Fiscal consolidation in general equilibrium models

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Introduction

In this paper, attention is focused on the effects of fiscal consolidation programmes in small open economies. The analysis concentrates on the intertemporal aspects of the problem: how will private sector behaviour be affected by public sector actions on public expenditure, taxes and deficits? Other aspects of fiscal programmes, such as the optimal tax decision, the possible distortions of taxes or the external effects of public capital formation, will not be discussed.

We start with a brief overview of the fiscal consolidation experience in Belgium. The magnitude and the specific content of the Belgian consolidation programme give it a special interest for those wishing to test some of the factors behind successful consolidation programmes. The specific characteristics of the Belgian experience become clear if they are compared with other European experiences.

In Section 2, we briefly review the literature on fiscal consolidation. Starting with a simple textbook model, different views on fiscal consolidation are discussed. The relative magnitude of the different channels of interaction between public and private sector behaviour will determine the success of the fiscal consolidation programme. In the literature, the experiences of Ireland and Denmark are considered as interesting examples of successful consolidation programmes. The simulation results from existing macroeconomic models are in most cases less optimistic, especially as far as the short-term effects of restrictive fiscal policies are concerned. General equilibrium models, although they rely on a totally different theoretical framework to traditional Keynesian models, also tend to yield negative output effects of fiscal consolidation programmes, at least insofar as the analysis is limited to the intertemporal aspect of the problem.

In Section 3, we present a theoretical general equilibrium model for a small open economy, so that the different aspects of the interdependence of public and private sector behaviour can be analysed in a coherent framework. This model allows us to analyse the sensitivity of certain effects to theoretical parameters: in particular, we can test the dependence of the result on the planning horizon and liquidity constraints of households, the importance of the labour supply reaction and the public consumption role in the utility function, the degree of price stickiness in an economy with imperfect competition, the exchange rate behaviour and the monetary policy reaction function.

In Section 4, we estimate a structural VAR model for Belgium, based on the theoretical insights of the general equilibrium model. The special contribution of fiscal shocks to economic growth and inflation (or the real exchange rate) will be estimated. The sensitivity of the results can be tested with alternative theoretical restrictions and empirical variables. Finally, we also apply the SVAR model to the Irish and Danish data, in order to identify the contribution of fiscal shocks to the growth process in these countries, and to compare the results with the Belgian experience.

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1. Belgian experience in fiscal consolidation

In Belgium, fiscal consolidation has been one of the central topics of economic policy since the beginning of the 1980s. The public deficit at the beginning of that decade was up to 12.8% of GDP, and public debt was rising quickly, from 60% in 1975 to more than 100% in 1982. Starting in 1982, there has been a gradual improvement in the situation of public finance, only temporarily interrupted at the beginning of the 1990s. The public deficit decreased and in 1997 Belgium is set to fulfil the Maastricht deficit criteria, with an estimated public sector borrowing requirement of 2.0% of GDP. Public debt is also declining, after reaching a peak of 135.2% in 1993; in 1997 it is estimated to be 122.2%.

This result was obtained despite a strong "snowball" effect. Interest charges increased from 6% of GDP in 1980 to 10.5% of GDP in the second half of the 1980s and the beginning of the 1990s. This implies that the improvement in the primary surplus shows an even stronger reversal: from -5% of GDP in 1981 to 5.9% of GDP in 1997 (see Figure 1).

These data are well known. What is less well known is that Belgium obtained these results almost exclusively via a decrease in government expenditure. Government revenue as a percentage of GDP has hovered around 46.7% over the period. Primary government expenditure, on the other hand, has decreased from 51.3% in 1981 to 41.7% in 1997, a level that is even below the European average. The effort that was made in terms of government expenditure cuts can be further illustrated by comparing the growth of real government expenditure in Belgium with the average European figures. In Belgium government expenditure, deflated by the consumer price index, increased by 15% over the period 1980-97, or 0.7% annually, against an average European growth of 2.3%.

All components of government expenditure have contributed to this result: government investment experienced the strongest decline over the period, with an average decrease of 4.8% in volume (European average +0.3%); purchases of goods and services decreased by 1.4% on average (+2.8% for the 15 EU countries); compensation of employees increased by 0.4% (1.4% for the 15 EU countries); subsidies to enterprises decreased by 0.8%, while the European average was +0.7%; and transfers to households increased by 1.9%, compared with an average of 3.1% for Europe.

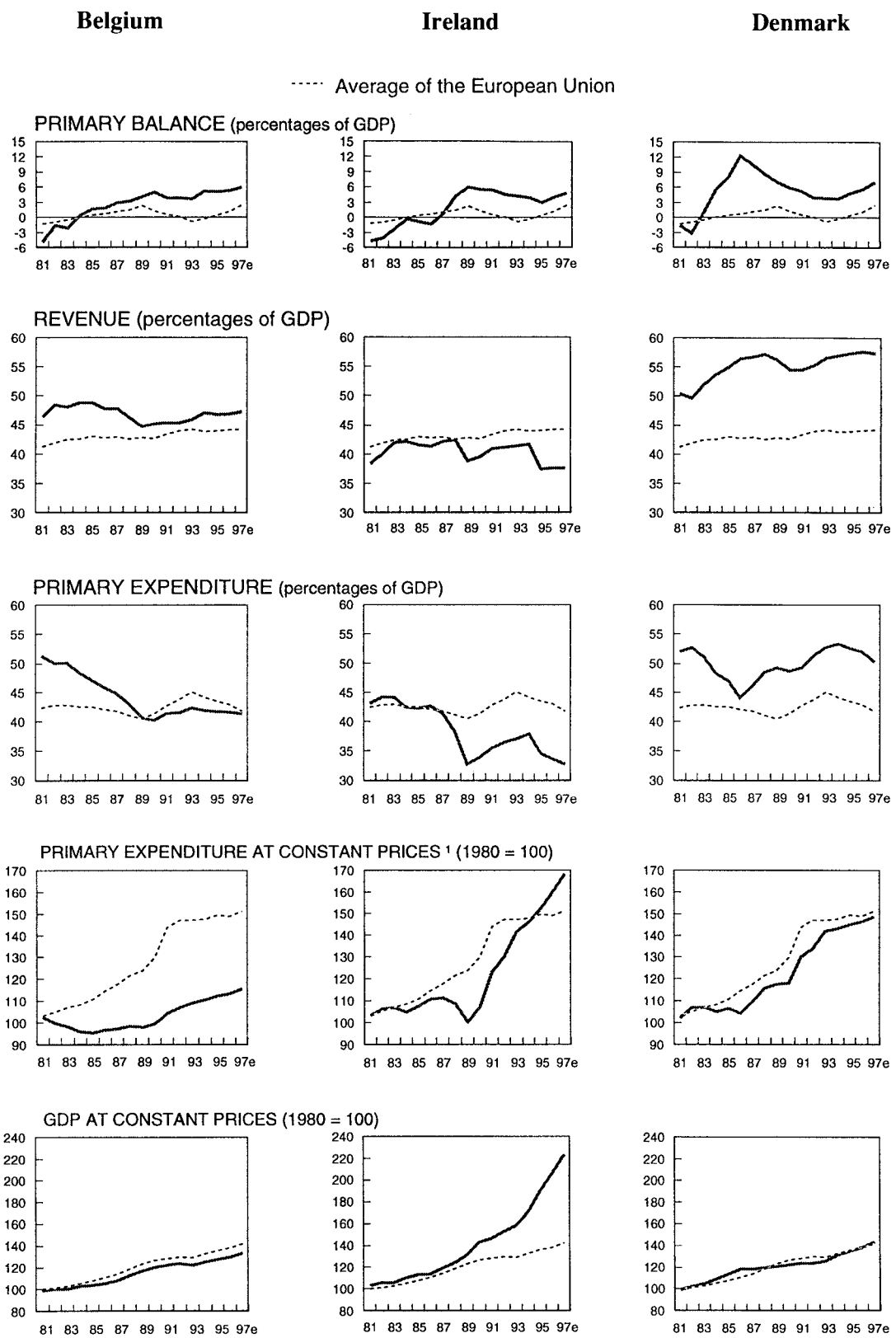
During this long period of fiscal consolidation, economic growth in Belgium was slightly below the European average. However, the improvement in public deficits was accompanied by an amelioration in other macroeconomic fundamentals. Inflation and interest rates converged towards the German level, and the improvement in the public deficit also occurred simultaneously with the improvement in the current account balance.

In the recent literature on fiscal adjustment, and especially the studies undertaken by the IMF (Alesina and Perotti (1996-97), McDermott and Wescott (1996)), Belgium is not cited as an example of successful fiscal consolidation, where the latter is defined as a period of tight fiscal stance such that the government debt/GDP ratio falls by at least 3 percentage points within two years, although, according to the most recent figures, Belgium qualifies for this definition over the period 1996-97. These studies have suggested not only that the size of the fiscal adjustment process is important (sharp contractions increase the probability of success) but also that the nature and composition of the measures are key elements for the success of the programme. Examples of such successful consolidation programmes were found in Ireland and Denmark, and these experiences are often discussed in the literature.

In Figure 1, we compare the Belgian experience with that of Ireland and Denmark. Although these countries experienced larger cuts in expenditure, over the whole period the consolidation effort was greater and more persistent in Belgium. In Section 4 these three examples of fiscal consolidation programmes are further analysed and, in particular, we try to estimate the specific contributions of public consumption cuts on observed economic growth and inflation.

Figure 1

Consolidation of public finances in some European countries



[1] Deflated by the consumer price index.

Sources: EC, NAI and NBB.

2. A survey of the literature on the effects of fiscal consolidation

In the literature one finds many simulation exercises for fiscal policy shocks using existing econometric and more theoretically oriented models. As fiscal consolidations affect in the first instance the intertemporal constraints on private sector behaviour, we focus especially on those studies that incorporate forward-looking expectations for the expected income streams, as only these models can take into account the effects of announced fiscal policies.

Fiscal policy affects economic growth via many different channels. In this section we review those channels that have received most attention in the literature. Starting with more theoretical arguments on planning horizon, expectations and labour supply reaction, we move on to the more practical or empirical questions such as the rigidity of prices, exchange rate behaviour and monetary policy reactions. While the second category of topics is crucial in explaining the short-run impact of fiscal adjustments, the theoretical arguments remain important as they determine the long-run reaction of models to fiscal shocks. In the next sections some of these topics will be further discussed within the framework of a small general equilibrium model for an open economy.

2.1 The time horizon of the private sector

In the traditional Keynesian models, consumption is determined by current income. The outcome of a fiscal consolidation in this case is simple. A decrease in fiscal spending has contractionary real effects in terms of both consumption and output, because it shifts the aggregate demand curve downwards and prices are rigid. Consumers do not perceive the positive effects of lower public deficits on future taxes and therefore on wealth. The typical multiplier analysis implies that the effect of government spending cuts will be larger than the effect of tax increases.

In the neoclassical Ramsey model, agents have an infinite time horizon and the labour supply is inelastic. In this model, consumption is proportional to wealth, defined as the present value of all future revenue. Lower taxes and debt financing will leave wealth unaffected as consumers discount the higher expected future taxes. A permanent change in public consumption financed with lump-sum taxes results in an equal but opposite change in private consumption, as consumption moves proportionally with wealth. So aggregate demand, output and employment are unaffected. As consumers are forward-looking, they recognise the wealth effect resulting from the change in the present value of future taxes necessary to finance public expenditure. This neutral effect of fiscal spending on economic activity is a result of the Ricardian equivalence hypothesis (Barro (1974)).

The hypothesis of infinite horizons is however a strong hypothesis. In reality, consumers have finite lives and they typically save for consumption in later periods of the life cycle. So unless intergenerational transfers are given a similar valuation to consumption in the utility function, household horizons will be less than infinite. In modern macro-modelling, this finite horizon assumption is typically introduced by using a constant probability of death or the perpetual youth hypothesis (Blanchard (1985)). This approach implies that future taxes are discounted at a higher discount rate (the discount rate plus the expected probability of dying), and therefore receive a lower expected value, as the consumers are uncertain whether they will still be alive at the time the future taxes are levied. Under this hypothesis, government taxes will have an impact on wealth, and therefore on private consumption. For the same reason, public spending cuts will be less than fully offset by the increase in private consumption and declining aggregate demand will cause lower real interest rates. This will stimulate investment and increase the optimal capital stock. Given the hypothesis of fixed labour supply, output will increase with permanent public spending cuts.

Finite horizons are not the only reason for an absence of Ricardian equivalence. Other reasons are imperfect capital markets and liquidity constraints. Empirical consumption functions show in most cases an excessive sensitivity with respect to current income. Therefore, an alternative (or complementary) solution to make economic models more realistic is to define part of the households

as being liquidity constrained. Such market imperfections enhance the real effects of fiscal policy, as we will see in our model discussion later.

Up to now, we have considered only permanent changes. Transitory changes have a smaller effect on wealth but they entail an additional intertemporal substitution effect as they may affect the rate of interest. A temporary spending cut will have a smaller impact on wealth compared with a permanent one, increasing private consumption less than proportionally, and so lowering aggregate demand and, therefore, the interest rate. Lower interest rates will shift consumption towards the present period and at the same time stimulate capital accumulation. So a transitory contractionary fiscal programme has a positive effect on output as the capital stock increases. As public spending subsequently returns to its original level, private consumption will decline less, causing a temporary increase in interest rates and lower investment, so that capital stock, output and consumption will return to their original levels.

The main conclusion here is that the introduction of the intertemporal budget constraint for households, in contrast to the current income approach in Keynesian models, lowers the multiplier effects of permanent government spending or tax changes. But two further remarks should be made.

Although these models are able to yield expansionary fiscal contractions, the logic behind the results contradicts recent ideas behind expansionary fiscal consolidation programmes. It is the decline in aggregate consumption that lowers the interest rates and stimulates capital accumulation and output gradually. Transitory spending shocks, which have larger impacts on interest rates, will be more effective in the short run. The modern view on expansionary fiscal consolidation, on the contrary, stresses the importance of the permanent character of fiscal programmes to generate positive effects on expectations, private consumption and investment demand. To achieve such expansionary expectations effects, one has to introduce specific assumptions as to expectation formation that rely on uncertainty about the future action of the public sector and on non-linear reaction functions of the public sector to unsustainable fiscal programmes. Futhermore, the results obtained in the present section were derived under the hypothesis of constant employment equal to the fixed labour supply. These two remarks will be further discussed later on.

2.2 The impact on expectations: credibility, persistence and composition of the fiscal programme

With regard to the deep recession in West Germany in 1981-82, with historically high public deficits (4.9% in 1981 and 4.4% in 1982), followed by a quick recovery during a period of restrictive fiscal policy in 1983-86, some German economists have put forward the hypothesis that economic growth was strongly influenced by the expectation effects of fiscal policy (Fels and Froehlich (1986), Hellwig and Neumann (1987)). Rapidly growing deficits may undermine private sector confidence in the future economic outlook, causing a decline in consumption and investment and leading to higher interest rates. Fiscal austerity, on the other hand, could stimulate a "psychological crowding-in", given public approval of a policy aimed at long-term stability. By absorbing a smaller share of GDP, the public sector made room for the private sector to expand. In particular, more savings could be channelled into productive private investments. The decrease in the government borrowing requirement, together with a strict anti-inflationary monetary policy, paved the way for a substantial decline in interest rates.

The Danish (1982-86) and Irish (1987-89) experiences gave further support to this hypothesis. Giavazzi and Pagano (1990) explained the strong recovery in both countries after their fiscal adjustment programmes by the "German view": a fiscal shock can trigger a positive reaction of private demand, lower real interest rates and create positive wealth effects. Giavazzi and Pagano (1995) later applied their explanation to a broader set of OECD countries. The same view underlies the work by Alesina and Perotti (1996-97), which seeks to define a "successful fiscal consolidation plan".

Given these observations, some theoretical justifications for stronger-than-proportional wealth effects following a fiscal adjustment programme were developed. Blanchard (1990) argues that a tax increase today can have expansionary effects if it generates expectations of less dramatic and disruptive tax increases tomorrow. By removing the uncertainty about the evolution of future fiscal policy, it may reduce precautionary saving.

Bertola and Drazen (1993) introduce trigger points for the government expenditure/output ratio at which sharp policy changes are expected to occur. Such trigger points make government expenditure follow a discrete process. Once expenditure reaches the critical level, a drastic stabilisation programme is expected. So if public spending comes close to a trigger level, a further rise in expenditure will increase the possibility of a drastic future stabilisation programme, and will therefore lead to a decrease in the expected future expenditure stream. As a critical level is reached, either the stabilisation programme will be put into action and government spending will be cut while consumption will increase, or the expected stabilisation process will not be implemented, and then consumption will make a negative jump and a higher trigger level for public spending will be established. Such a process can explain the Danish and Irish cases to the extent that the stabilisation programmes were effectively expected by the household sector.

These models introduce non-linear effects based on the change in the perception of uncertain future fiscal policies. Increases in public debt in a context of an already high level of debt can have different effects to an increase of debt at a low level. At a high debt level, a further increase makes a shock programme with drastic measures more likely because the continuation of past policies becomes unsustainable. In such a case, a further deficit expansion not only raises future taxes proportionally but, as it also increases the probability of a drastic programme in the near future with a finite time horizon (as in the model of Sutherland (1995)), this also leads to a more-than-proportional fall in future income. So a fiscal expansion can have contractionary effects on aggregate demand, while a fiscal contraction can lead to an expansion in aggregate demand.

Another possible channel that can increase the strength of the wealth effect is the decrease in interest rates that follows the stabilisation process. Interest rates can fall if monetary policy follows a rather expansionary stance to compensate for the restrictive fiscal policy. This effect will be addressed in a later section, where the interaction between fiscal and monetary policy is further discussed. Long interest rates can also decrease because the required risk premium declines. Falling public debt will diminish the danger of its monetisation and, therefore, the inflation bias due to public debt devaluation. The restored confidence can also attract foreign investors looking for interesting capital gains on high-yield bonds. A decrease in public debt will also reduce the default risk as it minimises the probability of an unsustainable snowball effect.

The lower interest rates will increase the value of financial assets, equity and house prices. Together with the optimistic expectations about future growth prospects in the private sector, this can lead to a boom in investment demand in both housing and business sectors.

The strength of the wealth effect depends strongly on the private sector's perception of future fiscal policy. Some authors therefore stress that the size and specific composition of the fiscal programme can be important in bringing about the necessary confidence shift (Alesina and Perotti (1996-97)). The size of the fiscal measures taken is important as it gives a signal on the unobservable future course of the process. A small adjustment programme can disappoint the private sector and will therefore not cause the necessary jump in expectations and private expenditure. Following this logic, it is also important to demonstrate that the measures taken are permanent measures, to signal clearly that a significant break has occurred with the past process of public deficits and expenditure. The composition of the adjustment programme can be important in this context. As some expenditure cuts, for instance transfers and compensation cuts, are politically more difficult to implement, they will be more convincing in signalling the willingness for further changes. Alesina and Perotti and McDermott and Wescott provide evidence which shows that successful stabilisation programmes are typically of larger magnitude and share a similar composition, with a preference for spending cuts and an aversion

to income tax increases. The authors cite the Irish experience of 1987-89 and the Danish programme of 1982-86 as typical examples of successful programmes.

The empirical relevance of this "expansionary fiscal contraction" is difficult to prove, as the argument is strongly based on the behaviour of unobservable expectations. The non-linear nature of the proposed relation also makes it difficult to model the hypothesis and to test it empirically. One approach for identifying the presence of these expectation effects is to estimate consumption and investment functions and check whether the observed reaction in private spending corresponds to the normal behaviour of consumers (Giavazzi and Pagano (1990, 1996)). Unexplained positive shocks in private demand around periods of fiscal contraction are then considered as evidence of positive expectation effects. This approach can give an indication of a structural break in the consumption function, but it cannot prove the hypothesis or the specific channel of the expectation effect. Barry and Devereux (1995) show that alternative interpretations for the remarkable results of Ireland and Denmark are possible. These can be found in the presence of other shocks affecting the economy at the time the fiscal shock took place. Indeed, the fiscal consolidation programme was preceded in both countries by a real depreciation that improved competitiveness and net exports. The fiscal measures were also accompanied by a shift in monetary policy. Both countries shifted towards a policy of a stronger currency, which may have influenced expected inflation and interest rates. Furthermore, real wages and labour markets experienced shocks at the same time as the fiscal programme was being carried out. So there is a clear problem of disentangling different shocks that were occurring simultaneously, and this makes interpretation of these experiences very difficult. A more general and structural approach is necessary to identify alternative shocks and interpret the joint observation of different macroeconomic variables. In our SVAR experiments, we try to take a step in that direction.

Most empirical macro models simulate the deflationary effects of government cuts on aggregate demand, although some arrive at rather small-short term costs (for instance the IMF Multimod exercise on Canada by Bayoumi and Laxton (1994)). But such results are mainly due to other channels. As these economies are small and open, competitiveness should play a dominant role in the interpretation of the simulation results. At the same time, the monetary policy reaction and its effects on the exchange rate are crucial for the outcome of such measures. These points will be taken up in later sections.

Up to now, the discussion has focused on demand effects. In the next two sections we discuss the effects on the supply side of the economy: household labour supply and firm's demand for labour.

2.3 The effect on the labour supply

In Section 2.1, following the classical Ramsey model, the labour supply was assumed to be inelastic. In general equilibrium models, the utility of households depends on both consumption and leisure. The labour supply then reacts to changes in consumption or wealth. In Barro (1989), Baxter and King (1993) and Aiyagari, Christiano and Eichenbaum (1992), the increase in private consumption and wealth, following public spending cuts, also stimulates a higher demand for leisure and therefore gives rise to a negative labour supply effect. This results in higher private consumption but lower employment and output in the new steady-state equilibrium. As the equilibrium capital stock and investment also decrease, the total multiplier effect in these general equilibrium models can easily exceed one. A permanent reduction has greater output effects than a temporary one, because the wealth effects, and therefore the impact on the labour supply, are larger with permanent measures. These results are remarkable as they reproduce the Keynesian result in a neoclassical framework of full employment and flexible prices.

In practice, such wealth effects on the labour supply may be rather limited. Furthermore, negative labour supply effects of fiscal consolidation may be compensated for by a positive impact of lower distortion effects of taxes on employment and investment as, in reality, taxes are not of a lump-sum type. Income taxes in neoclassical models (Baxter and King (1993)) cause a divergence between

real wage costs for firms and the disposable wage for employees. By driving a wedge between private and social returns on labour, employment will be lower in an economy with labour tax distortions than in the optimal world with lump-sum taxes. Fiscal consolidation in these models will therefore have a positive supply effect by eliminating tax distortions.

These different steady-state supply effects of both assumptions are also present in the simulation results of modern macroeconomic models that are constructed around a well-defined steady-state model. The simulation results of the Quest II model (Roeger and In't Veld (1997)), for instance, show how the impact of a fiscal consolidation programme depends on the financing decision. If the decrease in public spending goes together with a reduction in lump-sum transfers, the long-term effect on output is negative. If the spending cuts give room for a decrease in labour taxes, there will be a significant positive effect on employment. The importance of the financing decision was also stressed by Bartolini, Razin and Symanski (1995), using the IMF Multimod model to simulate fiscal restructuring in the G-7 countries.

The relative size of these different effects in empirical studies is ambiguous. Studies on the labour supply give different results according to whether they are based on micro- or macroeconomic data. The size of distortion effects will, in addition, depend on the structure of the labour market. Labour tax distortions can also be offset by the external effects of public expenditure and investment on private labour and capital productivity. In this paper, however, we concentrate on the intertemporal aspects of fiscal consolidation, which should be distinguished from the other aspects of fiscal policy, no matter how important the structure of the financing decisions and of the expenditure composition may be.

The effects of fiscal contractions on the labour supply may also be different in models with labour unions and bargaining. Changes in the system of accommodating transfers, especially those related to unemployment, can change the insider behaviour of unions in the labour market (Calmfors and Horn (1985-86)). Abolition of the automatic indexation of transfers and public sector compensation can have spillover effects on the private sector wage formation process. These channels are interesting as they offer a different view on expansionary fiscal consolidations. They suggest that the negative demand effects of spending cuts may not be offset by private demand shocks, but rather that positive supply shocks could be important. As supply shocks tend to have more permanent effects on output, this distinction can have major consequences for the long-run outcome as well. In the SVAR exercise, we will be able to discuss the offsetting role of these different channels.

2.4 Imperfect competition models with sticky prices

Up to now, the models discussed have all assumed flexible prices and full employment. Under these neoclassical assumptions, demand shocks do not affect the supply decisions of the firms directly, and the short-term effects of public finance shocks on output are thus rather small. In reality, however, the decision to cut government expenditure is often taken in a context of unemployment, and spending cuts are often postponed because of the expected short-run costs in terms of negative employment effects in a situation of already high unemployment.

Therefore, the problem of fiscal consolidation should be examined using a model with unemployment and rigid prices or wages, so that demand shocks do have short-run output effects.

Perfectly competitive models predict that aggregate demand shocks can raise output and employment only by increasing households' willingness to supply labour (Woodford and Rotemberg (1992)). A profit-maximising firm in perfectly competitive output and factor markets produces and hires labour until marginal productivity equals marginal costs. As these variables depend only on supply-side conditions in the form of installed capital, technology, etc., demand shocks will not affect the real output and employment decisions of the firm. The demand for labour will shift only if the assumption of perfect competition and price flexibility is dropped. The neoclassical models, by assuming perfect competition and flexible prices, do not allow for the effect of fiscal spending shocks

on the supply decisions of the firms and labour demand in particular. In neglecting these effects, the neoclassical model underestimates the short-run costs of fiscal adjustments.

Imperfectly flexible wages can explain the influence of aggregate demand shocks on real output, but they imply countercyclical real wages. Therefore, it is more realistic to look for a solution in terms of imperfect competition in the goods market as the rationalisation for the impact of demand shocks on firms' supply decisions. Monopolistic competition in the goods market also implies equilibrium situations with unemployment. Price rigidity can be rationalised in these environments both as a consequence of collusive behaviour between oligopolies (Rotemberg and Woodford (1992)) or in terms of price adjustment costs (Calvo (1983), Kollman (1997) and Hairault and Portier (1993)).

In such models, aggregate demand shocks affect the mark-up as prices do not fully reflect the increase of marginal costs. The reaction of output will no longer depend exclusively on the labour supply reaction of households; labour demand by firms will also shift. These neo-Keynesian models succeed in combining price rigidity and the importance of the demand shocks in the short run within the long-run neoclassical framework.

Empirical macroeconomic models typically incorporate sticky price and wage assumptions in the short run, and are therefore demand-driven in the short run. They are able to illustrate important short-run output costs of public spending cuts. The problem, however, is that such models, by incorporating more realistic, empirically estimated short-run dynamics, lose their theoretical consistency, especially in terms of the profit maximisation behaviour of firms in output and price decisions. This was certainly the case in traditional macroeconomic models, inspired by the old Keynesian view and lacking the long-run steady-state framework that is needed to determine long-run stock flow equilibrium. But even more modern models, built around a theoretical steady-state model, have a somewhat arbitrary combination of short-run dynamics and long-run steady-state properties.

2.5 Open economies and monetary policy reaction functions

The simple Mundell-Flemming approach implies that fiscal spending cuts will decrease aggregate demand and result in a real depreciation of the exchange rate together with an improvement in the current account.

This result remains more or less valid in the modern approach using rational expectations and intertemporal optimisation. In a small open economy model with one good and finite horizons, aggregate demand declines with spending cuts. As the interest rate is fixed for the small economy, contrary to the closed economy case, investment does not react but net exports increase. The accumulation of net foreign assets substitutes for the accumulation of domestic capital, and therefore output remains unchanged. In the ultimate steady state these effects will be reversed, allowing a further increase in private consumption, as equilibrium in the balance of payments requires the trade deficit to compensate for the increase in interest income on net foreign assets.

In a model with two goods and imperfect substitution, there will be additional effects via changes in the real exchange rate, as the price of the domestic good in terms of the foreign good will decrease. The real depreciation goes hand in hand with a decrease in the real interest rate so that investment and output rise, a result that compares well with the one obtained in the closed economy case. Further complications of the model (e.g. Ahmed (1987) and Cuddington and Vinals (1986)), introducing tradable and non-tradable goods and wage-price inflexibility, can, however, make these results ambiguous. The non-tradable sector output declines with the public spending cuts, and real wages go down, boosting exports in the tradable sector.

In practice, the behaviour of the nominal exchange rate depends strongly on the reaction of monetary policy and the change in risk premia for small open economies.

Bayoumi and Laxton (1994), using simulations of the IMF Multimod model for Canada, illustrate how the outcome of a fiscal consolidation programme depends on the interaction between

the exchange rate and monetary policy. A deficit reduction package that uses a combination of increases in taxes less transfers and a decrease in government expenditure to bring the debt/GDP ratio down was simulated for Canada. Monetary policy responds endogenously as it pursues an inflation target and long-term interest rates incorporate a small risk premium that depends on the public debt ratio. In this simulation, the size of the short-run costs depends on the perception by economic agents of the persistence of the deficit cut. With a fully credible fiscal programme, economic agents anticipate the decline in future interest rates, and the exchange rate depreciates immediately. Exports rise and the total output effect can even become positive. If the programme is not credible, the exchange rate depreciates less as economic agents do not correctly anticipate future lower interest rates. Therefore, output and inflation decline initially. This example illustrates the importance of the currency depreciation and a monetary policy rule in determining the outcome of consolidation programmes for small open economies. An increase in competitiveness and net exports can be an important channel to offset negative domestic demand shocks in the short run.

This result is typical for many simulations on fiscal consolidation. In a discussion of the impact of the Maastricht criteria and the deficit reduction programmes on economic growth, Buiter (1993) also points to the dependence of the short-run costs on the behaviour of interest rates and exchange rates to offset the negative impact on demand. In that context, the disappearance of long-term interest rate differentials with Germany did play an important role in softening the short-run costs.

In addition, in the QUEST model (Roeger and In't Veld (1997)) the short-run effects of fiscal contractions depend strongly on the monetary policy rule. With a nominal interest rate target, money supply decreases following spending cuts and this will enforce the negative short-run costs. On the other hand, if monetary policy follows a strict money supply rule, nominal interest rates decline and such a type of monetary policy can even reverse the short-run effects.

3. Fiscal consolidation in a general equilibrium model for a small open economy

In this section, a small general equilibrium model for an open economy is presented. The model integrates most of the topics that were discussed in the previous section, and therefore allows us to analyse the importance of such effects in a coherent framework. After a brief description of the model, the impulse response effects of public spending cuts and tax increases are presented and the sensitivity of the results with respect to the parameter values is tested.

3.1 The household sector

A first group of households is liquidity constrained and has no access to the capital market. These households consume disposable labour income during the period in which it is earned, and it is supposed that their labour supply is perfectly elastic so that it fluctuates together with total employment, determined elsewhere in the model.

The behaviour of these households is summarised by the following equation:

$$C_t^w = \frac{w_t}{p_t}(1-L)_t - T_t \tag{1}$$

where income is equal to labour income minus net taxes. Notice that taxes are treated as lump-sum taxes and are therefore not proportional to income. The question of tax distortions is not considered in this model.

The second group of households has full access to the capital market: they hold money balances (M), domestic government bonds (B), foreign interest-bearing bonds (F) and domestic equity

(V). Bonds are one-period assets on a discount basis, such that the price in period t of the domestic bond (b) equals $1/(1+R)$ and, similarly, for the foreign bond with price (f):

$$\frac{M_{t+1}}{p_t}+\frac{b_t B_{t+1}}{p_t}+s_t\frac{f_t F_{t+1}}{p_t}+\frac{d_t V_{t+1}}{p_t}= \tag{2}$$
$$(1/pr)\left[\frac{M_t}{p_t}(1+gm_t)+\frac{B_t}{p_t}+s_t\frac{F_t}{p_t}+\frac{d_t V_t}{p_t}+\frac{w_t}{p_t}(1-L)_t-C_t^1-C_t^2-T_t\right]$$

pr is the probability of survival. A perfect insurance market inherits consumers' wealth on their death and redistributes wealth in the form of an annuity payment in proportion to household wealth. V stands for domestic equity with price d. Real wealth (W) is equal to:

$$W_t=\frac{M_t}{p_t}(1+gm_t)+\frac{B_t}{p_t}+s_t\frac{F_t}{p_t}+\frac{d_t V_t}{p_t} \tag{3}$$

The utility function is of the following type:

$$V_t=a\ln C_t^1+(1-a)\ln\left[C_t^2+\theta G_t\right]+\frac{1}{1-\varpi}L_t^{1-\varpi} \tag{4}$$

Utility depends on the consumption of cash ($C1$) and credit goods ($C2$), public consumption (G) and leisure time (L).

The households have a discount factor (β) and a finite expected life, with pr the probability of survival and a lifetime horizon $1/pr$, so that the objective function becomes:

$$\max\ \underset{t}{E}\sum_j(\beta pr)^j V\left[C_{t+j}^1,C_{t+j}^2,G_{t+j},L_{t+j}\right] \tag{5}$$

and the cash constraint applies to the consumption of cash goods:

$$C1_t\le\frac{M_t}{p_t}(1+gm_t) \tag{6}$$

The first-order conditions are derived from the Lagrangian, combining the optimisation function and the constraints, with λ the Lagrange parameter for the budget constraint and η for the cash constraint:

$$V_t^{C1}=\lambda_t+\eta_t \tag{7}$$

$$V_t^{C2}=\lambda_t \tag{8}$$

$$V_t^1=\frac{w_t}{p_t}\lambda_t \tag{9}$$

$$E_t\left[\frac{\beta pr}{\gamma}\frac{\eta_{t+1}}{p_{t+1}}+\frac{\beta pr}{\gamma}\frac{\lambda_{t+1}}{p_{t+1}}\right]=\frac{\lambda_t}{p_t} \tag{10}$$

$$E_t\left[\frac{\beta pr}{\gamma}\frac{\lambda_{t+1}}{p_{t+1}}(1+R_t)\right]=\frac{\lambda_t}{p_t} \tag{11}$$

$$E_t\left[\frac{\beta pr}{\gamma}\frac{\lambda_{t+1}}{p_{t+1}}\frac{s_{t+1}}{s_t}(1+R_t^f)\right]=\frac{\lambda_t}{p_t} \tag{12}$$

$$E_t\left[\frac{\beta pr}{\gamma}\frac{\lambda_{t+1}}{p_{t+1}}\frac{d_{t+1}}{d_t}\right]=\frac{\lambda_t}{p_t} \tag{13}$$

γ stands for technological progress (but it is assumed to equal 1 in the rest of the analysis).

Equations (7) and (8), combined with the first-order constraint on cash holdings (10) and the interest rate condition (11), result in a velocity of money that depends positively on the interest rate. Using the equality between $C1$ and real money holdings (M/P), the equation can then be rewritten as:

$$C_t \Big/ \frac{M_t}{p_t}(1+gm_t) = \frac{1}{a} + \frac{1-a}{a} R_{t-1} \tag{14}$$

In the simulation of the model, this money demand equation is specified in terms of total consumption and not just in terms of the consumption of the unconstrained consumers.

Equations (11) and (12) represent the uncovered interest rate parity condition for nominal exchange rate determination. Equation (13) shows that the expected holding return on equity equals the expected one-period interest rate under certainty equivalence.

The consumption of the second type of household can be approximated by using the first-order conditions and the restriction that the net present value of consumption must equal total expected revenue and actual wealth. The consumption of cash goods becomes:

$$C1_t = (1-\beta pr/\gamma)a \frac{1}{(1+R_{t-1})}\left[W_t + R_{t-1}\frac{M_t}{p_t}(1+gm_t) + H_t + \theta PG_t \right] \tag{15}$$

and the consumption of credit goods, including government consumption, is related to the consumption of cash goods in the following way:

$$C2_t^T = C2_t + \theta G_t = \left(\frac{1-a}{a}\right)(1+R_{t-1})C1_t \tag{16}$$

Total aggregate consumption can then be expressed as a function of total wealth:

$$C_t^T = \beta_t^0 \left[W_t + R_{t-1}\frac{M_t}{p_t}(1+gm_t) + H_t + \theta PG_t \right] \tag{17}$$

where $\beta_t^0 = (1+\frac{1-a}{a}(1+R_{t-1}))\frac{(1-\beta pr/\gamma)a}{1-(1-\beta pr/\gamma)a}\frac{1}{(1+R_{t-1})}$ and H and PG stand for the present value of disposable labour income and government expenditure discounted with $pr/(1+RR)$.

Substituting out human wealth and the present value of government expenditure, the equation can be rewritten as:

$$C_t^T = \frac{(1+RR_t)(\beta_t^0/\beta_{t-1}^0)\beta/\gamma}{(1-(1-\beta pr/\gamma)a)} C_{t-1}^T - \frac{(1-pr)}{pr}\beta_t^0\left[W_t + R_{t-1}\frac{M_t}{p_t}(1+gm_t) \right] \tag{18}$$

The introduction of two types of household and a finite horizon allows a generalised permanent income approach. The liquidity constraint on part of the consumers can explain the excess sensitivity of consumption to current income innovations. The finite time horizon assumption allows testing of the impact of different planning period hypotheses on the effect of public deficits on private consumption. By incorporating government consumption and private consumption in the consumers' utility function, the results of different assumptions about the substitution or complementarity between both types of goods can be analysed. A negative value for θ implies that an increase in government consumption raises the marginal utility of private consumption (i.e. the two are complements), whereas a positive θ suggests that an increase in government consumption diminishes the marginal utility of private consumption (i.e. the two are substitutes).

In the case of monopolistic competition, aggregate consumption has to be considered as an index of many different consumer goods. The allocation is considered in two steps together with

the other final demand components: investment and government consumption. First, aggregate demand is allocated between domestic and foreign goods and then between an infinite series of differentiated domestic or foreign goods. The final demand index is defined as a CES function $(C+G+I) = (H^{1/(1+sa)}+F^{1/(1+sa)})^{(1+sa)}$, where H is an index of consumption goods produced in the country, and F is an index of imported goods. The final demand price index is defined as: $P = (1/(pH^{-1/sa}+pF^{-1/sa})^{(-sa)}$. The optimal share is $YH/(C+G+I) = (pH/P)^{-(1+sa)/sa}$.

H is an index of domestic goods h. There exists a continuum of home-produced goods, indexed by s element of [0,1]. So yH, the demand for home goods by domestic (H) and foreign sources (exports), and yF, the total demand of import goods, can be defined as follows:

$$y_t^H = \left[\int_0^1 h_{j,t}^{1/(1+\upsilon)} dj\right]^{1+\upsilon} \tag{19}$$

$$y_t^F = \left[\int_0^1 f_{j,t}^{1/(1+\upsilon)} dj\right]^{1+\upsilon} \tag{20}$$

with $1+\upsilon/\upsilon$ denoting the price elasticity of demand. The optimal consumption allocation implies:

$$y_{j,t}^H = (p_{j,t}^H / p_t^H)^{-(1+\upsilon)/\upsilon}(y_t^H / n) \tag{21}$$

$$y_{j,t}^F = (p_{j,t}^F / p_t^F)^{-(1+\upsilon)/\upsilon}(y_t^F / n) \tag{22}$$

3.2 The firm problem

We assume that firms have some market power and behave as monopolistic competitors. The model allows increasing returns to scale (either in the form of overhead costs or in terms of externality). Firms use labour, capital and energy inputs. Energy is used in a fixed proportion to output.

Firm j maximises its expected profit, discounted with a rate (ρ) which is determined by the valuation of the shareholders (the unconstrained consumers). ρ_{t+1} can be replaced by the shadow value of wealth λ_{t+1} of households.

The model of price determination, inspired by Calvo (1983), assumes that firms are not allowed to change their prices, unless they receive a random "price change signal". The probability that a given price can be changed in any particular period is constant ($1-\varsigma$). This probability also determines the fraction of all prices that are changed in each period. Consider now the problem for firm j, which is allowed at time t to set a new price p_j. At the time that firm j changes its price, there are three control variables p_j, H_j and K_j. Firm j will maximise the following expectation:

$$E\sum_t\sum_i \beta^{t+i}\rho_{t,t+i}\left[\begin{array}{l}\zeta^i p_j^H y_{j,t+i} + (1-\zeta^i)p_{j,n}^H y_{j,t+i} - w_{t+i}H_{j,t+i} - p_{t+i}^e s_{t+i}\dfrac{i_e}{1+i_e}y_{j,t+i} \\ - p_{t+i}K_{j,t+1+i} + p_{t+i}(1-\tau)K_{j,t+i} - p_{t+i}\dfrac{\psi}{2}\dfrac{(K_{j,t+1+i}-K_{j,t+i})^2}{K_{j,t+i}}\end{array}\right] \tag{23}$$

subject to the production technology and the demand for good j:

$$y_{j,t+i} \le (1+i_e)A_{t+i}K_{j,t+i}^{\alpha\mu}H_{j,t+i}^{(1-\alpha)\mu}e^{\gamma t} \tag{24}$$

$$y_{j,t+i} \le y_{j,t+i}^H = \left(\frac{p_{t+i}^H}{p_j^H}\right)^{\frac{1+\upsilon}{\upsilon}}\frac{y_{t+i}^H}{n} \tag{25}$$

The first-order condition for labour is:

$$w_t = (1+i_e)F^H_{j,t}(p^H_{j,t} - v_{j,t}) - p^e_t s_t i_e F^H_{j,t} \tag{26}$$

or, introducing the real marginal cost:

$$\frac{w_t}{(1-i_e)p^H_{j,t}F^H_{j,t}} + \frac{p^e_t s_t i_e}{(1-i_e)p^H_{j,t}} = mc_{j,t} \tag{26'}$$

The first-order condition for capital is:

$$\rho_t p_t (1+\psi\frac{(K_{j,t+1+i} - K_{j,t+i})}{K_{j,t+i}}) = \beta\rho_{t+1}p_{t+1} \left[1-\tau+(1+i_e)F^K_{jt}(1-\frac{v_{j,t+1}}{p^H_{j,t+1}}) - \frac{p^e_{t+1}s_{t+1}i_e}{p^H_{j,t+1}}F^K_{jt} + \psi\frac{(K_{j,t+2+i} - K_{j,t+1+i})}{K_{j,t+1+i}}\right] \tag{27}$$

By introducing Tobin's Q into the demand for capital, equation (28) can be simplified:

$$\rho_t p_t Q_t = \beta\rho_{t+1}p_{t+1}\left[Q_{t+1} - \tau + (1+i_e)F^K_{jt}(1-\frac{v_{j,t+1}}{p^H_{j,t+1}}) - \frac{p^e_{t+1}s_{t+1}i_e}{p^H_{j,t+1}}F^K_{jt} + \psi\right] \tag{27'}$$

And the condition for the price is:

$$\sum_i \beta^{t+i}\rho_{t+i}\varsigma^i\left(\frac{p^H_{t+i}}{p^H_j}\right)^{\frac{1+\upsilon}{\upsilon}}\frac{y^H_{t+i}}{n} = \sum_i \beta^i\rho_{t+i}\varsigma^i v_{j,t+i}\frac{1+\upsilon}{\upsilon}\left(\frac{p^H_{t+i}}{p^H_j}\right)^{\frac{1+\upsilon}{\upsilon-1}}\left(\frac{1}{p^H_j}\right)p^H_{t+i}\frac{y^H_{t+i}}{n} \tag{28}$$

Using (26) and (27), the price at time t can be derived as:

$$p^H_j = \frac{\sum_i \beta^{t+i}\rho_{t+i}\varsigma^i(1+\upsilon)(p^H_{t+i})^{\frac{1+\upsilon}{\upsilon}}\frac{y^H_{t+i}}{n}\left[\frac{w_{t+i}}{(1+i_e)F^H_{t+i}} + p^e_t s_t i_e\right]}{\sum_i \beta^{t+i}\rho_{t+i}\varsigma^i(p^H_{t+i})^{\frac{1+\upsilon}{\upsilon}}\frac{y^H_{t+i}}{n}} \tag{28'}$$

which shows clearly that the price set by firm j, at time t, is a function of expected future marginal costs. The price will be a mark-up over marginal costs. If prices are perfectly flexible, the mark-up will be constant and equal to $(1+\upsilon)$. With sticky prices, the mark-up becomes variable over time when the economy is hit by exogenous shocks. A cost increase temporarily lowers the mark-up such that production is less affected than in the flexible price case. A positive demand shock also lowers the mark-up and stimulates employment, investment and real output. Through this last channel the model obtains a Keynesian character: following a government demand shock, firms are stimulated to increase production. This contrasts with the classical real business cycle tradition, where the supply reaction of firms is not directly affected by demand shocks. The introduction of increasing returns to scale can further enhance the supply reaction of firms following a demand shock.

3.3 The government sector

The government sector has to satisfy the following budget restriction:

$$\frac{b_t B_{t+1}}{p_t} = \frac{B_t}{p_t} + G_t - T_t \tag{29}$$

The primary deficit (G-T), together with the debt servicing has to be financed by the issuance of new public debt B at price b. To prevent the public deficit becoming explosive, the following endogenous tax behaviour is assumed:

$$T_t = g(\frac{B_t}{p_t} - \frac{B_t^0}{p_t}) + \varepsilon_t^T \tag{30}$$

with g greater than the real interest rate minus real growth ($g > R\text{-}\pi\text{-}\gamma$), so that stable public debt is guaranteed at the long-term objective B^0. ε^T represents stochastic tax shocks. The effect of the tax shocks will depend on the specification of the time horizon and the liquidity constraints on consumers. In the most simple specification with infinite horizon and no liquidity constraints, taxes will be a perfect substitute for debt financing and the size of parameter g will have no impact on the dynamics of the model. With finite horizons and liquidity constraints, the impact of taxes becomes more complicated since it influences the households' budget constraints.

Government expenditure affects the budget constraint on the private sector via the wealth effect, even with infinite household time horizons. But in that case the financing decision becomes irrelevant. With finite horizons or liquidity restrictions, the financing decision will make a difference.

3.4 The balance of payments and foreign demand

The accumulation of foreign assets (F) is determined by the current account relation:

$$\frac{s_t f_t F_{t+1}}{p_t} = \frac{s_t F_t}{p_t} + \frac{p_t^H}{p_t} x_t^H - s_t \frac{p_t^F}{p_t} y_t^F - s_t \frac{p_t^e}{p_t} IE_t \tag{31}$$

The net external position F depends on the interest payments and the trade balance: the value of exports x^H minus the imports of final products y^F and energy inputs. Energy acts only as an input in the production process:

$$IE_t = ieA_t K_t^{\alpha} H_t^{1-\alpha} e^{\gamma t} \tag{32}$$

Exports are determined by the price elasticity of foreign demand and by the demand in the rest of the world (ROW):

$$X_t = f(ROW_t, \frac{s_t p_t^F}{p_t^H}) \tag{33}$$

3.5 Market equilibrium

Most of the relations above are derived for an individual household or firm. With the exception of aggregate consumption, presented above, aggregate and individual behavioural equations remain the same, such that the interpretation can switch from the micro to the macro level.

The goods market is in equilibrium if firms' production equals demand by domestic and foreign buyers.

The labour market is in equilibrium if firms' demand for labour equals households' supply. Wages adjust to equilibrate demand and supply. It is assumed that firms use labour inputs of both types of household in fixed proportions, so that the labour supply of the unconstrained households determines the employment outcome and the wage rate following demand shocks. The impact of labour supply elasticity will be discussed later as it will become an important variable in the model outcome.

$$H_t = 1 - L_t \tag{34}$$

So far, the labour market has been considered as a competitive market and this is a very unrealistic hypothesis. In future research it will be replaced with a bargaining.

The demand for money was derived in equation (14). The supply of money follows the following process:

$$M_{t+1} = M_t(1 + gm_t) \tag{35}$$

in which *gm* represents the money supply growth rate. This growth rate can react endogenously to output, inflation or the exchange rate. So different monetary policy reaction functions can be introduced into the model. The effects of monetary policy shocks can be further enhanced by liquidity effects. When such liquidity shocks affect the consumer after his consumption/savings decision is made, they create temporary deviations from the first-order conditions by pushing the nominal interest rate lower.

In the capital market, equilibrium means that government debt is held by domestic investors (assuming that the country is in a positive net foreign asset position) at the market interest rate *R*, and that the net foreign assets are held by investors at the going interest and exchange rates. Both assets are considered to be perfect substitutes, such that the domestic interest rate equals the foreign rate plus expected exchange rate movements (uncovered interest rate parity). The risk premium, present in the first-order conditions, disappears during the linearisation process (certainty equivalence).

3.6 Simulation of public expenditure and tax shocks

The model can be used to simulate the impact of public expenditure cuts and tax increases. As far as possible, the parameters of the model are chosen to reflect the characteristics of the Belgian economy. The structural and technical parameters such as the components of GDP, the wealth composition, the production function, etc. therefore represent a very open economy, with a large public debt and positive net foreign assets vis-à-vis the rest of the world. The calibration of the behavioural parameters, on the other hand, is much more difficult and as the empirical calibration exercise is not yet finished, the obtained impulse responses should not be considered as necessarily representative for the Belgian economy. Therefore, we will confine the analysis to the impact of some of the crucial parameters on the outcome of the simulation results.

Following the discussion in the literature, we examine the impact of the planning horizon and the importance of liquidity constraints, the difference between permanent and transitory shocks, the substitution between private and public consumption, labour supply behaviour, price rigidity and monetary policy reactions. We also briefly present the impact of some other shocks, in particular the impact of a productivity shock as an example of a supply shock and a demand shock (foreign and domestic). These impulse response effects can serve as a benchmark for evaluating the SVAR results in the empirical part of the paper.

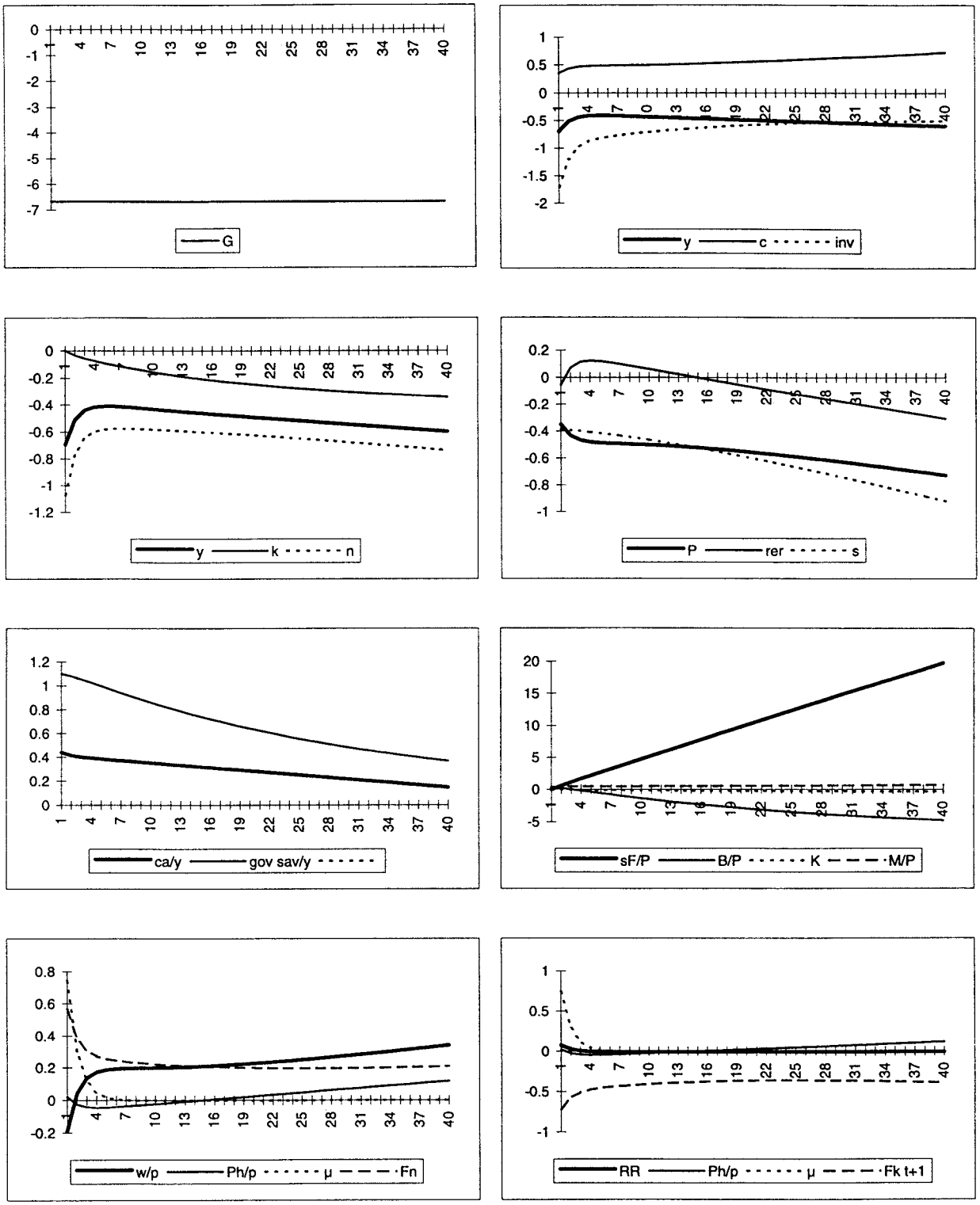
(a) The baseline simulation

We simulate a permanent reduction in government consumption of 1% of GDP and an equivalent increase in lump-sum taxes. These policy actions cause a decline in the public deficit. As public debt decreases below its original level, lump-sum taxes start falling such that the public debt stabilises at a lower level with a multiplier of $1/(g\text{-}RR)$, where g represents the fiscal reaction to the debt level in equation (31) and *RR* is the real interest rate. In the baseline example, this means that the level of public debt is around 5.5% lower in the new steady state. In Figures 2a and 2b, the impulse response outcomes of these simulations are summarised. As the public sector has a large debt service burden, the percentage decrease in public expenditure (6.66%) is higher than the increase in lump-sum taxes (4.5%).

The decrease in public expenditure lowers output (y) by 0.7% and employment (n) by 1.1% during the first quarter. After one year the fall in output is reduced to around 0.4%, but subsequently output converges to a steady-state level of almost 1.5% below the baseline. On the demand side, private consumption reacts positively following the improvement of the private wealth

Figure 2a

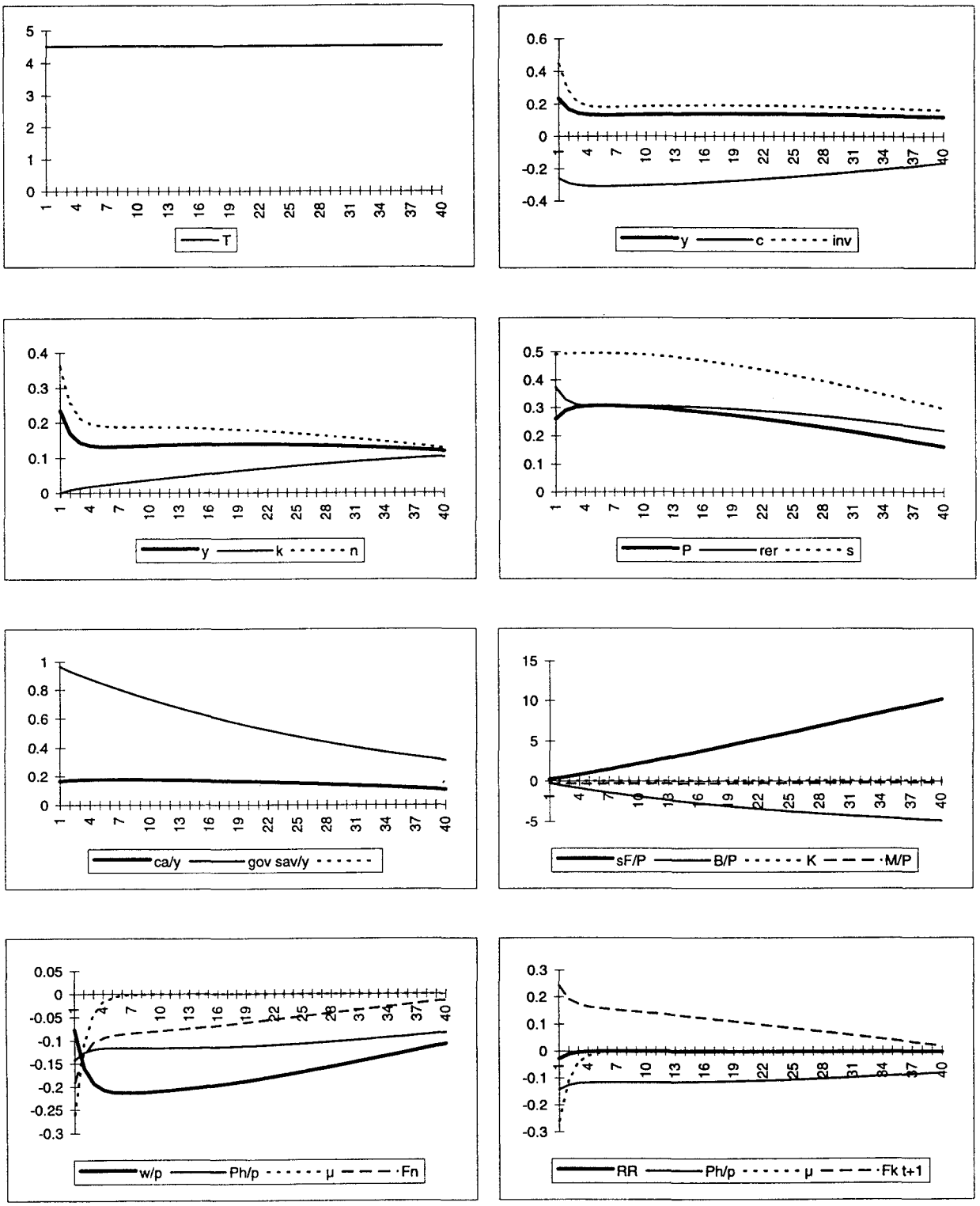
Impulse response of a permanent decrease in government consumption (1% GDP)



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 2b

Impulse response of a permanent decrease in the exogenous taxes (1% GDP)



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

position. As consumers have a finite horizon (50 quarters or 12.5 years in the baseline scenario) and taxes decrease gradually over time in line with the debt reduction, private wealth and consumption show a further increase over time as future generations profit more from the consolidation process. Investments (*inv*) decline strongly in the short run and further depress aggregate demand. Increasing consumption goes hand in hand with an increasing demand for leisure or a declining labour supply. Together with the lower capital accumulation (*k*), this explains the gradual decline of output in the long run.

In the baseline simulation, nominal money supply is kept constant. As money demand is specified in terms of consumption, the aggregate demand price deflator (*p*) has to decline in order to equalise money demand and supply. The nominal interest rate does not change as the higher real rate is compensated for by lower expected inflation. With a constant nominal interest rate, the exchange rate (*s*) has to jump directly towards its new equilibrium path. During the first few years, the nominal appreciation does not offset the decline in the price level so that the real exchange rate (*rer*) depreciates. The subsequent weak real exchange rate appreciation is in line with the lower real interest rate.

The real depreciation during the first few years helps to offset the negative domestic demand shock. It is, however, limited by the rigidity of prices and the corresponding downward reaction of aggregate supply. The current account (*ca*) strongly improves through the decrease in imports and the improvement in competitiveness. As the net foreign asset position (*sF/p*) improves over time, the exchange rate starts to appreciate. In the new steady state, equilibrium in the current account requires a real appreciation and a trade deficit to compensate for higher interest income from abroad. This current account and real exchange rate behaviour is in line with the growing divergence between private consumption and output.

The composition of financial wealth shifts away from public debt and equity towards foreign assets. As the decrease in public debt finds its counterpart in the lower present value of future taxes, and therefore higher human wealth, the accumulation of foreign assets reflects, to a large extent, a net increase in private wealth. This evolution is in line with the consumption and labour supply behaviour of the households.

The impulse response effects on the supply variables are important in explaining the short-run output costs. Marginal costs are a function of labour productivity (*Fn*), the real wage (*w/p*) and the relative output price (*ph/p*). At a lower output level, marginal costs decrease as labour productivity increases and real wages in terms of output prices decline. Prices follow the lower production cost only gradually as firms temporarily increase their mark-ups. Higher mark-ups shift the demand for labour and the supply by firms downwards. Higher mark-ups and lower marginal productivity of capital also explain the strong decline in Tobin's Q and investment. Together, these negative supply reactions of firms explain the high short-run output costs of a demand shock in this new-Keynesian framework.

A fiscal consolidation through a lump-sum tax increase or a decrease in transfers has a very different impact on the economy (Figure 2b). As consumers have a finite horizon, the burden of public debt shifts from the future to the present generation, and private consumption will decrease. But aggregate demand increases as investment and, especially, net exports rise strongly. So there is a shift in the use of resources away from consumption towards capital accumulation, both domestically and abroad in the form of net foreign assets.

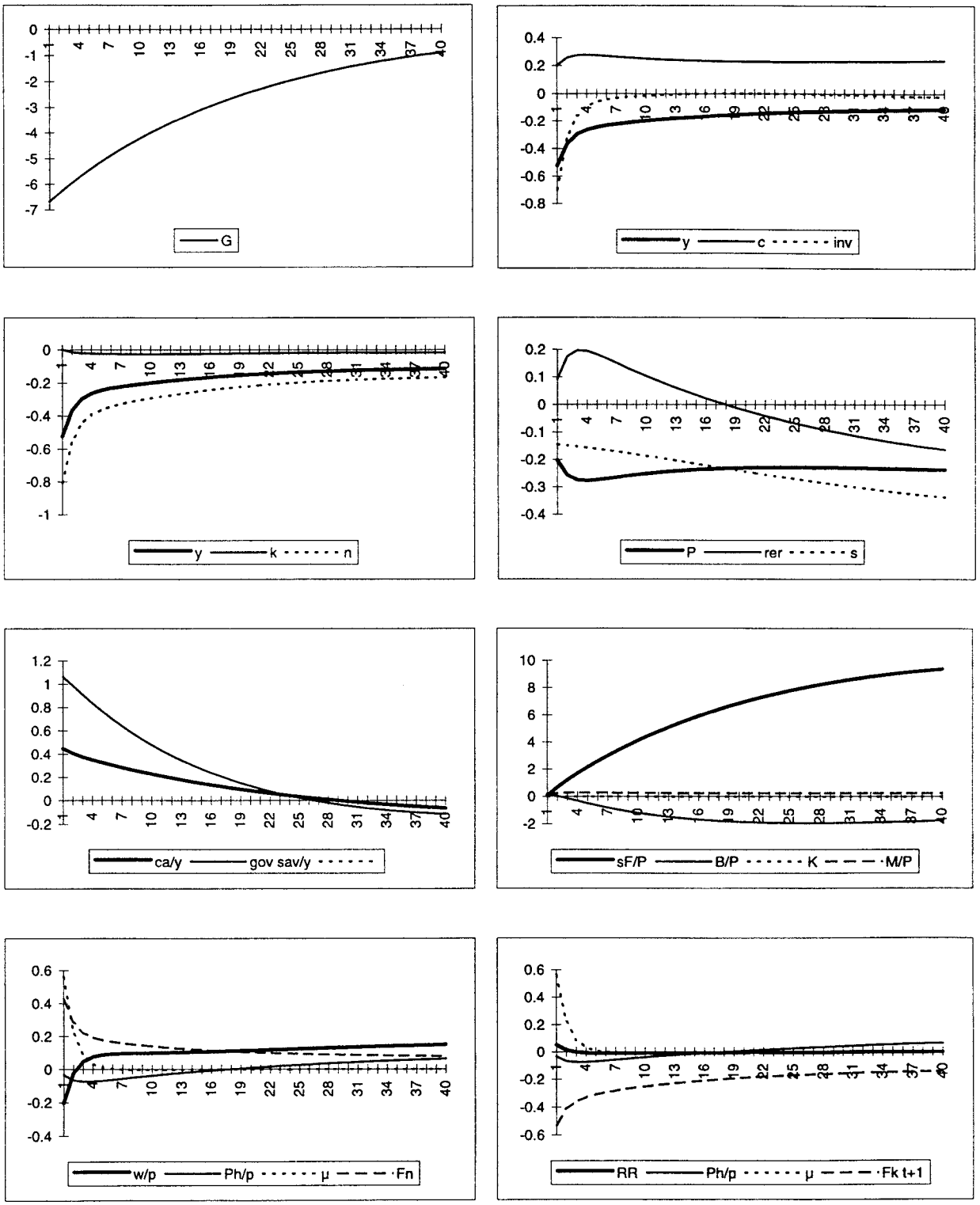
The positive net export evolution is possible because there is a strong real depreciation of the exchange rate, which compensates for the higher demand for imports following the increase in aggregate demand. Over time the exchange rate will appreciate again so that in the new steady state net exports will turn negative and compensate for the higher capital income.

The increase in total demand is accompanied by an increase in prices but a decrease in the mark-up. Temporarily lower mark-ups push labour demand, investment and production up further. This extra supply of domestic goods, in the short run, enhances the downward pressure on the price of

Figure 3

Impulse response of a transitory decrease in government consumption (1% GDP)

Persistence $\rho = 0.95$



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

the domestic good in terms of the foreign good. Over a longer period, there is a decrease in the marginal productivity of labour and a decline in the relative output price of the home good, but these negative influences on the demand for labour are compensated for by a lower real wage.

(b) Transitory versus permanent shocks

In the literature, some authors emphasise that permanent public spending cuts should be less costly than transitory measures. Private wealth and expectations should react more positively to permanent measures. We therefore compare the impact of a transitory spending cut with the results of a permanent spending cut as described in the baseline projection (Figure 3).

A transitory spending cut has a smaller wealth effect, so consumption increases less than it would in response to a permanent measure. This reflects the basic argument behind the original expansionary fiscal contraction. But of course our model does not contain the non-linear effects that can further strengthen the normal wealth effect via a shift in expectations on future fiscal policy.

However, in our model this lower increase in private consumption does not translate into a higher short-run output cost for a strict fiscal policy. On the contrary, the short-run output costs of a transitory shock are lower because investment declines less and because there is a stronger real depreciation and, therefore, a better performance by exports.

(c) The impact of the planning horizon and liquidity constraints

Figure 4 shows the result for a permanent spending cut with a lower expected life for households: five years instead of 12.5 in the baseline simulation. The length of the horizon is an important determinant for the strength of the wealth effect. By increasing the probability of death, the discount rate of households for future income and taxes increases. The decrease in future taxes, following the fiscal consolidation, therefore receives a much lower weighting in the calculations of the households. Wealth increases less, and private consumption will also increase less during the first period of the simulation. As taxes are effectively lowered later in the process, consumption tends towards the same level as in the baseline simulation.

The smaller impact on consumption is again compensated for by more investment and, in particular, by a stronger real depreciation and, therefore, higher exports. Unemployment and output are also higher because of the improvement in the supply conditions: real wages decline relative to the baseline simulation with a similar productivity. This result illustrates that for a small open economy the impact of the fiscal programme on competitiveness and foreign demand can be more important in determining the output costs than the impact on domestic demand.

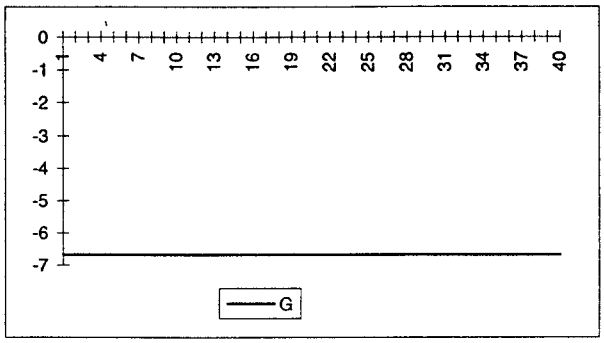
The relevance of this simulation is probably also important as it can also capture the case of higher uncertainty about future fiscal policy. If the fiscal consolidation process is not considered credible by households, they will also discount future tax promises at a higher discount rate. The lower domestic demand that results in this case could be offset by a stronger exchange rate depreciation and lower real wages, which stimulate foreign demand.

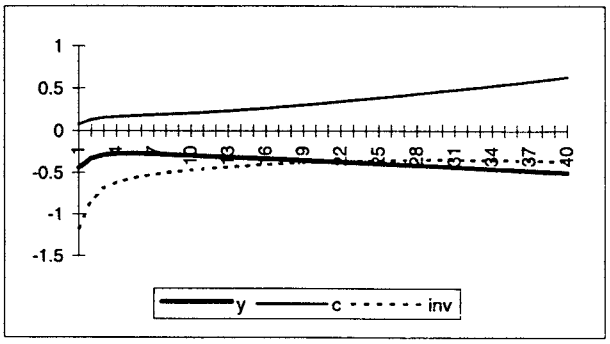
The impact of liquidity constraints on a certain proportion of households has a more complex effect. Lower output and labour income decrease the income and consumption of the constrained households. Consumption of the unconstrained households will, however, go up, but this result depends on the specification of the production function and the corresponding income distribution. The output cost increases in this scenario as the labour supply is lower and real wages higher, but these effects are rather small compared with the influence of the horizon length.

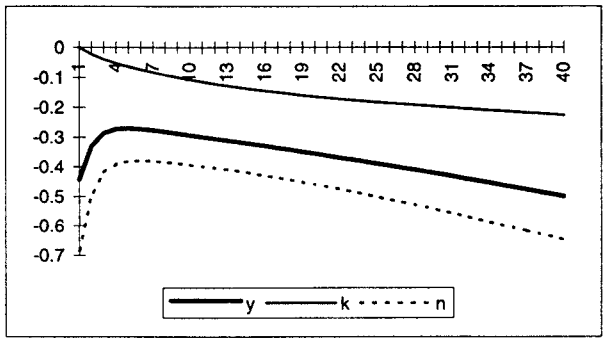
If the proportion of liquidity-constrained households is further increased, the dynamic properties of the model change and the solution path is no longer uniquely determined. Sunspots and self-fulfilling expectations allow a large diversity of outcomes in this case, so that a general conclusion can no longer be drawn.

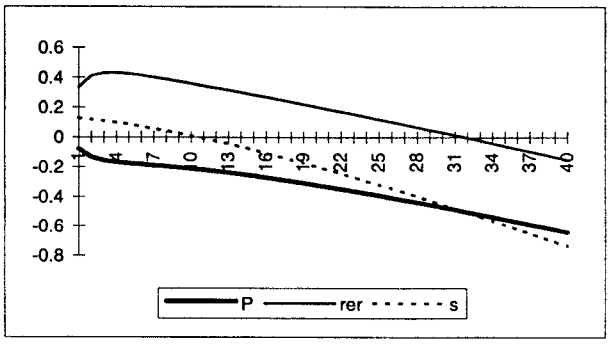
Figure 4

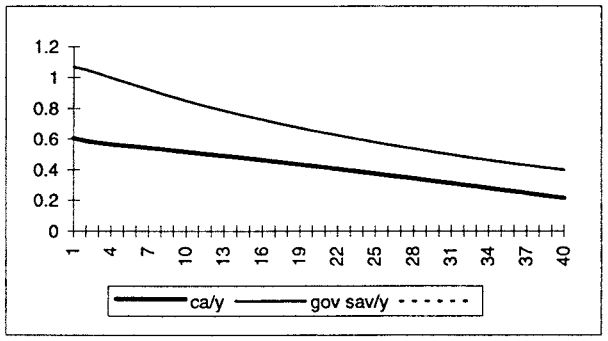
Impulse response of a transitory decrease in government consumption (1% GDP): scenario with a shorter expected life

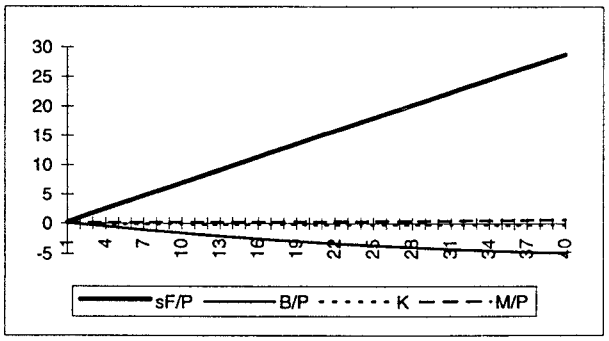


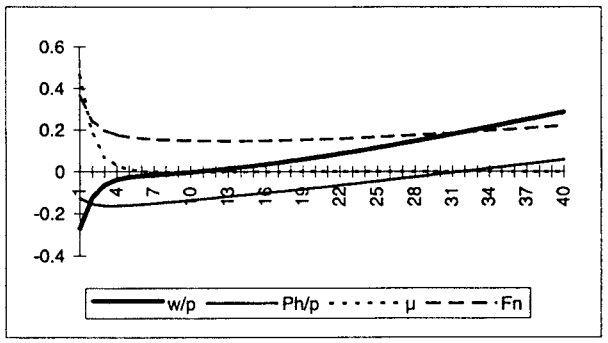


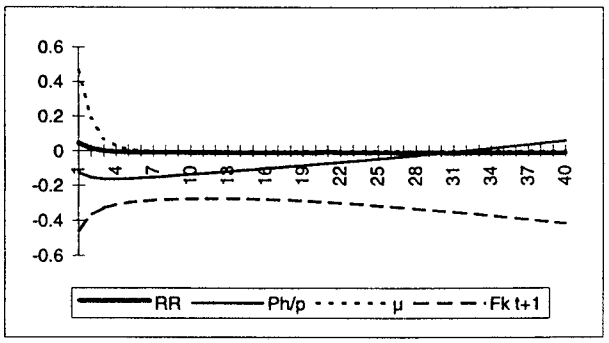








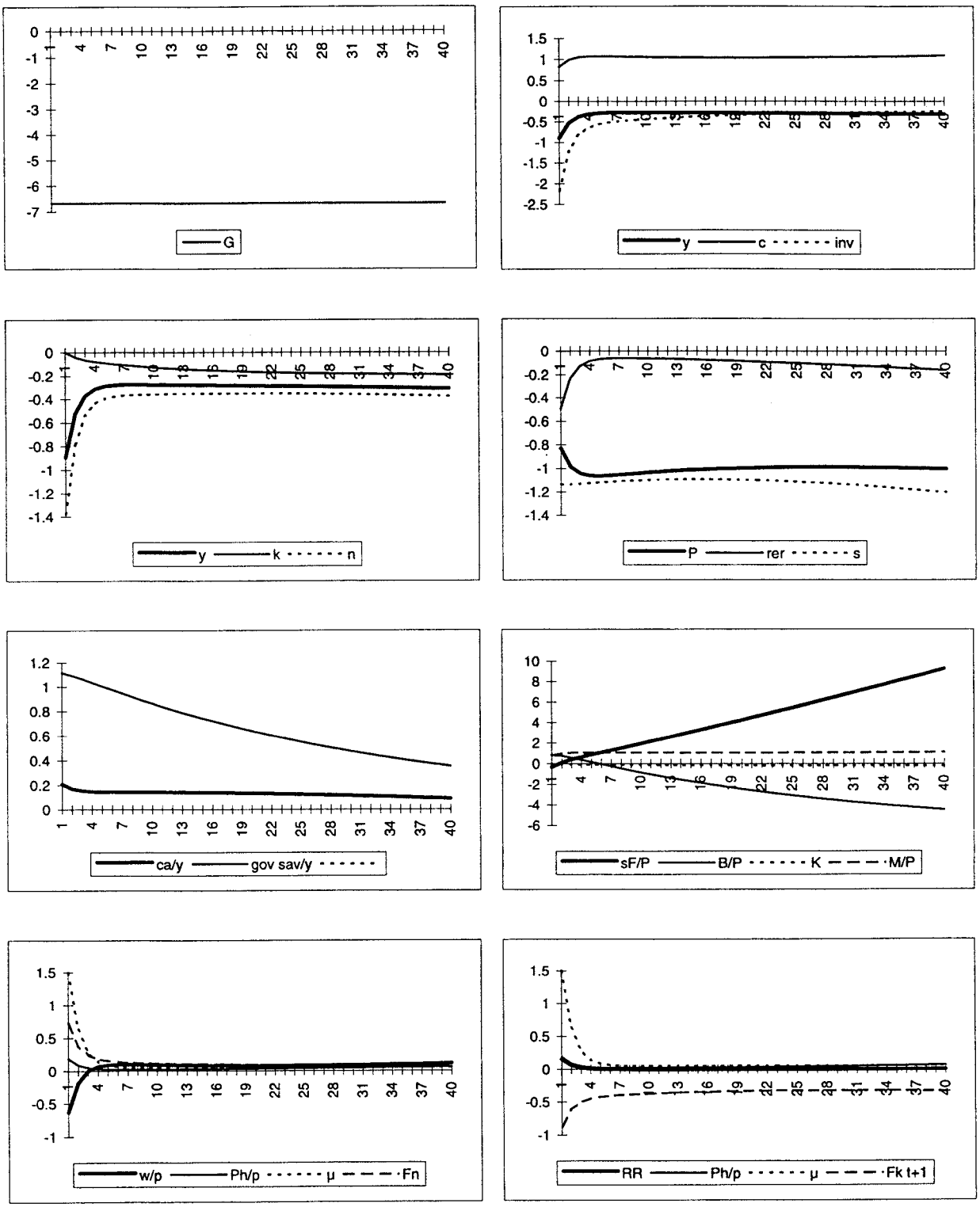




Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 5

Impulse response of a permanent decrease in government consumption (1% GDP): scenario with substitution between private and public consumption (θ = 0.5)



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

(d) Substitution between private and public consumption

As an alternative scenario, we consider the case where public consumption is a substitute for private consumption (Figure 5). This affects the model via two channels. Public consumption is added to the utility function together with private consumption (with a positive coefficient in the case of substitution) and the present value of future public consumption (with the same coefficient) is added to the disposable wealth of the households.

If the government reduces the supply of public goods, this will increase the private consumption demand in the case of substitution. But a decline in the supply of public goods also directly decreases the wealth constraint: the gain from lower future taxes is offset by the fall in the present value of future public goods. In the extreme case, where public goods are a perfect substitute for private consumption, there would be no impact on the model. With less-than-perfect substitution, private consumption will increase more than in the baseline simulation, and the output costs will be lower.

(e) Labour supply behaviour

With a utility function that is linear in leisure, aggregate labour supply becomes infinitely elastic (Hansen (1985)). In this scenario both private consumption and output turn out to be lower (Figure 6). Firms can adjust supply and employment more easily following the decline in aggregate demand. As there is no downward pressure on real wages from the decline in employment in this scenario, real wages increase more in line with the higher marginal productivity of labour. Both factors limit the real depreciation of the currency, so that exports further depress aggregate demand. The current account remains positive as import demand also decreases.

This result illustrates the importance of the supply-side reaction in determining the outcome of a fiscal adjustment programme, especially for an open economy. In our simple model of the labour market, this effect depends only on the elasticity of the supply of workers. In reality, this effect will be much more complex. A fiscal adjustment programme, by cutting public employment, reducing public sector wages and lowering social security payments, is likely to lower the reservation wage of workers. This effect reduces the bargaining power of labour unions in the wage negotiations. In such a context, a strict fiscal adjustment programme is likely to also create a positive supply shock. By lowering real wage costs and increasing profitability, firms will be stimulated to decrease prices and increase production, in particular by boosting exports. By decreasing the labour supply elasticity in our model, we can generate a similar effect. But further development of the labour market block is necessary to obtain a realistic representation of the supply-side behaviour and to analyse the impact of these complications on the rest of the model.

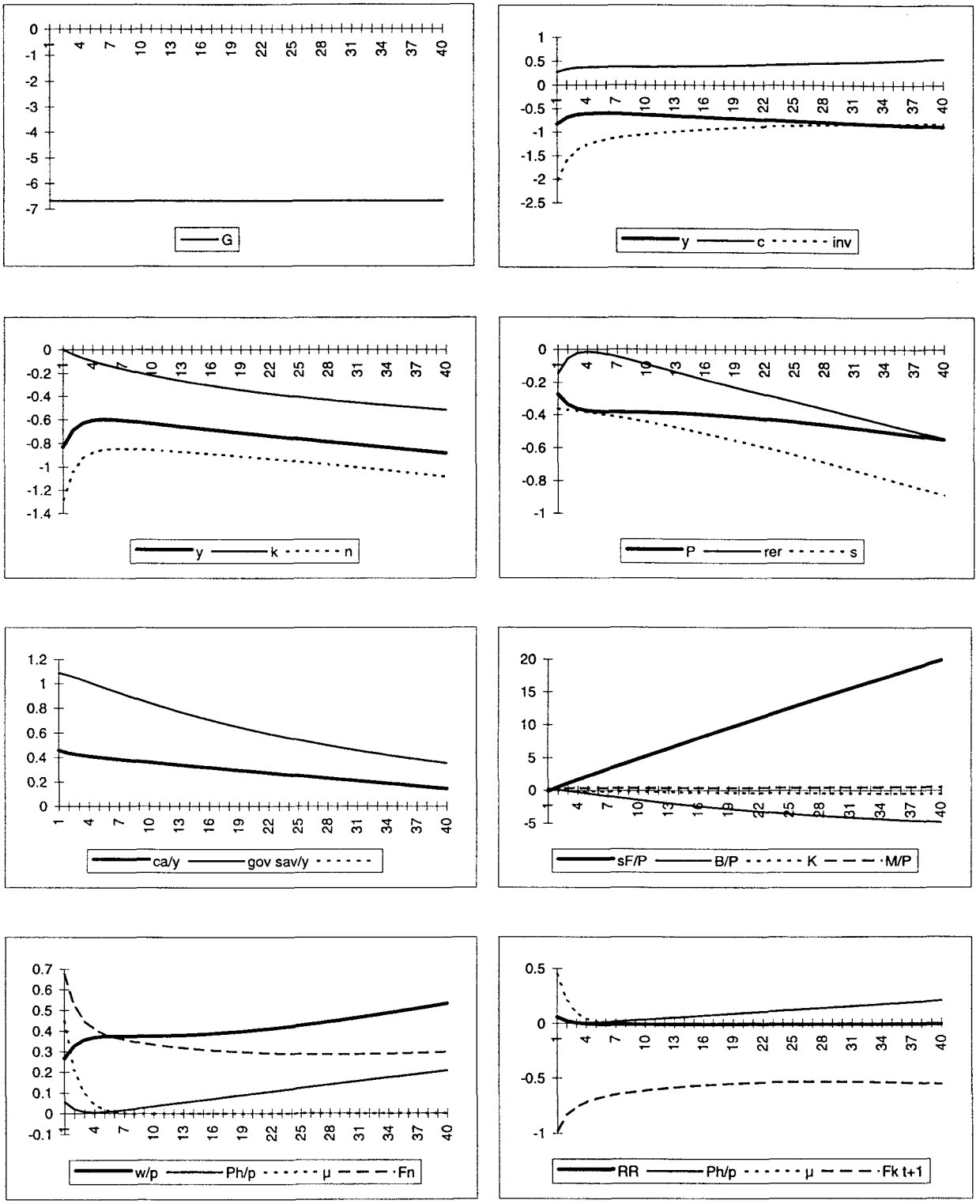
(f) Degree of price rigidity

The degree of price rigidity is the crucial variable in the determination of the short-run output costs of a negative demand shock. In Figure 7, we present the simulation results for the model where the adjustment speed of prices is decreased from 0.4 in the baseline to 0.1.

In this scenario, a negative demand shock results in higher and more persistent mark-ups. As firms pursue higher profit margins they limit employment, investment and output. Since prices do not follow the declining marginal costs, the real exchange rate will appreciate as the relative price decline of the domestic good is smaller than the nominal appreciation. Despite the fall in real wages, the competitive position worsens because firms are unwilling to pass on lower costs to output prices. So exports will also decline, further aggravating the decrease in aggregate demand. Once the price adjustment process is finished, the results converge to the same long-run effect as in the baseline simulation.

Figure 6

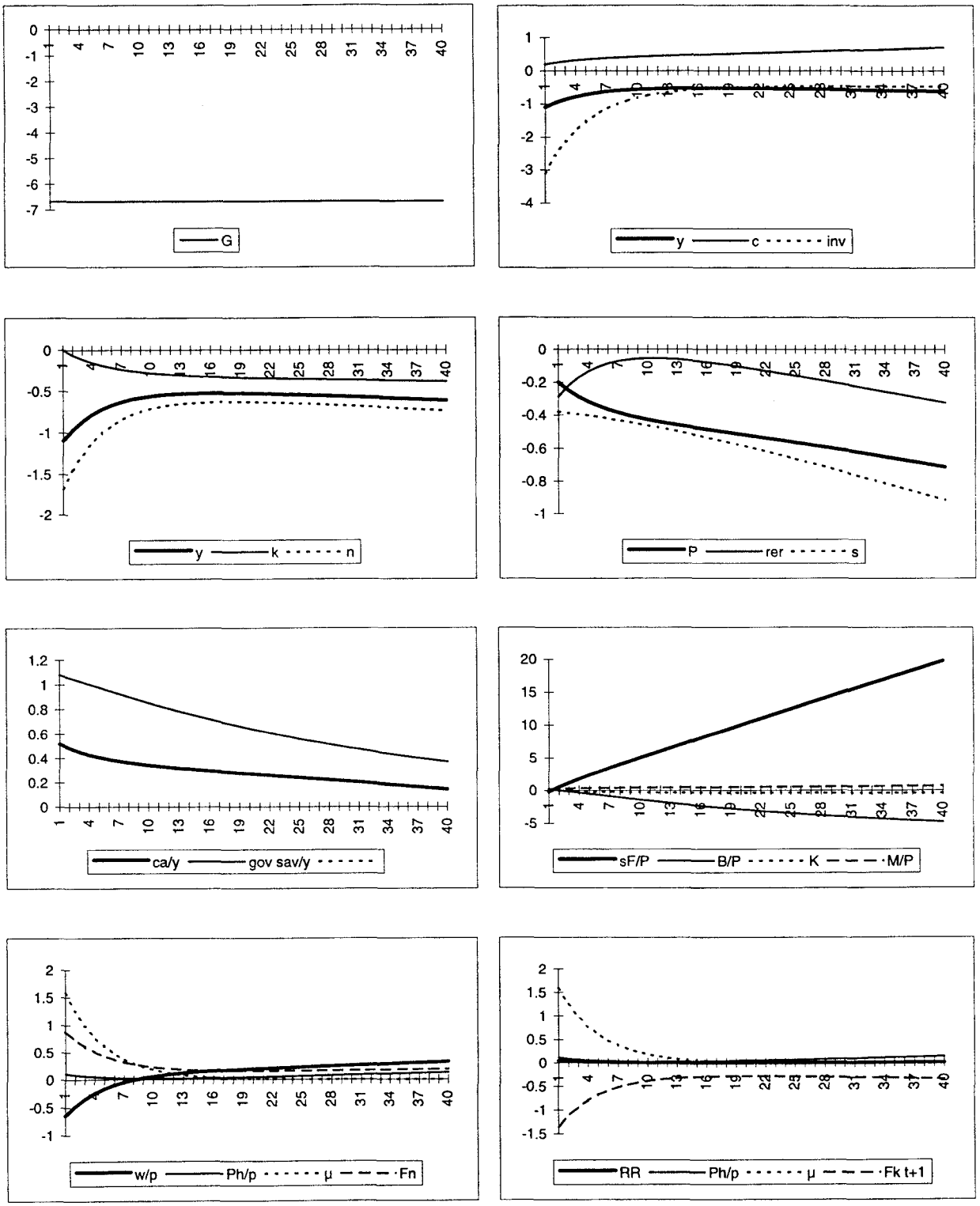
Impulse response of a permanent decrease in government consumption (1% GDP): scenario with infinite elastic labour supply



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 7

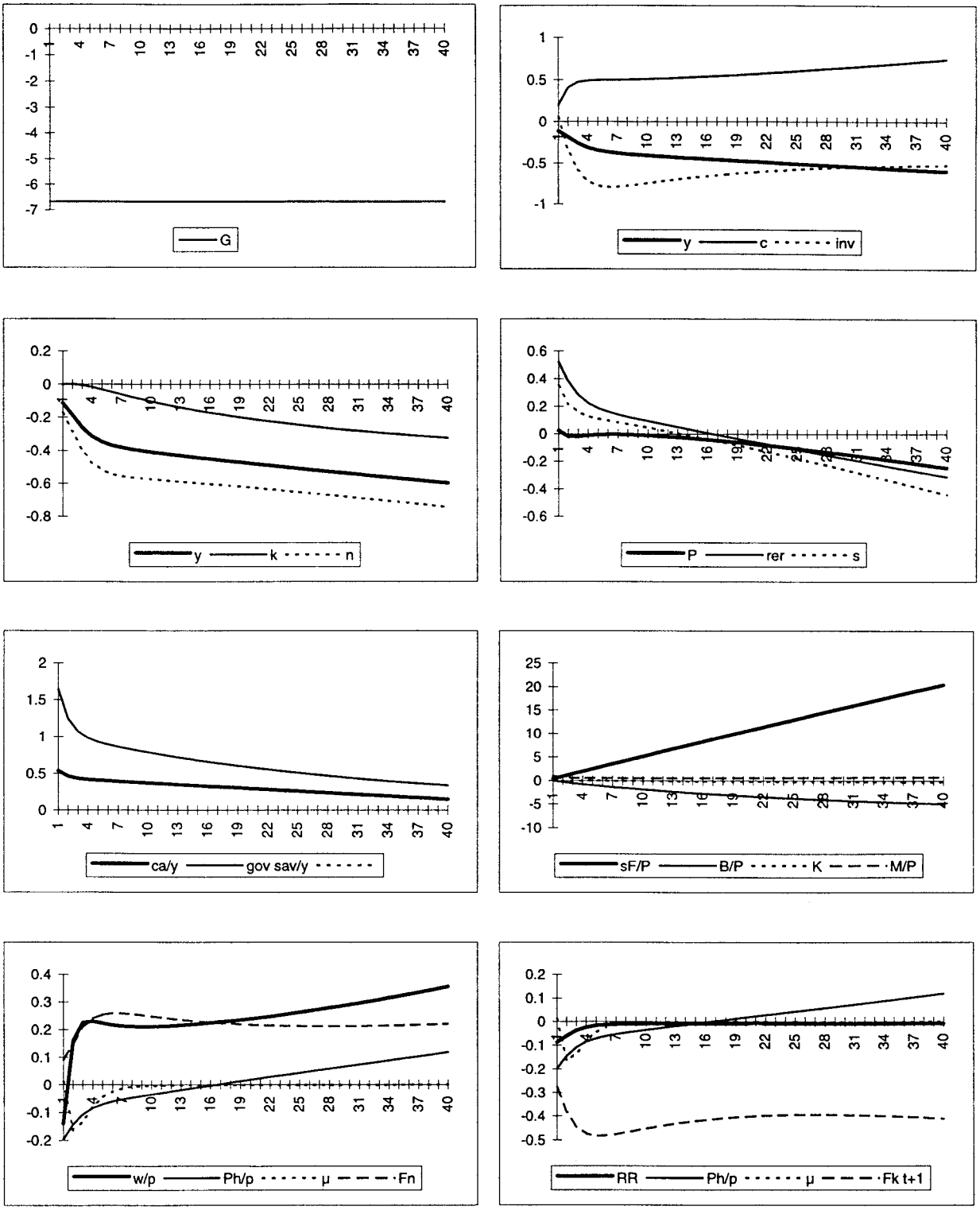
Impulse response of a permanent decrease in government consumption (1% GDP): scenario with higher price rigidity ($\zeta = 0.9$)



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 8

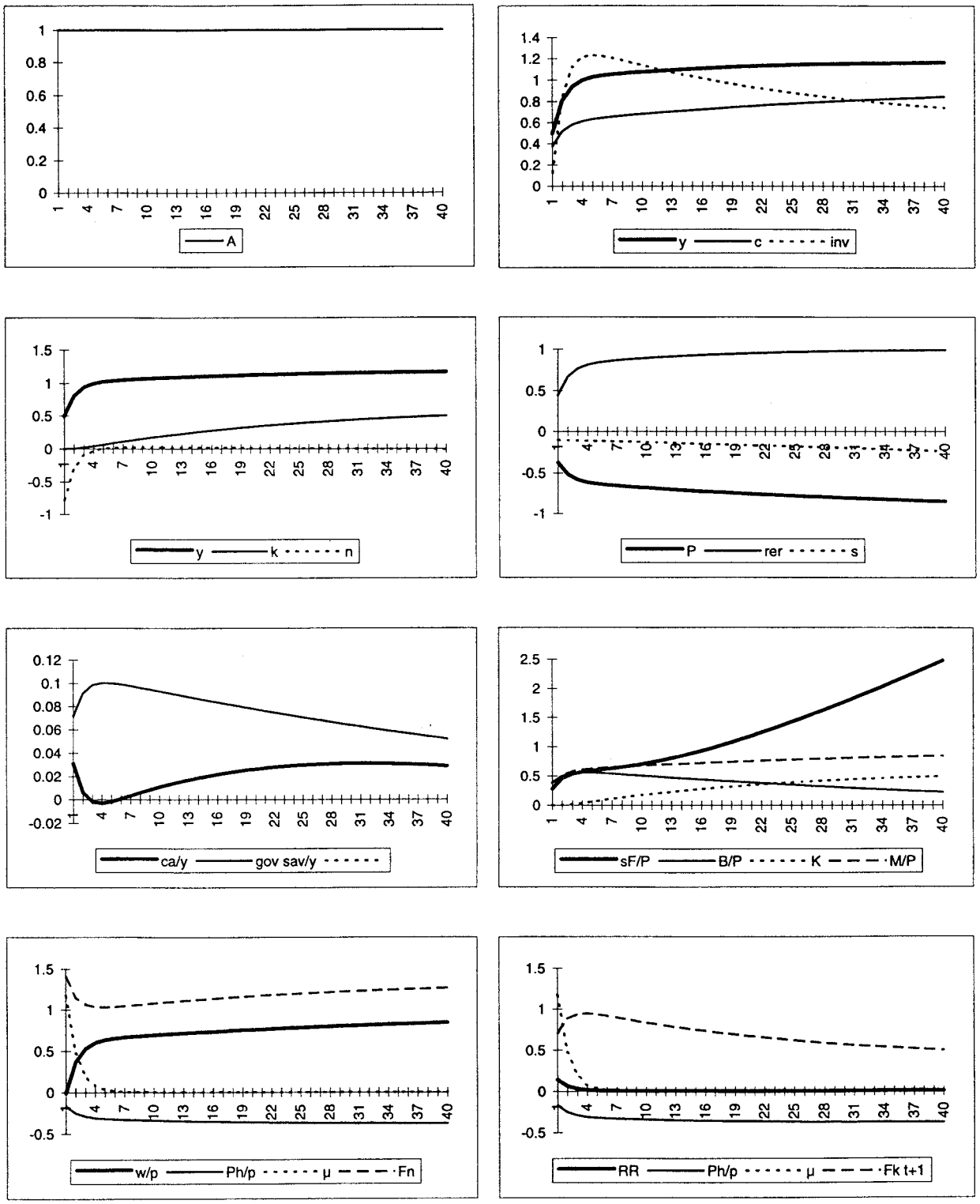
Impulse response of a permanent decrease in government consumption (1% GDP): expansive monetary policy to stabilise the price level



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 9

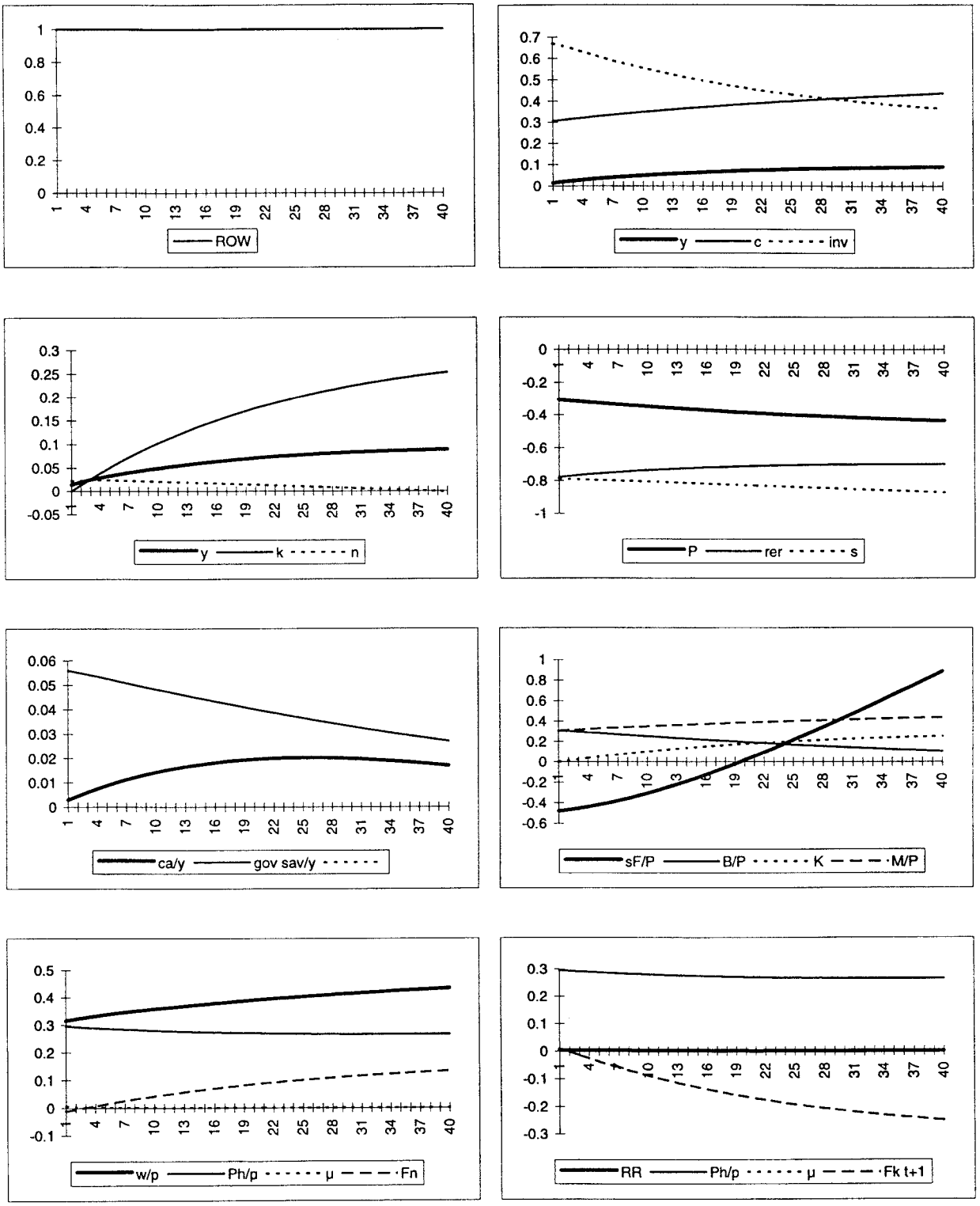
Impulse response of a permanent productivity shock



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

Figure 10

Impulse response of a permanent increase in foreign demand



Notes: Absolute deviations for the real interest rate *RR*, current account and government savings/GDP ratio; percentage deviations otherwise. An increase in the exchange rate (*s*) represents a depreciation. The real exchange rate (*rer*) is defined as *spf/ph*.

(g) Monetary policy behaviour

In the baseline simulation, a cut in public expenditure produces a decline in the price level and an appreciation of the nominal exchange rate. This result is obtained with a fixed nominal money supply rule. Under this behaviour, the real interest rate increases during the price adjustment process, which shows the rather restrictive character of the policy.

If monetary policy targeted a fixed nominal exchange rate or inflation, it would react more expansively. A combination of a restrictive fiscal policy and an expansionary monetary policy lowers significantly the short-run real output costs of a fiscal consolidation.

In Figure 8, the results of a spending cut are shown for the hypothesis that monetary policy tries to stabilise the price level, and will therefore react with a loose stance. A policy aimed at stabilising the nominal exchange rate should be somewhat less expansive, but the result goes in the same direction. The stabilisation of the price level is obtained through a depreciation of the nominal exchange rate, so that lower domestic output prices are offset by higher import prices.

Such a monetary policy reaction is able to neutralise a large portion of the short-run output costs. The real depreciation stimulates exports and the decrease in interest rates supports investment. As output prices or marginal costs are more stable, the mark-up also remains stable (or declines temporarily), so that one can also prevent negative supply reactions of firms. But these expansionary effects of monetary policy are short-lived, and after one or two years the economy is back on the same dynamic path.

Finally, in Figures 9 and 10 the impulse response to a productivity shock, as an example of a favourable supply shock, and an increase in demand in the rest of the world for the domestic good, as an example of a positive demand shock, are presented. These outcomes can serve as a benchmark for evaluating the effects of the SVAR estimation results in the next section.

4. Structural VAR estimation results

The SVAR approach is an appropriate technique for estimating the impulse response to public spending shocks. It allows us to identify the specific impact of government expenditure on economic growth, after correcting for other macroeconomic shocks. This separation of different shocks is important as many studies on the effects of consolidation report the problem of a number of different shocks occurring simultaneously. It is therefore crucial to isolate the specific role of public spending measures in the observed growth process.

In our exercise, we use a very simple model with three variables: GDP growth, inflation and growth in government expenditure. The structural identification restrictions determine three types of shock: supply shocks, demand shocks and public spending shocks. Small open economies depend heavily on developments elsewhere in the world; we therefore include foreign growth, inflation and short-term interest rates as exogenous variables in the model. The three structural shocks explain the remaining fluctuations of domestic origin. Of course, the reduction of the observed fluctuations to three shocks and three foreign variables is a strong simplification of reality, and the results of the exercise should therefore be analysed critically and considered as rough indications.

The model is estimated for three European countries: Belgium, Ireland and Denmark, using annual data over the period 1964-96.All data are taken from the EEC Annual Macro Economic Data Base. Real government expenditure is represented by the (national accounts) series for public consumption in constant prices. Inflation is measured by the log change in the GDP price deflator and growth by the change in the log of GDP at constant market prices. German GDP growth, inflation and three-month interest rates are used as exogenous variables.

Following the discussion of the theoretical model in the previous section (but which is also generally accepted in the SVAR literature), demand shocks, including monetary policy shocks,

are assumed to have no important effects on output in the long run. The long-run equilibrium output depends on foreign shocks, supply shocks and, as this is the central topic of the paper, possibly also on public spending shocks. As public spending directly affects the budget constraints of households, it is more likely to have long-run effects on output than demand shocks stemming from other sources. This theoretical restriction on the long-run outcome of demand shocks is combined with specific restrictions to distinguish public spending shocks from the other types of disturbance. Two variants were used. In one version, supply and demand shocks do not affect public spending during the period in which the shock occurs, that is, all "innovations" in public spending are considered as public spending shocks. In the second variant, we use long-run restrictions and assume that government spending in the long run depends only on policy decisions and is independent of supply or demand shocks. This second version is used to check the sensitivity of the results to the specific form of the restrictions used. But it also changes somewhat the interpretation of the results as it only looks for permanent changes in public spending. Transitory shocks are excluded and this may possibly change the impact on output and inflation.

The same exercise was performed using real exchange rate changes vis-à-vis the Deutsche mark (defined with the GDP deflator) instead of inflation. By comparing the results for inflation and the real exchange rate, one should get an indication of how the nominal exchange rate and monetary policy react to public spending shocks. If the real exchange rate moves by much less than inflation, this means that the nominal exchange rate movements were compensating for the relative price developments. So if spending cuts put downward pressure on the domestic price level and inflation, the real exchange rate should depreciate, unless the nominal exchange rate was appreciating strongly. Such an appreciation is most likely if monetary policy is independent from fiscal shocks, so that interest rates do not decline strongly following the fiscal adjustment and the fall in inflation. This monetary policy reaction should increase the real impact of spending shocks, and the negative pressure on prices will also be reinforced by the nominal appreciation. On the other hand, if monetary policy is rather expansive following a restrictive spending policy, the real exchange rate will depreciate more than the price level and fiscal policy will have smaller short-run multiplier effects on output, with less reaction in prices.

To ensure that the economic interpretations of the shocks make sense, the historical series of the three shocks are used as explanatory variables in simple autoregressive equations for a set of macroeconomic variables related to supply, demand and public finance conditions. These regressions should indicate whether the structural error series are indeed correlated with innovations in the macroeconomic variables they are supposed to summarise (Table 1).

In all three countries, the supply shock is significantly positively correlated with the innovations in total factor productivity and labour productivity. In Belgium, the supply shock is also significantly negatively correlated with the change in the tax burden as measured by income taxes and social security contributions as a proportion of total compensation of employees. In Denmark, a negative correlation with the trade balance is found, probably explained by a strong import content of investment.

The results for the demand shock are more diverse: in Belgium, it is significantly positively correlated with final demand (total and national), but also with the public deficit. This last effect can be interpreted as the result of stronger domestic demand, nominal growth and income. In Ireland, the demand shocks are correlated negatively with innovations in taxes, while for Denmark no significant relations are found. Government spending shocks are negatively correlated with public deficits in Ireland, but not in Denmark, where a strong correlation is found with taxes. In Denmark, government consumption is also positively correlated with productivity and final demand, but negatively with the trade balance.

So while the results for the supply and public spending shocks are acceptable, the demand shocks are less easy to identify. As demand shocks represent a diversity of disturbances that affect the economy in the short run, it is probably acceptable that a stable relation is not shown with any of the individual variables tested over the whole period.

Table 1

Marginal significance of the shock variables in autoregressive equations for a set of macroeconomic variables

	Belgium						**Ireland**						**Denmark**					
	Supply shock		**Demand shock**		**Public spending shock**		**Supply shock**		**Demand shock**		**Public spending shock**		**Supply shock**		**Demand shock**		**Public spending shock**	
GDP (*cte* prices)	0.78	[2.36]	0.82	[2.52]	-0.14	[-0.40]	1.89	[7.53]	0.31	[0.72]	0.96	[2.43]	1.09	[3.16]	0.14	[0.34]	0.79	[2.10]
GDP deflator	-0.50	[-1.92]	0.75	[3.19]	-0.13	[-0.47]	-1.20	[-1.92]	2.15	[4.03]	-0.31	[-0.46]	-0.40	[-1.67]	0.81	[4.04]	-0.19	[-0.74]
Real exchange rate	0.39	[0.66]	-0.33	[-0.53]	-0.10	[-0.16]	2.09	[2.21]	-2.09	[-2.24]	-0.41	[-42.00]	0.15	[0.27]	-1.10	[-2.26]	0.67	[1.33]
Public expenditures (*cte* prices)	0.00	[0.00]	0.00	[0.00]	1.16	[6.97]	0.00	[0.00]	0.00	[0.00]	2.06	[5.54]	0.00	[0.00]	0.00	[0.00]	1.33	[8.94]
Total factor productivity	0.65	[2.42]	0.53	[1.89]	-0.12	[-0.42]	1.41	[5.55]	0.42	[1.17]	0.59	[1.71]	0.79	[3.06]	-0.11	[-0.36]	0.58	[2.10]
Real compensation per person	0.95	[3.22]	-0.14	[-0.40]	-0.04	[-0.10]	0.68	[1.67]	-0.59	[-1.33]	0.50	[1.26]	0.11	[0.33]	-0.19	[-0.64]	0.45	[1.36]
Labour productivity	0.67	[2.55]	0.36	[1.27]	-0.16	[-0.54]	1.08	[4.06]	0.56	[1.74]	0.58	[1.82]	0.64	[2.36]	-0.07	[-0.24]	0.59	[2.15]
Tax burden on labour income	-14.00	[-3.40]	0.01	[0.02]	-0.02	[-0.36]	1.55	[0.04]	-42.90	[-1.38]	-0.33	[-1.00]	0.55	[1.03]	-0.22	[0.38]	1.09	[2.36]
National final demand (*cte* prices)	0.41	[1.28]	0.85	[2.89]	-0.05	[-0.14]	0.96	[1.71]	0.22	[0.38]	0.94	[1.71]	1.81	[3.63]	0.50	[0.84]	1.44	[2.67]
Exports (*cte* prices)	0.93	[1.14]	1.09	[1.32]	0.28	[0.33]	1.34	[1.87]	-0.78	[-1.01]	0.65	[0.78]	-0.54	[-1.09]	-0.25	[-0.49]	0.13	[0.25]
Tax receipts	-0.70	[-0.86]	0.50	[0.61]	1.39	[1.60]	-1.22	[-1.12]	-1.27	[-1.91]	-0.69	[-0.90]	1.03	[1.22]	-0.42	[-0.46]	1.78	[2.94]
Total receipts	-0.59	[-1.49]	0.42	[1.04]	0.21	[0.52]	-0.58	[-0.97]	-0.79	[-1.29]	-0.69	[-0.61]	0.55	[0.56]	-0.66	[-0.66]	2.11	[2.49]
Public transfers	-0.75	[-1.08]	-0.84	[-1.41]	0.39	[0.55]	0.05	[0.04]	0.08	[0.96]	1.81	[1.75]	-1.44	[-2.24]	0.44	[0.61]	0.00	[0.00]
Public deficit	0.12	[0.49]	0.58	[2.75]	-0.21	[-0.86]	-0.35	[-1.07]	-0.39	[-1.34]	-0.72	[-2.65]	0.64	[2.04]	-0.17	[-0.50]	0.21	[0.65]
Export/import ratio (*cte* prices)	0.56	[1.73]	-0.25	[-0.68]	0.09	[0.26]	0.34	[0.19]	1.19	[0.69]	1.55	[0.93]	-1.77	[-2.64]	0.07	[0.08]	-1.50	[-2.15]
Current account	0.07	[0.40]	-0.24	[-1.26]	0.19	[1.03]	-0.64	[-1.18]	0.38	[0.71]	-0.14	[-0.25]	-0.58	[-2.51]	-0.16	[-0.66]	-0.55	[-2.40]
Short-term interest rate	0.06	[0.15]	0.75	[1.91]	-0.24	[-0.63]	-0.18	[0.51]	0.08	[0.16]	0.41	[0.79]	-0.69	[-1.79]	0.21	[0.58]	0.13	[0.35]

Notes: The values represent the coefficient (b) and the t-statistic of the shock variable in the following equation: $\Delta x(t) = cte + a1 * \Delta x(t\text{-}1) + a2 * \Delta x(t\text{-}2) + b * Shock(t)$. Shocks of the model with the short-run restrictions for the identification of public spending shocks and with inflation as the dependent variable.

Table 2

Correlation of structural shocks identified with different models

Belgium				**Ireland**				**Denmark**			
Supply shock				Supply shock				Supply shock			
	(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)
(p, s)	0.99	0.68	0.66	(p, s)	0.90	0.64	0.62	(p, s)	0.99	0.87	0.84
(p, l)		0.61	0.61	(p, l)		0.56	0.68	(p, l)		0.86	0.85
(rer, s)			0.99	(rer, s)			0.95	(rer, s)			0.93
Demand shock				**Demand shock**				**Demand shock**			
	(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)
(p, s)	0.95	0.48	0.51	(p, s)	1.00	0.51	0.51	(p, s)	0.99	0.50	0.48
(p, l)		0.48	0.54	(p, l)		0.48	0.48	(p, l)		0.48	0.51
(rer, s)			0.99	(rer, s)			1.00	(rer, s)			0.91
Public spending shock				**Public spending shock**				**Public spending shock**			
	(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)		(p, l)	(rer, s)	(rer, l)
(p, s)	0.95	0.97	0.96	(p, s)	0.89	0.97	0.92	(p, s)	0.99	0.98	0.96
(p, l)		0.93	0.96	(p, l)		0.90	0.94	(p, l)		0.98	0.97
(rer, s)			0.99	(rer, s)			0.95	(rer, s)			0.98

Notes: (p, s) represents the model with short-term restriction to identify the public spending cuts, and with the inflation variable. (rer, s) represents the model with short-term restriction to identify the public spending cuts, and with the changes in the real exchange rate as dependent variable instead of inflation. (p, l) represents the model with long-term restriction to identify the public spending cuts, and with the inflation variable. (rer, l) represents the model with long-term restriction to identify the public spending cuts, and with the change in the real exchange rate.

The resulting series for the shocks of the different model specifications should be related to illustrate their independence from the identification restrictions and the variables selected (Table 2). The government spending shocks are always very strongly correlated in both the short and long-run restrictions, and in both versions with inflation or with changes in real exchange rates. Supply and demand shocks are independent from the identification of the public spending shock. They differ, however, if inflation is replaced by real exchange rate changes. But the series for the supply shock are still highly correlated and as the demand and monetary shocks have different effects on inflation and the change in the real exchange rate, the overall result is acceptable.

The impulse response graphs show the macroeconomic reactions to the three types of shock (Figure 11). The reaction of growth and inflation to public spending shocks is of particular interest in this paper.

For Belgium, spending cuts do not have a significant effect on growth, nor on inflation. Gradually the reponse becomes negative, but only the negative effect on the price level is important in the long run. The real exchange rate does not show any strong reaction. So the nominal exchange rate appreciation more or less follows the price decrease, but this process develops slowly over time.

In Ireland, there is a strong and significant (for the first year only) negative impact on GDP following spending cuts, implying a real impact multiplier greater than one. Prices, on the other hand, do not react on impact but gradually decrease afterwards. The real exchange rate depreciates less than prices, so that the nominal exchange rate appreciates slightly.

In Denmark, too, the effect on output is strong and significant, but that on prices is small. As the government spending shock is followed by further cuts, output reacts relatively less in the long run, with very strong price effects. The real exchange rate does not show any movement in the long run, implying a strong appreciation following price declines (the absence of a relaxation in policy can explain the strong real multiplier and the strong price declines in this case).

Together, these results show that fiscal shocks have insignificant effects on prices in the short run. In fact, in all three countries prices increase on impact, but not significantly so. Strong price rigidities can explain both the small price reaction and the strong output effects in the short run. In Belgium, the reduction in interest rate differentials with Germany, following fiscal policy adjustments (improving the Belgian fundamentals), may explain the small output effects. In the long run, output and prices are affected negatively in all three countries. So the negative demand effect is not offset by a strong private demand response, implying that horizons were less than infinite. The theoretical hypothesis of the negative wealth effect on the labour supply is not rejected by the results.

The evidence from the impulse response analysis should be complemented with the forecast error variance decomposition (Table 3). These results illustrate the importance of the public spending shocks in explaining growth and inflation on average over the estimation period. In Belgium, public spending shocks make almost no contribution to the variance decomposition of growth or inflation. In Ireland, spending shocks explain some 20% of the variance of growth but they are not important for inflation (with the long-run restriction to identify spending shocks, fiscal shocks become much more important for growth). In Denmark, spending shocks are even more important and explain more than 30% of the variance of growth, and they are the dominant source of disturbances in inflation in the long run.

For Belgium, Ireland and Denmark we also show the contribution of the different shocks to output growth over the period 1980-96 (Figure 12). This should indicate the relative role of the different shocks in explaining economic performance over this period, and especially during the fiscal adjustment programmes. With these results, we are able to describe the role of the public spending cuts during the adjustment process in the 1980s.

When the adjustment programme started in Ireland in 1987, output was very low because of unfavourable supply conditions during the first half of the 1980s. The tax increases during that period do not appear in the demand shocks, but probably worked through the negative supply shocks. The expenditure cuts that were undertaken in 1987-89 are very evident in the spending shocks. They

Figure 11a

Impulse response of the SVAR model with inflation and a short-run restriction for the identification of public expenditure shocks

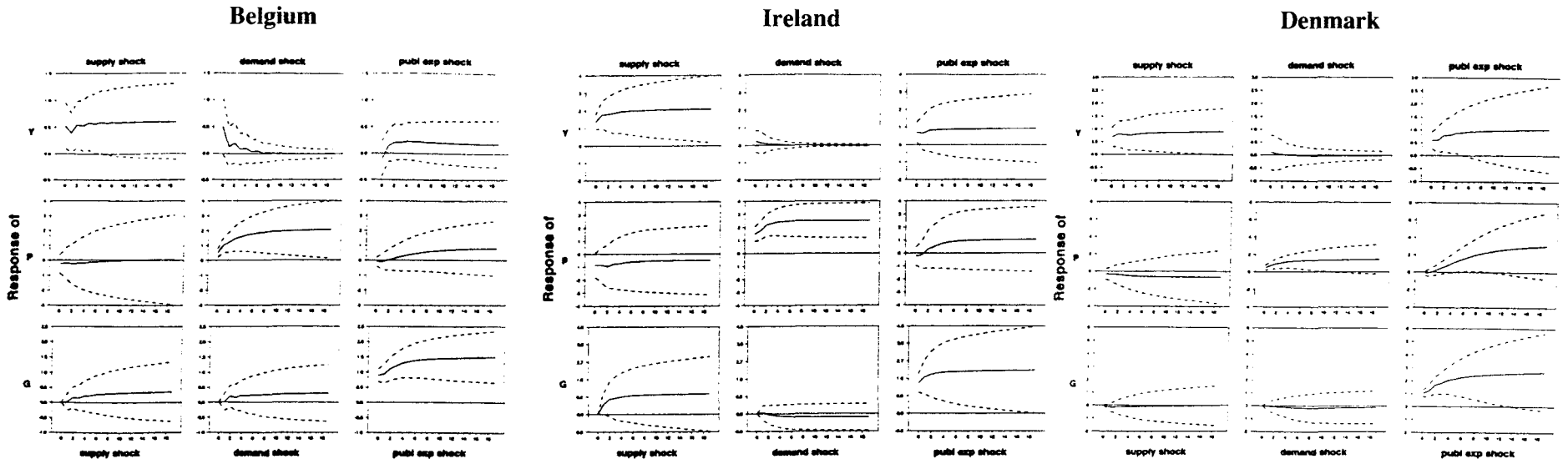


Figure 11b

Impulse response of the SVAR model with real exchange rate changes and a short-run restriction for the identification of public expenditure shocks

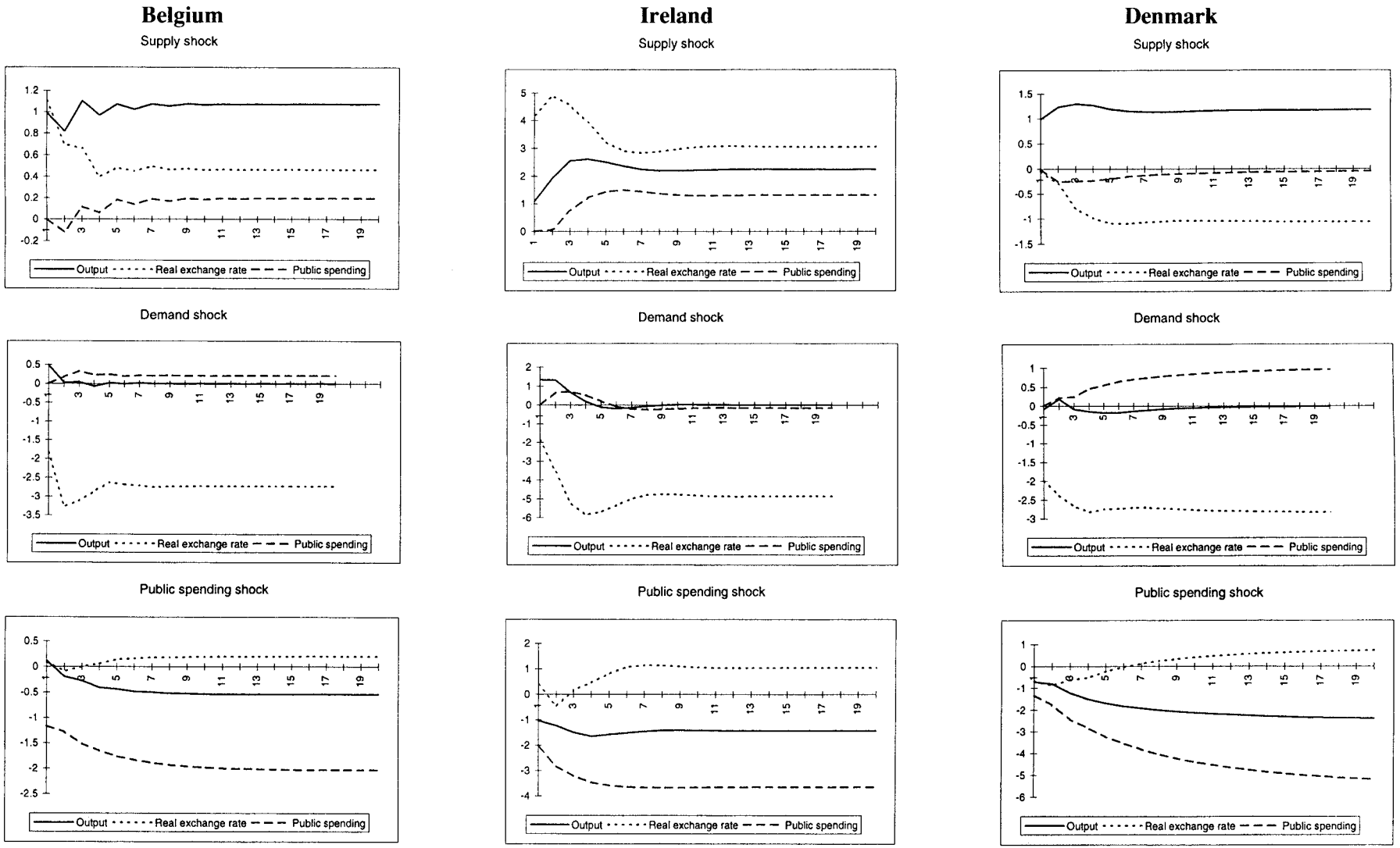
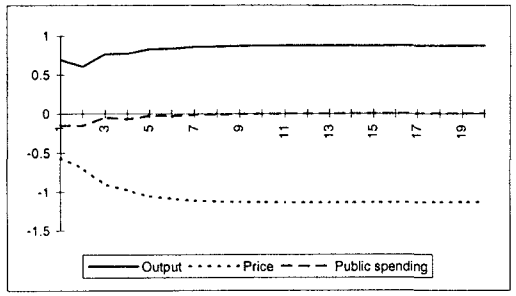


Figure 11c

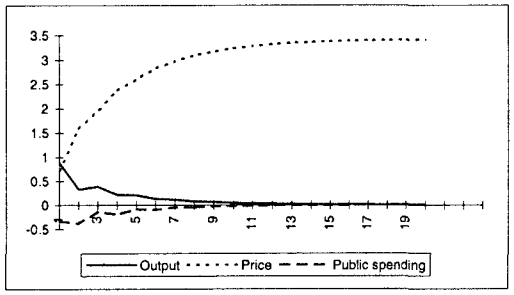
Impulse response of the SVAR model with inflation and a long-run restriction for the identification of public expenditure shocks

Belgium

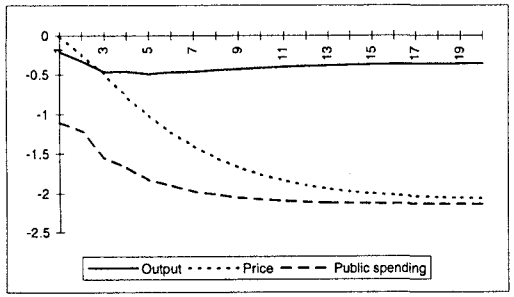
Supply shock



Demand shock

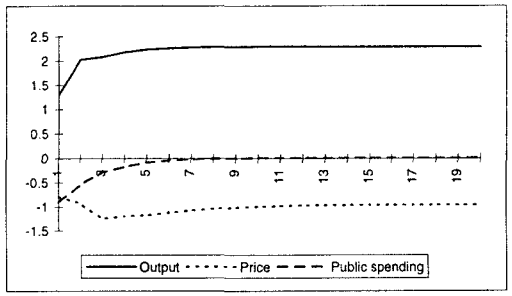


Public spending shock

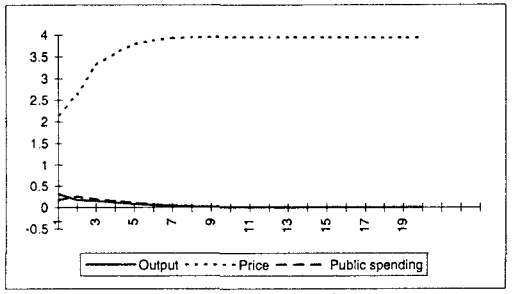


Ireland

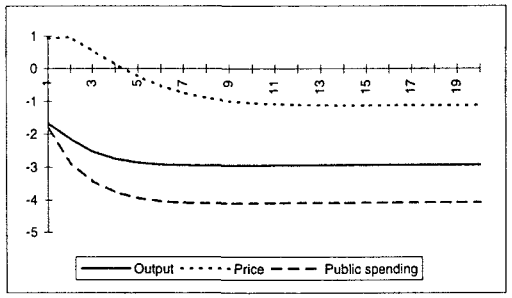
Supply shock



Demand shock

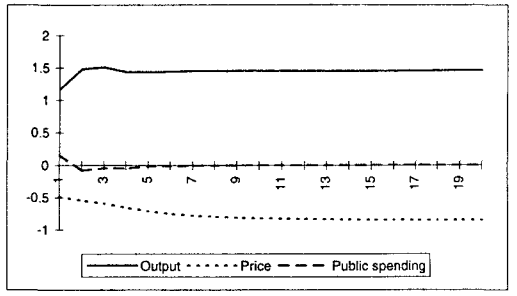


Public spending shock



Denmark

Supply shock



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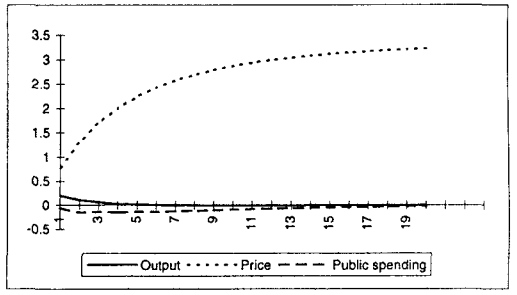


Public spending shock

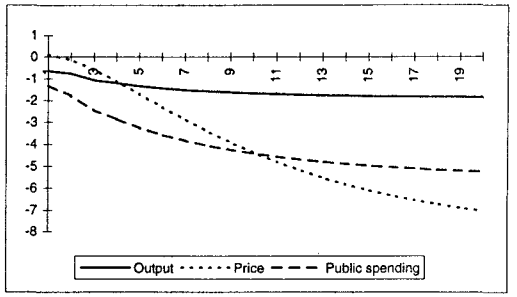
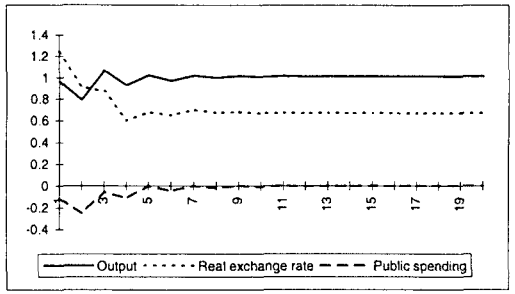


Figure 11d

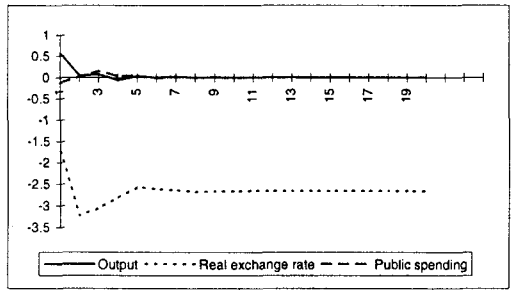
Impulse response of the SVAR model with real exchange rate changes and a long-run restriction for the identification of public expenditure shocks

Belgium

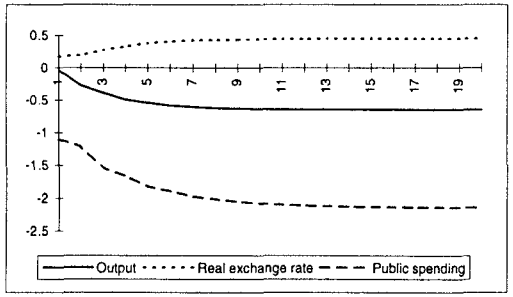
Supply shock



Demand shock

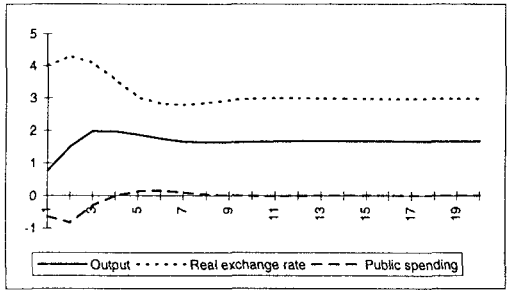


Public spending shock

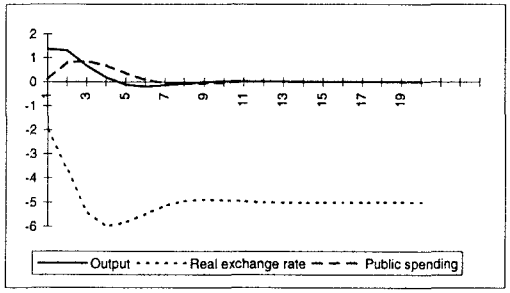


Ireland

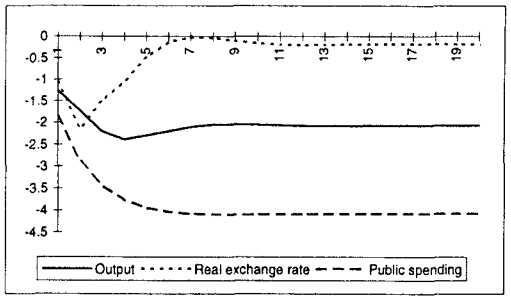
Supply shock



Demand shock

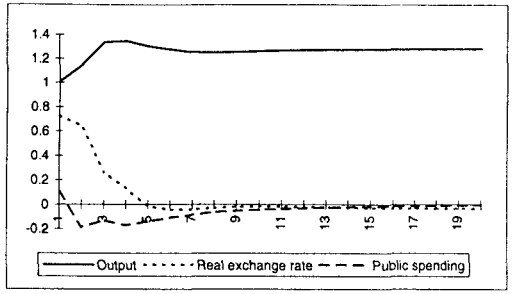


Public spending shock

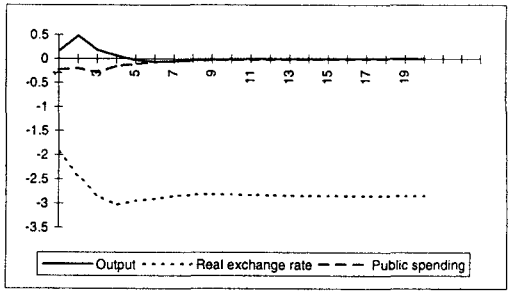


Denmark

Supply shock



Demand shock



Public spending shock

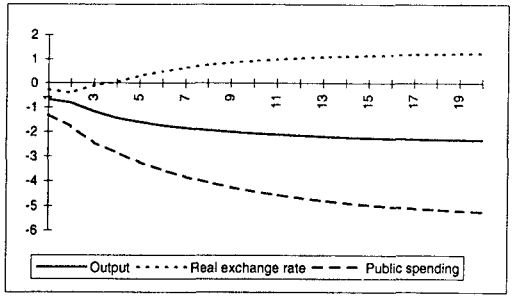


Table 3

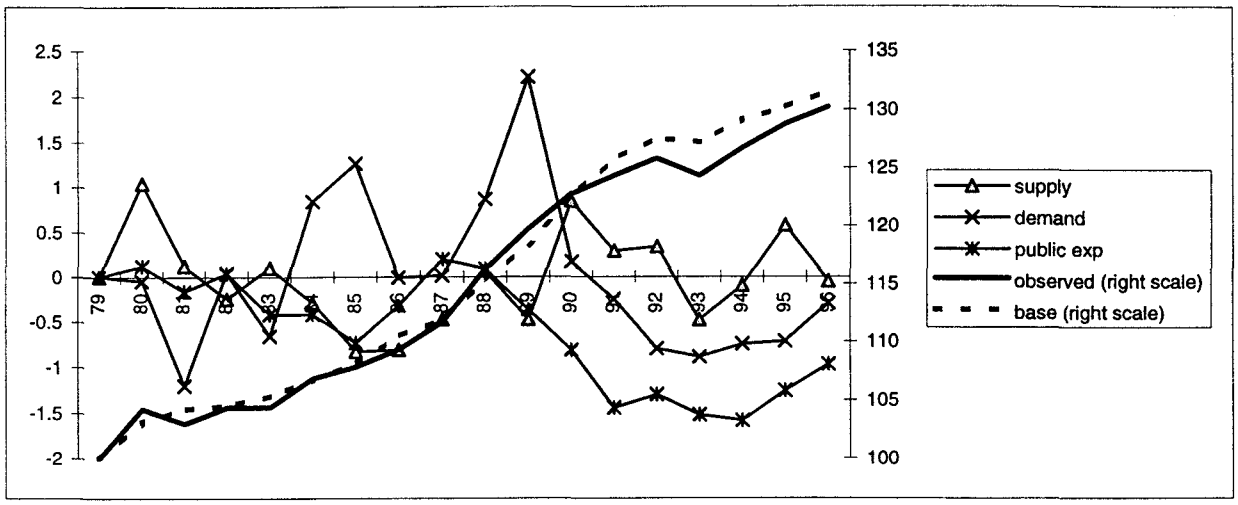
Variance decomposition of the forecast error: model with inflation and short-run restrictions

Belgium				Ireland				Denmark			
GDP growth				GDP growth				GDP growth			
Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.
1	46.58	51.82	1.59	1	77.93	2.07	20.00	1	65.11	1.05	33.84
2	37.85	55.86	6.29	2	80.69	2.02	17.29	2	65.49	1.59	32.92
3	38.74	54.65	6.61	3	79.41	1.99	18.61	3	62.42	1.56	36.02
4	38.07	55.33	6.60	4	79.16	2.01	18.83	4	62.18	1.57	36.24
5	38.18	55.20	6.62	5	79.10	2.02	18.88	5	61.53	1.56	36.91
6	38.04	55.37	6.60	6	79.08	2.03	18.88	6	61.32	1.55	37.13
7	38.04	55.36	6.59	7	79.08	2.04	18.88	7	61.11	1.55	37.34
8	38.00	55.41	6.59	8	79.08	2.04	18.88	8	61.01	1.54	37.44
9	37.99	55.41	6.59	9	79.08	2.04	18.88	9	60.94	1.54	37.52
10	37.98	55.42	6.60	10	79.08	2.04	18.88	10	60.89	1.54	37.57
Inflation				Inflation				Inflation			
Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.
1	29.69	68.33	1.98	1	23.54	74.93	1.53	1	18.96	77.01	4.03
2	14.93	84.07	1.00	2	23.03	75.43	1.54	2	13.67	80.16	6.17
3	14.17	83.75	2.08	3	20.88	73.23	5.89	3	10.77	73.53	15.70
4	12.49	84.47	3.04	4	20.85	71.62	7.53	4	9.19	64.93	25.88
5	11.87	84.12	4.01	5	20.73	70.31	8.95	5	8.08	57.04	34.89
6	11.40	83.82	4.78	6	20.87	69.50	9.62	6	7.25	50.87	41.88
7	11.17	83.48	5.35	7	20.96	69.08	9.96	7	6.63	46.17	47.20
8	11.02	83.22	5.75	8	21.02	68.88	10.10	8	6.17	42.66	51.17
9	10.94	83.04	6.02	9	21.05	68.79	10.16	9	5.83	40.03	54.14
10	10.89	82.91	6.20	10	21.07	68.76	10.18	10	5.58	38.06	56.36
Public expenditure				Public expenditure				Public expenditure			
Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.	Years	Supply	Demand	Public exp.
1	0.00	0.00	100.00	1	0.00	0.00	100.00	1	0.00	0.00	100.00
2	0.01	0.00	99.99	2	11.10	0.05	88.84	2	4.30	0.09	95.61
3	1.93	6.25	91.82	3	14.28	0.16	85.56	3	3.58	0.18	96.24
4	1.92	6.19	91.89	4	15.01	0.19	84.80	4	3.46	0.18	96.36
5	2.24	7.24	90.52	5	15.32	0.23	84.45	5	3.26	0.21	96.54
6	2.23	7.22	90.54	6	15.40	0.25	84.35	6	3.19	0.22	96.59
7	2.29	7.43	90.28	7	15.42	0.27	84.31	7	3.13	0.24	96.63
8	2.29	7.43	90.28	8	15.43	0.27	84.30	8	3.10	0.25	96.65
9	2.30	7.47	90.22	9	15.43	0.27	84.30	9	3.07	0.26	96.67
10	2.30	7.48	90.22	10	15.43	0.27	84.30	10	3.05	0.28	96.67

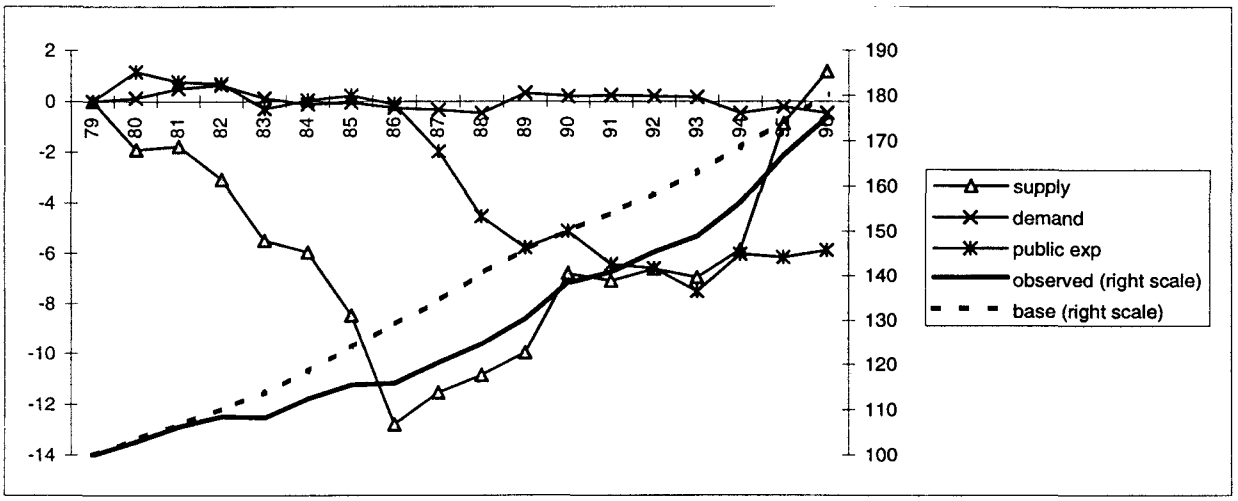
Figure 12

GDP evolution over the period 1980–96:
contribution of the three shocks in the explanation of gap to observed – base

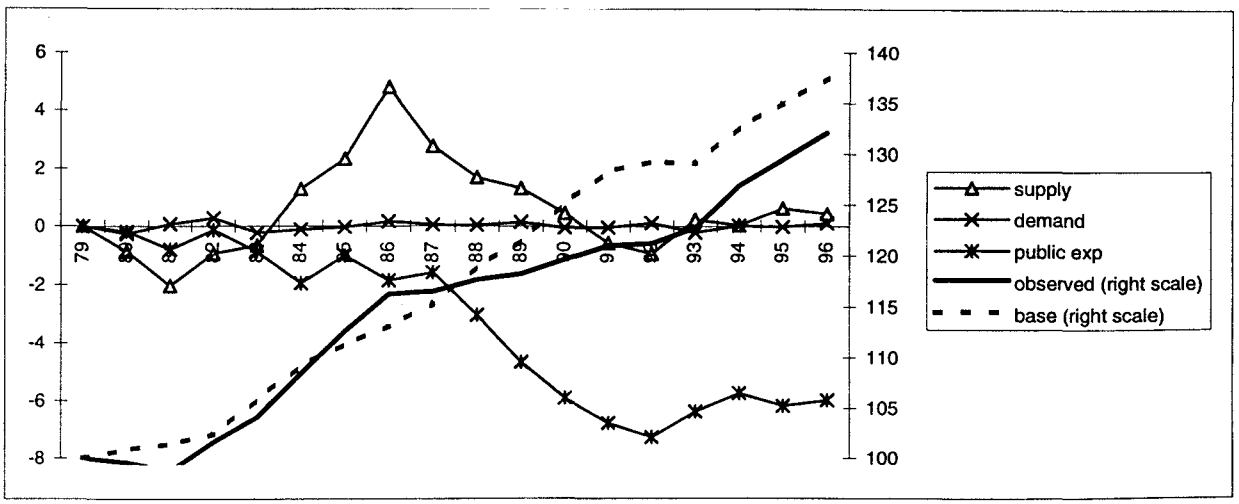
Belgium



Ireland



Denmark



had a very strong negative effect on economic growth, and that effect remained present until the end of our estimation period (1996). In the model with inflation, the negative influence of public spending cuts is neutralised by major positive supply shocks that not only compensated for the negative influence of public spending but also allowed the gap that was built up at the beginning of the 1980s to be closed. However, in the model with the real exchange rate, there were major positive demand shocks from 1986 to 1990. Supply shocks only occurred in the 1990s. These results therefore point to the importance of the Irish depreciation in 1986 in offsetting the negative public spending cuts. These results contradict the hypothesis of Giavazzi and Pagano, in which it was positive domestic private demand shocks, following the positive wealth effect, that were responsible for the overall positive outcome of the stabilisation programme. Our results are in accordance with the remarks of Barry and Devereux, who claim that the Irish success was due to shocks other than those in public expenditure.

Denmark experienced substantial spending cuts in the periods 1983-84 and 1988-91. During the first period, the shocks were offset by positive supply innovations. During the second, there were no offsetting shocks and growth remained below its normal growth path. The fiscal shocks contributed to the good inflation record in Denmark.

In Belgium, public spending shocks occurred in 1982 and in 1987-90, according to the model. The negative influence on GDP was relatively small. The impact on inflation was greater and, as in the Danish case, it contributed to the good performance in terms of inflation in the 1990s.

Conclusion

General equilibrium models offer a suitable framework for analysing the impact of fiscal consolidation programmes for small open economies. Different arguments that are encountered in the literature and in empirical macroeconomic model simulations can be reproduced with these theoretical coherent models. Simulation exercises allow us to indicate more precisely the specific assumptions behind some results such as the "expansionary fiscal contraction". These exercises also reveal the importance of supply conditions, monetary policy reactions and exchange rate behaviour in determining the outcome of fiscal shocks, especially in the context of small open economies with price rigidity in the short run.

Although the empirical significance of the SVAR results is low, there is some evidence that government expenditure cuts had short-term negative demand effects on output in countries such as Belgium, Denmark and Ireland. This result contradicts the hypothesis of large positive wealth effects following the fiscal contractions in these countries. Our decomposition provides some support for the hypothesis that simultaneously there were positive supply shocks at work that offset the negative demand effects and were responsible for the overall positive growth effects.

Further research should be oriented towards a better integration of the theoretical model and the empirical evidence. Therefore, a fully calibrated general equilibrium model is needed. Within the theoretical model one should pay more attention to a realistic representation of the labour market and the monetary policy reaction function, as the interaction between public spending shocks and these behavioural functions is crucial for the outcome of the shocks. Especially in the context of small open economies, examination of these channels would seem to be more important than the further elaboration of specific wealth effects following fiscal consolidations.

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