between actual outcomes and past projections by euro area central banks.

23 According to standard theory, if labor markets are competitive, a small elasticity of the individual labour supply, as generally found empirically, implies that the burden of a tax on labour is borne almost entirely by the worker. But if workers are organized in monopolistic unions, they can succeed in shifting the burden of labor taxes onto firms (Daveri and Tabellini, 2000).

24 In the BE model a "theoretical" wage setting equation which includes the implicit rate of social security contribution among its exogenous variables has been estimated. However in the usual configuration of the model (and also that used in the case of these simulations) wages are exogenous in real terms, reflecting the "wage norm" stemming from an agreement of social partners, which defines real wage increases for a two-year period.

25 In the IT model, the equation determining the production (i.e. net of indirect taxes) deflator for non-durable consumption goods includes among regressors VAT and other excise rates and the estimated coefficient has a negative sign. This estimated offsetting mechanism slowly vanishes and in the eighth quarter the impact is close to that consistent with full pass-through. In the AWM the pass through after one year on consumer prices is 80% with a full indexation on GDP deflator at market prices in the longer run.

26 The role of the tax wedge in wage bargaining has also been discussed above, with reference to direct taxes.