PRESSURES ON THE STABILITY AND GROWTH PACT FROM ASYMMETRY IN POLICY

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Abstract

This paper focuses upon various economic concerns with the SGP: problems of distinguishing structural and cyclical fluctuations, whether the current constraints are too tight for fluctuations, whether the measurement system is well thought-out, whether the structural aims are consistent. Our conclusions are that the problems with the SGP and indeed with macro-policy more generally are more political than economic. The asymmetry of governmental behaviour in the member states in response to shocks means that they tend to develop their fiscal stance in a way that is inconsistent with a long run sustainable balance and debt ratio. This can be interpreted as saying either that they are persistently too optimistic about growth and hence this gives them pressure on the deficit limit which they then blame on cyclical causes or that it is politically easier to cut taxes and increase expenditures than there it is to increase taxes and cut expenditure, so the incentive is always to go for the former rather than the latter under uncertainty (hence the bias towards optimism). The recent proposals by the Commission partly address this problem by allowing member states that do not have problems with the sustainability of their debt position to have more flexibility in responding to adverse shocks.

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1 Introduction

It is clear that the behaviour of the euro economy is asymmetric, not just in the obvious sense that the component countries are subject to different shocks and respond differently to shocks, but in the sense that all the economies respond differently to 'upward' and 'downward' pressures. More importantly in present context, it is not just the economies that respond asymmetrically but also policy. In Mayes and Virén (2003) we show that monetary policy in the euro area appears to have been somewhat asymmetric since the ERM crisis in 1992. In Mayes and Virén (2002*b*) we show that fiscal policy has also been asymmetric (both over a longer period and in more countries). One of the main criticisms of the Stability and Growth Pact (SGP) has been that it too is asymmetric, with concerns over excess deficit and debt ratios without matching concerns over surpluses or 'low' debts. The main purpose of the present paper is to explore the inter-relationship between the observed asymmetries on behaviour and policy and ask whether the asymmetry in the SGP is an appropriate response or merely a further distortion to symmetric behaviour.

One of the best known 'biases' in macro-economic policy is that governments (and indeed the voters who support them) have a tendency to wish to achieve higher real growth rates than are actually attainable. As a result this can impart an 'inflation bias' to the setting of policy. There is also a well-developed arm of the literature relating to the political business cycle, which explores the extent to which governments may try to get electoral advantage from exploiting to the fact that in the short run extra growth can be observed before the inflationary consequences of any excess become apparent. As soon as people believe that governments may succumb to these temptations, then this belief will be built into their expectations of inflation and the costs of monetary policy to achieve price stability will be greater. Modern governance structures recognise this problem and governments have put in place regimes that assign central banks the objective of achieving society's objective of price stability and provide a framework where they cannot easily overturn that objective in the short run when opportunities for engineering a political cycle or exercising undue optimism occur.[1] In Europe, this approach is embodied in the legal framework for the European Central Bank and similar arrangements exist in other non-euro area members, not just the UK, Sweden and Den-

[1] Rogoff (1985) is a clear early exposition of these concerns and a route to their possible solution. This is a fairly simple example of the problem of 'time consistency'. If you can persuade people that you will not renege then when the opportunity to renege appears, it is worth taking. Everybody can work that out in advance so it becomes impossible to make a credible precommitment not to renege.

mark within the EU but also in other EEA members such as Norway and Iceland and in the ten new members that will join the EU in 2004.[2]

The same sorts of ideas can be applied directly to fiscal policy, as in New Zealand's 1994 Fiscal Responsibility Act. This requires that public accounting be sufficiently transparent that government's can plausibly show that their fiscal policy is prudent in the long run and that the short-run path is consistent with achieving that long-run prudence. This long-run prudence can be thought of as requirement for solvency or the ability to demonstrate that future tax revenues are likely to be sufficient to meet future expenditure requirements including any existing debt.[3] The drawback to all of this is that it is highly dependent on a set of assumptions about the future that are not verifiable at the time they are made. Even setting aside the fact that governments cannot fully bind their successors even though they may be able to constrain them for a number of years, the prudence of current settings depends upon assumptions about sustainable economic growth rates, population structures and possible shocks from natural or human-induced disasters. There is only so far that it is possible to go in setting the constraints on what is plausible. Financial markets will give their opinion in the pricing of sovereign debt, as will rating agencies and the IMF. This market approach to measuring the prudence of the current setting of fiscal policy and the framework in which the decisions are embedded gives one of the clearer assessments. It is obscured in the current euro area framework. The pricing of individual member state debt reflects the default risk of the area as a whole and not just that of the particular state.

It is not very clear how far countries can go in setting governance structures for fiscal policy that impose ex ante plausible constraints in the way they have for monetary policy. One such route is to try to set up some technical assessment exercise akin to the technical nature of the setting of policy. The Johansson Commission (2002) in Sweden suggested that it would be possible to do this for the contentious issue of establishing the plausible longer-term growth rate and the degree to which the economy was currently deviating from it. This would cover one of the trickiest aspects over overcoming the innate optimism that people have. This optimism takes the form of hoping that when growth rates pick up, this is a sign that the underlying sustainable rate has risen but that when current growth falls this is merely a short-run deviation from the previous sustainable trend. The behaviour of the US stock market and to some extent the policy reaction to the period from 1996 to the present day illustrates the pervasiveness of this understandable outcome. Shiller (2000) explains at considerable length how such 'irrational exuberance' can emerge even though we all recognise the problem in advance and after the event.

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[2] Although in this last case some of the mechanisms are not as yet fully implemented and central bank independence may lack some credibility.

[3] New Zealand does this by insisting that the public sector's net worth most not be negative but this is not the only possible criterion for prudence.

Current European governance structures for fiscal policy also recognise the problem and offer some approach to a solution. The rules of the SGP both offer no opportunity to try to relitigate the plausible growth rate in good times, short of renegotiating the pact as a whole, and, through the Commission, offer a technical and independent assessment of how well the current fiscal stance compares with simple rules on prudence. There are various well-known drawbacks to this simplicity. Clearly focusing more directly on sustainable growth and the assessment of the current position relative to it might help but our interest here is specifically on the asymmetry of the system. We focus on two, which are related.

- The SGP imposes penalties and constraints on excessive deficits and seeks to reduce excess debt. It does not offer matching 'rewards' for very prudent behaviour nor does it consider whether fiscal policy that is in surplus may also be destabilising.
- The second and related point is that it does not differentiate in assessing excessive deficits between member states according to whether they already have problems over sustainable debt positions.

In having this focus we leave many core issues untouched. We do not explore how much independence the member states should have in the setting of fiscal policy. Nor do we consider whether there should be limits on tax competition or the degree of redistribution within the economy. Nor do we consider whether greater fiscal federalism might help, although we have elsewhere (Mayes and Virén, 2002*b*) suggested that this may well be chosen in future. The discussions are inter-related and our conclusions would need to be reappraised in the light of changes to the current regime in those other respects.

In the coming sections we therefore begin by explaining how we define asymmetry in the present context before going on to set out some of the main asymmetries in the economy as they affect macroeconomic policy and finally exploring how the asymmetries in macroeconomic policy themselves are reflected in the constraints and features of the SGP. Previewing our conclusions will help in motivating the particular shape of the analysis. We argue that the asymmetry in the pact is probably appropriate in that it provides a counter-balance to the asymmetry both in the process of economic development and in policy preferences. However, we also suggest that the system does not discriminate well enough between the member states that are running sustainable fiscal policies from those that face rather greater difficulties. While some refinement of the SGP might help in that regard we also suggest that some of the solution can lie outside the pact and in permitting rather more market pressure in the pricing of the debt from the various member states, as is the case in the US.

2 The nature of asymmetry

Before we go any further we need to sort out what is meant by asymmetry, as there is no commonly accepted definition. Sorting out nonlinearity is a simpler task as we take it here to refer to relationships that are curvilinear or have different parameter values over different ranges, rather than exhibiting discontinuities or chaotic behaviour.

In the context of European integration the most common use of the word 'asymmetric' merely means 'different'. The simplest example comes in the concept of asymmetric shocks, which are just shocks that affect one part of the economy rather than another. Secondly, asymmetry is commonly used to refer to relationships where there are omitted variables or even omitted secondary equations. We show in the next Section that there is one source of 'asymmetry' in this sense in the Okun curve. Namely that the dispersion of unemployment rates across the euro area affects the impact that the rate of economic growth has on unemployment rates. Similarly, Gaiotti and Generale (2001) and Loupias *et al.* (2001) in showing that there is a credit channel for monetary policy describe this additional feature as 'asymmetry' in the monetary transmission mechanism.

In the present paper we normally use the concept of asymmetry in a much more direct sense - that relationships are not symmetric in the sense of having the same coefficients either side of given value. Thus a relationship

$$x = a_0 + a_1 y + e \qquad (1)$$

is not symmetric if $a_1 \neq a_2$ in

$$x = a_0 + a_1 y^+ + a_2 y^- + e \qquad (2)$$

where $y^- = y$ when $y < y^T$ (= 0 elsewhere) and $y^+ = y$ when $y \geq y^T$ (= 0 elsewhere). y^T is a 'threshold' value (Granger and Teräsvirta, 1993; Tong, 1993). A simple example would be the Phillips curve, where inflation responds differently depending upon whether the output gap is positive or negative. We can easily respecify x and y in first difference form (or first difference of logarithms) and show that for example the impact of changes in GDP on unemployment depend on whether the economy is growing or contracting.[4]

We have deliberately made this asymmetry very simple but one could argue that while the cointegrating relationship is symmetric the error correction mechanism could be asymmetric (Harris and Silverstone, 1999; Huang *et al.,* 2001). Thus if $\hat{a}_0$ and $\hat{a}_1$ are the estimated values of a_0 and a_1 and $\hat{e}$ the computed error, then the error correction process will be asymmetric if in

$$\Delta x = c_0 + c_1 \Delta y + a_2 \hat{e}^+_{-1} + a_3 \hat{e}^-_{-1} + e \qquad (3)$$

[4] In a very recent paper Corrado and Holly (2003) try to estimate a general hyperbolic functional form for the Phillips curve. In practice, they end up by estimating two thresholds. Their results for the UK and the US suggest that the Phillips curve is steeper for larger positive output gaps than it is for larger negative gaps, while in the middle, for small positive and negative gaps, the curve is fairly flat.

where $\hat{e}^{-} = \hat{e}$ when $\hat{e} < \hat{e}^{T}$ and $\hat{e}^{+} = \hat{e}$ when $\hat{e} \geq \hat{e}^{T}$ (= 0 elsewhere). $\hat{e}^{T}$ is a 'threshold' value.[5]

Furthermore, one could assume that the distributions of errors or shocks are not symmetric, as is the case in frontier models (Mayes *et al.* 1994). All of the above would constitute examples of asymmetry in the more restricted sense that we use it.

Much of the traditional treatment of asymmetry (Keynes, 1936; Diebold and Rudebusch, 1999) is concerned with the shape of the business cycle. Three characteristics of asymmetry in shape can be identified: *deepness* – do recessions tend to be deeper than booms are high (compared to some trend or sustainable growth path); *length* – do expansions tend to last longer than recessions and *steepness* – does the decline occur more rapidly than the recovery.[6] This asymmetry in outcome will tend to be a product of the asymmetries in relationships and shocks that we have identified. It is certainly an important part of the concept of asymmetry relevant for the treatment of the SGP.

We identify six main issues of asymmetry which face the euro economy in the context of the SGP

- *the Phillips curve is clearly nonlinear* – positive output gaps result in considerable inflationary pressure, whereas negative gaps have a much more limited effect in reducing inflation
- *the Okun curve is clearly asymmetric* – periods of low growth/economic decline shed more jobs than periods of symmetrically higher growth add jobs/reduce unemployment
- *it is the tightest labour markets that tend to influence inflation not simply the average* – the stronger variation in unemployment across Europe then the less any given level of unemployment will hold inflation down
- *monetary policy reacts much more strongly to large deviations from its target than small ones* – monetary policy appears to operate differently outside a corridor of limited reaction, responding strongly both to high inflation and even more to the threat of deflation
- *beyond a point that most euro area countries have reached, attempting to expand the share of public sector activity in the economy further tends to reduce the overall rate of growth*
- *the behaviour of the fiscal authorities over the cycle is not symmetric* – not only do governments appear to be more ready to sustain larger deficits in bad times than they do smaller deficits/surpluses in good times but they tend to reduce taxes more rapidly and not hold down expenditure so strongly in periods of good performance than they do the reverse when economic performance worsens.

These six aspects of asymmetric behaviour, which we substantiate in the coming sections, between them add up to a considerable problem for the economy. The asymmetry in the Phillips curve

[5] It is possible to specify the asymmetric adjustment process in terms of $\Delta\hat{e}$, as in Huang *et al.* (2001), using the M-TAR model of Enders and Siklos (2001), rather than the TAR model in terms of $\hat{e}$, described in (3). M stands for momentum.
[6] See Verbrugge (1998) for empirical evidence on these nonlinear properties in cross-country data.

means that faster price increases are more readily generated by positive demand shocks than smaller price increases or declines are generated by adverse shocks – to achieve any particular inflation target policy will therefore have to be tighter on average than it would in a linear symmetric economy. The asymmetry in the Okun curves means that to prevent unemployment from rising (participation rates from falling) in the longer term there has to a preponderance of faster rather than slower economic growth. This problem is worsened if the euro area does not have a very coherent growth cycle and some regions are facing tight labour markets while others are slack. The inflation from those tight markets tends to be exported. The slack markets do not have a matching downward influence. Monetary policy seems to respond appropriately to these pressures, not reacting strongly if there is little threat to price stability but only reacting strongly when more serious pressures emerge. The reaction is stronger to offset the threat of deflation that the threat of excess inflation. Trying to react to these asymmetries by increasing the size of the public sector and trying to substitute public sector jobs for 'lost' private sector jobs can lower the growth of the economy. (There may be a trade-off between equity and growth.) Asymmetries in fiscal policy over the economic cycle tend to make problems of achieving fiscal balance more difficult as governments react more to good news than bad news. This means they tend to make less use of good periods to reduce structural deficits and lower debt than they allow deficits and debt to increase under adverse conditions.

None of these problems is surprising and the description above does not distinguish between asymmetries that arise as part of the cause from those that are part of the reaction. The findings are clearly in part dependent upon the simple stylised facts of recent years, where unemployment ratcheted up readily but proved stubborn to reduce and where public sector debt has tended to rise. Indeed it is only with the run up to monetary union that that both the fiscal and the unemployment pictures appeared to improve.

The structure of EU macroeconomic policy, including the Stability and Growth Pact, the Broad Macroeconomic Policy Guidelines and the Lisbon Strategy stand in the light of this background. The SGP contains two obvious elements of asymmetry. The first is that it seeks to bring down the overall indebtedness of the euro area. The Maastricht criteria aimed at a debt ratio of less than 60% of GDP for each member state, which was in effect trying to bring each down to what was roughly the prevailing average before the process started. It is not that 60% rather than any other specific number has much meaning but that two characteristics are required of overall government debt ratios. The first is that they should be in some sense 'sustainable'. In other words that it should be possible to map out a reasonable future path for meeting their costs with a plausible evolution of taxes and economic activity given the likely demands on expenditure. The second is that the cost of the debt in terms of the real interest rate to be paid should be acceptable. The two are related, as the interest rate premium will reflect the perception of risk that the government might default on its debt.

The asymmetry in this regard has two features. One is simply the need for a reduction in the overall level of the debt ratio but the other is that not all member states 'need' to reduce their own debt ratio to reach the 60% level. There is therefore a tension between the overall and the individual need.

The second element of asymmetry in the SGP that has attracted much more adverse comment is the one-sided limit on the deficit ratio. Here there are again two concerns, one stemming directly from the debt ratio constraint. Simple arithmetic shows that, with current growth rates, deficits in excess of 3 percent would not be consistent with maintaining a debt ratio below 60 percent. The asymmetry therefore stems from the same source. The second concern fits less easily, namely that highly active fiscal policy can also pose a problem for macroeconomic management. A switch from a surplus of 5 percent of GDP to 1 percent has just the same aggregate impact on excess demand as a switch from balance to a 4 percent deficit, everything else unchanged. It is therefore not surprising that there is a push to focus on changes in 'structural balances', as then the position relative to the overall economy is taken into account. A change in the public balance is then evaluated with respect to the state of the economy as a whole.

However, as mentioned earlier, the concerns with the balance of the system run further across macroeconomic policy in the EU. The Lisbon Strategy, outlined in the Lisbon Council of 2000 sees increasing the overall growth rate of the EU economies as being essential to solving some of the imbalances, particularly in the labour market. With faster growth, the constraints of the SGP become less important, furthermore constant real levels of services become more consistent with cuts in tax rates and the need for some 'social' expenditures falls as unemployment and social exclusion fall. This virtuous circle is difficult to start, in so far as it involves reductions in the net burden of the public sector to improve incentives or an investment in skills and infrastructure to generate the faster rate of growth in the first place.

In the sections that follow we take the six aspects of asymmetry in turn and then assess how well these match up with the policy asymmetry under the SGP.

3 Asymmetry in the macroeconomy and monetary policy

In Mayes and Virén (2003) we set up a simple and very conventional four equation model of the economy, consisting of an IS curve, a Phillips curve, and Okun curve and a monetary policy reaction function to study the first four of the six aspects of asymmetry in the euro economy. It is summarised in equations (4) to (8) below.

Following Duguay (1994), Goodhart and Hofmann (2000), the IS curve is of the form

$$\nabla y_t = a_0 + a_1\nabla y_{t-1} + a_2\nabla y_{t-2} + a_3 rr_{t-i} + a_4 re_{t-j} + a_5\nabla y^*_{t-k} \quad (4)$$

where ∇y is the deviation of output y from its Hodrick-Prescott filtered trend, rr is the real 3-month interest rate (i.e. the nominal rate of interest r less the annual rate of consumer price inflation Δp), re the real exchange rate with the US dollar (in logs) and ∇y^* the deviation of OECD output from its HP trend. (Lag lengths i, j and k typically vary from 1 to 3 quarters in estimation). Equation (5) is the standard expectations augmented Phillips curve:

$$\Delta p = b_0 + b_1\Delta p_{t-1} + b_2\Delta p^e + b_3\Delta p^* + b_4 u \qquad (5),$$

p^e is expected inflation, p^* is the foreign price (in domestic currency) and u is the deviation of unemployment from its trend.[7] In its simplest form the Okun curve is

$$\Delta U = c_0 + c_1 \Delta y + c_2 \Delta pop \qquad (6)$$

where pop is the population of working age. Lastly we include a monetary reaction function in the form of a Taylor rule

$$r_t = \rho r_{t-1} + (1- \rho)[d_0 + d_1(\Delta p - \Delta p^T)_t + d_2\nabla y_t] \qquad (7)$$

where the parameter ρ permits an element of interest rate smoothing and Δp^T is the target for inflation (Huang *et al.* 2001; Gerlach, 2000*b*).

This set of equations determines inflation, output, unemployment and the rate of interest. Foreign prices, foreign output and the exchange rate are treated as exogenous to the system. Data constraints lead us to modify (5) in some of the estimation and price expectations are represented by the OECD forecast a year ahead.

In estimation we use a panel of quarterly data for the period 1985.1 to 2001.3 for all the euro area countries except Greece and Luxembourg, for which the information was not available. This gives a potential 770 observations. The initial truncation date of 1985.1 is determined partly by availability of data but mainly because it is difficult to sustain the idea that there is a single regime applied over the period as a whole. Prior to 1985 there was considerable realignment of exchange rates within the ERM (Exchange Rate Mechanism) of the EMS (European Monetary System and in some cases we find we cannot use the first two years because the data are incomplete or show indications of a regime shift. We also find that there are substantial problems in handling the monetary policy reaction function (7) across the exchange rate crisis of 1992/3. The period since the beginning of 1999 lies within Stage 3 of EMU although in practical terms that can probably be dated earlier in 1998. As some of these problems lie within individual equations we therefore build up to the simultaneous estimation of the entire system of equations by considering the four components in turn. While the simultaneous model is deliberately kept simple we use some additional information in some of the individual equations to explore robustness and some of the variation among the individual countries.

3.1 The IS Curve

2.1.1 Differences across the Euro Area

The model set out in (4) – (7) is linear without the threshold decomposition of (1) – (3). It is worth noting before proceeding that in the case of the IS curve in particular, there is very substantial asymmetry in the sense of variation across the member states. Parameter estimates of (4) (Mayes and Virén, 2000*a,* Table 4) for the period 1987.1 to 1997.4 for the EU countries (excluding Greece and Luxembourg) vary considerably across the individual countries, both in terms of lag structures and the values of the coefficients. The impact of a 100 basis point interest rate increase, after allowing for the lag structures, varies from 0.5 to 3.8 percent of GDP with the bulk of the estimates falling in the range 1.0 to 2.2 percent. Thus, if the problem to be corrected by policy lay in low response countries in the EU, other, more responsive, member states would bear a greater proportion of the adjustment if there an equal change in the interest rate across the whole area.[8]

The same problem of variation in response applies to external influences, which are incorporated in the IS curve (4) through the real exchange rate with respect to the US dollar.[9] The member states react differently to the real exchange rate. The significance of this for monetary policy can be judged better by considering the ratio of the real interest rate and real exchange rate coefficients $\lambda = a_3/a_4$. These ratios range from around 2 to 8 if we ignore the outliers. During 1999 and 2000 the euro depreciated by over 25 percent against the dollar. This would imply that the impact on the output gap ranged from the equivalent of a fall in the real interest rate of 300 to around 1200 basis points. Using a weighted average (GDP weights) the ratio for the euro area in the previous period was around 3.5 (Mayes and Virén (1998) use a variety models to establish this value and not just equation (4) above). Policy aimed at the area as a whole would therefore respond to this average value or rather to its estimated value for 1999 and onwards as policy is forward-looking if the ratio were computed in this manner.

The simultaneous estimates for the whole system, Table 1, indicate that satisfactory estimates can be obtained for the period 1993-2001 using panel data for the EMU10 countries. This problem

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[7] We used a more complex lag structure in estimation.

[8] The data period for estimation is prior to the operation of the ECB so using it to draw inferences about the operation of monetary policy under Stage 3 of EMU implies some strong assumptions about the invariance of behaviour. However, it would require implausibly large changes for the problem we illustrate to disappear rapidly.

[9] Other currencies, particularly sterling play an important role in some countries so focusing purely on the US dollar may be misleading. In Mayes and Virén (1998) we show that in the case of Finland, where both sterling and the Swedish krona account for significant proportions of trade, using a trade-weighted index does alter the numerical value of the coefficient noticeably. However, the qualitative impact, which is the focus of our discussion here, is small. The Irish Republic is the only country where the dollar is clearly not the most important external currency. Similarly over this period, although most of the countries were participating in the Exchange Rate Mechanism of the European Monetary System, exchange rates with respect to each other also changed, particularly around 1992. We show that adding the DM exchange rate adds very little to the overall explanation but results in poorly determined coefficients and perverse effects in four cases.

of aggregation under nonlinearity or asymmetry does not merely occur when trying to aggregate across different economies. It exists within economies as well. Mayes and Virén (2003) show that the range of estimates from highly closed industries like construction to open ones like manufacturing is even greater than the range across countries. Thus it matters for policy, not merely whether shocks are unevenly spread across the member states of the euro area but whether they are spread unevenly across industries. Or turning this argument round, the impact of a common shock will vary both by member state and by industry.

2.1.2 Asymmetry Picked up by Omitted Variables

There will be systematic departures from the simple relationship set out in (4) that affect the deepness, steepness and length of the business cycle if important relevant variables have been omitted. We can show this very simply by augmenting the equation to include two further asset prices in addition to interest rates and the exchange rate, namely house prices, *hp*, and stock prices, *sp*:

$$\nabla y_t = \alpha_0 + \alpha_1 \nabla y_{t-1} + \alpha_2 rr_{t-2} + \alpha_3 re_{t-2} + \alpha_4 \nabla yoecd_{t-1} + \alpha_5 \Delta hp_{t-1} + \alpha_6 \Delta sp_{t-1} + u_t, \qquad (8)$$

where as before, ∇y = (log) output (GDP at constant market prices) gap, $\nabla yoecd$ is the OECD (log) output gap, *rr* = real interest rate (ie nominal 3 month rate minus annual inflation in the consumer price index, *pc*, %) and *re* = real exchange rate vis à vis US dollar (ie 100*log[*e*/(*pc*/*pcusa*)]). Here *hp* = log of house prices deflated by the consumer price index and *sp* = log of stock prices deflated by the consumer price index.

Other financial variables can be added to list, including long as well as short interest rates, stock prices and even house prices (Goodhart and Hofmann, 2000), if they can be shown to have a distinguishable impact on economic activity. In common with other authors (Mayes and Virén, 2003) we also initially included a long (10-year) real interest rate but it contributed little to the explanation.

It is immediately apparent from the empirical estimates in Table 2 that adding house prices and stock prices affects the other coefficients and λ. Some of the impact of interest rates appears to be taken up by the house price variable. While house prices are clearly an important improvement to the over specification stock prices add relatively little (in common with the findings of other authors, Goodhart and Hofmann (2000), Barata and Pacheco (2003), for example). [10]

Asset prices are particularly important (Cecchetti *et al*. (2000) for example) in the determination of monetary policy as they can introduce substantial nonlinearity into the cycle if bubbles develop. The cyclical dynamics through asset prices can be augmented by ill-tuned policy with debt deflation (King, 1994). The Nordic crises around 1990 illustrate these asymmetric dynamics graphically, especially in the case of Finland (Mayes *et al.* (2001) *inter alia*). The sharp decline in the economy

[10] Research at the IMF (Ludwig and Sløk, 2002; Bayoumi and Edison, 2003) shows that the same pattern applies more widely across industrialised countries and, outside Japan, has been increasing rapidly in the 1990s as a result of upward valuations. The estimates shown in Table 2 allow for the possible endogeneity of house prices by joint estimation of house price equation of the form $\Delta hp_t = \beta_0 + \beta_1 \Delta hp_{t-1} + \beta_2 rr_t + \beta_3 Y_t + \beta_4 \Delta pc_t + \varepsilon_t$ with the IS curve using SUR.

with a 12% fall in real GDP in just three years was in strong contrast to the sustained periods of growth that surrounded it.

The problem posed for monetary policy by these 'asymmetric' differences even in the linear IS curve is magnified when the rest of our model is added. Estimating the effect of any particular setting of monetary conditions on inflationary pressure in the euro area involves not just the IS curve but the link from the output gap through to inflation.[11] If the economic cycles of the Member States are not in phase then the individual output gaps will be relevant in assessing the likely bite of monetary policy. In such a case it would be inappropriate to estimate an IS curve using aggregate data for the euro. Instead separate IS curves should be estimated at the disaggregated level and then aggregated.[12] This is particularly important if the short-run Phillips curve is not linear and positive output gaps have a much stronger impact on increasing inflation than negative gaps have on decreasing it, as we show in the next section.

3.2 The Phillips curve

While (4), although augmented, remains a linear relationship, (5), the Phillips curve (Phillips, 1958) is the archetypal nonlinear relationship in macroeconomics. Indeed it is only partly an accident of history, with the collapse of the long run regularity and its replacement with a short-run expectations augmented curve (Phelps, 1967) that it has frequently been estimated as a straight line.[13]

The form of the 'Phillips curve' that lends itself most readily to the application of our threshold model is the relationship between the output gap and price inflation (see Clark and Laxton (1997) for a brief review and alternative approach). Taking a backward-looking approach to expectations, allowing a slightly more complex lag structure and replacing unemployment with the output gap we can reformulate (5) and include the threshold in the form:

$$\Delta p = a_0 + a_1\Delta p_{t\text{-}1} + a_2\Delta p_{t\text{-}2} + a_3\Delta m_{t-1} + a_4\Delta m_{t-2} + a_5\nabla y^{+} + a_4\nabla y^{-} + \eta\,, \qquad (9)$$

where ∇y^{+} denotes the values of the output gap that exceed a threshold value. Accordingly ∇y^{-} de-

[11] It requires at least a 'Phillips curve' relating price inflation to the output gap. If the Phillips curve uses unemployment as the determining variable then an Okun curve is required as well to provide the link between output and (un)employment.

[12] It is not of course self-evident that it is the Member State level that is appropriate for the disaggregation. It should really be regions in which behaviour is fairly homogeneous. (Dupasquier *et al.* (1997) demonstrate that in some cases there is more variation between some Canadian provinces than there is between Canada and the US.) Commodity price shocks may have regional rather than national impacts. However, the data to hand are on a Member State basis.

[13] The discussion of the Phillips curve remains contentious. Gordon (1997) maintains that it is 'resolutely linear' in the US while Stiglitz (1984) suggests that it could have the opposite curvature with firms being more reluctant to raise rather than lower prices. Yates (1998) offers a helpful classification of the main different factors that could lead to nonlinearity.

notes the remaining values of ∇y.[14] Import prices, *m*, are used for the foreign price.

It is immediately clear from the first three columns of Table 3 that, with the exception of Spain and Finland, the results conform to the expected asymmetry whichever estimation method is used. GLS and SUR make the picture rather clearer yet do not weaken the overall explanatory power. In each case the positive output gap shows a clearly positive relationship, while the negative output gap does not appear to exert any significant influence on inflation either upwards or downwards.[15]

We now have a striking implication for policy. When the output gap is negative this will exert very little downward influence in its own right on inflation. Attempts to run the economy in an over-expansionary manner will on the other hand have substantial and quite rapid effects on inflation. There is therefore a strong incentive to avoid inflationary pressures taking hold. With this asymmetric model the costs of pursuing a price level as opposed to an inflation target could be considerable. If the actual relationship should be a curve and that there is unlikely to be any sharp regime shift around the zero gap then this model will tend to underestimate the importance of the output gap for small negative values and overestimate it for small positive values.[16] Values nearer the original single line will tend to be most appropriate. At large negative and positive gaps the misestimation will be the other way round. The line will overestimate the importance of large negative output gaps and underestimate the importance of large positive gaps, possibly exponentially so, depending on the shape of the curve, as limits are likely to be approached in both dimensions.

Countries with positive output gaps should have a much more important influence on monetary policy than those with negative gaps. Or turning the argument round, if policy is set symmetrically it will tend to have an inflationary bias; see Clark *et al.* (1996) for a clear description. In general the contribution of large negative output gaps to holding inflation down will be overestimated and the contribution of high positive gaps to driving inflation up will be under estimated. However, this is

[14] Obviously we could have more that two regimes (facets) for ∇y but since we have only limited numbers of observations we use this simple specification (which has been widely used elsewhere, see Yates (1998), Department of Treasury (1996) for instance). Corrado and Holly (2003) use a three facet curve for the UK and US but they have over double the number of observations. Alternatively we could smooth the once-and-for-all regime shift in the threshold model by using the so-called smooth transition regression model (STR) (Granger and Teräsvirta, 1993), also used by Eliasson (1999). The lack of sufficiently long time series also made this alternative less appealing. Introducing a quadratic term in the output gap would also be a straightforward way of incorporating nonlinearity.

[15] Estimation of specifications like (3) is quite straightforward but testing for the threshold is much more complicated, even though we treat the threshold value as a nuisance parameter; see Hansen (1999) for details. In particular, in the case of heteroscedasticity, the conventional percentage points of the F distribution can be quite misleading. The choice of a zero output gap as the point round which to split the data is somewhat arbitrary, although by construction of the output gap variable this will be a split around the mean value. A grid search revealed that this value was only trivially different from the error minimising result.

[16] Pyyhtiä (1999) using a similar model but with fewer countries and semi-annual data (without lags) obtains similar results for the pooled model. When the individual countries are estimated separately the pattern of the coefficients is similar in all cases, with positive gaps having a greater effect than negative gaps. Only in the case of Germany does the coefficient for the negative gap approach significance but the positive gap coefficients are not particularly strong except in the case of Italy. However, Pyyhtiä's main focus is on a curvilinear specification, using a quadratic representation of the output gap. Adding the quadratic term improves the explanation for 5 out of the 7 countries in the sample but the

assuming that there is a common relationship, which applies all of the euro economies. There is considerable evidence that there are important differences in the transmission mechanism across the member states. Thus it is necessary to add not just results from different points on a nonlinear relationship but from different nonlinear relations. We thus need to consider where each of the countries is on its own curve and add together the change in inflation that would stem from the impact of the single monetary policy on each country's output gap and then aggregate.[17]

From a practical policy point of view the use of a single linear relationship will only generate significant errors, if

- the shifts along the curves are expected to be substantial
- the nonlinearity is considerable[18]
- the different countries have very different output gaps (their cycles are not well coordinated)
- the individual country relationships are very different from each other.

We explore these issues in more detail with the full model in Section 2.5.

Equation (5) expresses the Phillips curve in the more traditional form with unemployment rather than the output gap indicating the degree of demand pressure on inflation. While this specification provides a similar explanation of inflation the Wald test shown in Table 3 indicate that there is little nonlinearity in the role of unemployment.[19] Nevertheless the two coefficients bear the expected relation to each other as in the normal Phillips curve. Unemployment that is above the Hodrik-Prescott trend has a weaker effect on inflation than unemployment when it is below it. We show in Table 1 for the complete model that this result depends somewhat on the exact data period chosen. Restricting the estimates to the period since the 1992 ERM crisis results in clearly different unemployment coefficients for the two regimes but with unemployment still having a weakly significant negative effect on inflation even when it is above trend. Yates (1998) also has problems with detecting a lower bound in the way we observed with the output gap.

2.2.1 The Problem at the Regional Level

The problem for aggregation from asymmetry and nonlinearity applies to some extent at whatever spatial level we choose to measure activity. Indeed regional data within countries will help show the

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findings are relatively weak even in the pooled case. Mayes and Virén (2000) also show examples of more explicitly curvilinear relations.

[17] This is simplistic because the component economies interact, see Virén (2001) for example.

[18] De Grauwe and Sénégas (2003) show that even if the Phillips curves are linear then it will be more accurate if the monetary authority reacts by estimating national responses and aggregating rather than using simply the area-wide relationships – a result which is amplified in the presence of uncertainty. Uncertainty on its own is a reason for nonlinear policy responses (Meyer *et al*., 2001). Initial deviations from target could be tolerated on the grounds that they might represent changes in behaviour. Large deviations on the other hand would be obviously inconsistent, whatever behavioural changes might have occurred, and warrant a robust response.

[19] The signs are of course reversed in this case compared to the output gap. Fabiani and Morgan (2003) estimate Phillips curves with this format for the five largest euro area members, their aggregate and pooled for the unemployment gap coefficient. While they find that the individual countries differ particularly in lag structures they do not explore asymmetry and hence their finding against aggregation bias does not include the problems we discuss in this paper.

extent of structural change and the degree of mismatch in behaviour across sectors and the economy. We therefore test the hypothesis that the greater the range/variance of regional unemployment at any given level of average unemployment then the more inflationary will be the impact as the low unemployment regions will contribute to inflationary pressure for the EU as a whole.[20] The variance of unemployment acts as a measure of the mismatch across the EU. However, it has also been argued that it is the pool of suitably qualified unemployed in the areas of the main demand for labour that are most important in determining inflation. Those with less relevant qualifications or unable to take a job offer quickly will be less relevant, thus generating an asymmetric departure from the simple Phillips curve.

The effect of the range of regional unemployment on inflation may be even more extreme. For the case of the UK Buxton and Mayes (1986) showed that the region with the lowest unemployment (the South East) had a highly disproportionate impact on wage inflation for the country as a whole. More than that it appeared to be short-term unemployment that had the effect. Those employed for a year or more appeared to be effectively out of the labour market from the point of view of affecting the inflationary process

The regional data available for the EU do not allow us simply to re-estimate the same formulation of the Phillips curve at a more detailed level. Most importantly the data are annual and relate to unemployment rather than the output gap. However, by using annual data it is no longer necessary to transform (5) and we can estimate it directly including a measure of forward-looking expectations

$$\Delta p = a_1 \Delta p^e + a_2 \Delta p_{t-1} + a_3 \Delta m + a_4 U + a_5 Udisp + a_6 t \ . \qquad (10)$$

The forward-looking estimate of Δp^e uses the forecasts that the OECD publishes annually for the year ahead.[21] *Udisp*, the variance of unemployment levels across each country has been included in two forms: the range, *Umax-Umin,* to capture any effect from the extremes and the standard deviation, *Usd.* [22] The Eurostat Regio database at the NUTS3 level for the EU has some 251 regions

[20] This can be regarded as an extension to the Lilien index (Lilien, 1982; Mayes and Silverstone, 1998)

$$L = \sqrt{[\Sigma_i w_i (e_i - E)^2]},$$

where e_i is the rate of growth of employment in region or sector *i* and *E* is the growth of employment in the area as a whole, w_i being the weight, the share of employment in that region in the total. Lilien's hypothesis is that the greater the dispersion of growth rates in employment the higher is likely to be the unemployment rate. This reflects the idea that it is costly to retrain or move labour. Purely macroeconomic statistics will cover up the consequences of this. If growth is not evenly spread then the more rapidly growing regions will not be as successful in reducing unemployment elsewhere as the less rapidly growing regions are at creating unemployment.

[21] Although picking on any one forecaster is inherently arbitrary we have used the OECD for three main reasons. Firstly, because the OECD uses a common methodology for each country there is a degree of coherence across the different countries in our sample. Secondly, although subject to political pressures the OECD view is likely to be fairly widely shared and respected. Lastly, because a formal methodology is employed there is likely to be some coherence over time.

[22] We have not attempted to include further variables to remove the effect of specific shocks such as oil price rises but there is a strong downward trend in inflation in many countries over the period, which needs to be accounted for in the

for our subset of countries.[23] The data are annual for the years 1984-98 but not all years are available for each country so we only obtain some 153 observations out of the potential 180.

We can see from Table 4 that the hypothesis is borne out whichever of the two unemployment variance measures is used. Variance in unemployment across regions has a positive effect on inflation. It is also clear from the comparison of columns 1 and 3 and 2 and 4 that the individual member states react differently. Inserting shift dummies into the equation improves the fit of the basic Phillips curve considerably, increasing the (negative) impact of average unemployment substantially while also increasing both the size and the significance of the positive impact of the spread.

In column 6 of Table 4 we try adding the asymmetry in the Phillips curve itself by replacing the single (linear) relationship with the two-piece threshold model. In this case the parameter (a_4) varies according to whether *unemployment* is above or below a threshold value. As there is no obvious *a priori* value for the threshold, we use Maximum Likelihood to estimate the threshold and the parameters of (10) jointly. This gives a value of 10.8% for the threshold, somewhat higher than the average value of unemployment of 8% for the estimation period. The difference in the two unemployment coefficients is not substantial but it is significant at the 1% level. The results follow the expected convexity with the effect of unemployment on inflation being greater at lower levels of unemployment and weaker at higher levels.[24]

Clearly to quite some extent this is illustrating what we know already as these asymmetric impacts would be picked up by other aspects of macroeconomic models. Sectoral shocks would have differing effects on the exchange rate or import prices for example. Nevertheless these results make it clear that neglecting the distribution of the impact below the EU level could have misleading implications for policy, whether the neglect was national, regional or sectoral. Even within smaller countries the distributional differences still matter.

Our results seem to be a little more robust to the finding of asymmetry and nonlinearity than some other recent studies. In their work on asymmetry and nonlinearity in the Phillips curve, Laxton *et al*.[25] find that while the evidence supports the existence of convex relationships between inflation and unemployment in an expectations augmented specification, the convexity is not strong over the policy relevant range and the evidence relatively weak.[26] Indeed they conclude (Laxton *et al*. 1999, p.1482) 'standard empirical techniques are not likely to be capable of providing a reliable answer on the functional form'. However, in no case is the convex relationship rejected by the data.

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relationship is to be meaningful. We are grateful to a referee for suggesting we might include a measure of the third moment of unemployment to reflect asymmetry directly.

[23] The Irish Republic also had to be excluded through lack of data.

[24] Mayes and Virén (2000) show that this same asymmetry applies to sectors within the euro area economy as well as regions.

[25] Laxton, Rose and Tetlow (1993); Laxton, Meredith and Rose (1995); Clark, Laxton and Rose (1996); Debelle and Laxton (1997); Clark and Laxton (1997); Laxton, Rose and Timbakis (1999)

[26] The authors use both piecewise linear and curvilinear specifications.

They use both the regime change model we employ and a continuous curve and consider the US, UK and Canadian economies. McDonald (1997) and Razzak (1997) find similar relationships for the Australian and New Zealand economies

Inside the euro area the convexity will have a particular effect if the various member states are out of phase in their economic cycle or have been subject to asymmetric shocks that require structural adjustment that may be slow to come if there is substantial hysteresis in the economy. The economies that are suffering a negative output gap will be doing less to bring inflation down than the economies with the positive output gaps are providing upward pressure. Therefore in general the more asynchronous the euro area turns out to be the tighter monetary policy will need to be compared with any given growth rate for the area as a whole. If cycles are asymmetric in the sense that it tends to be more difficult to get out of recessions then the problem will be exacerbated.[27]

3.3 The Okun Curve

The discussion of the Phillips curve dealt both with asymmetry from the labour market and asymmetry from excess demand. The Okun curve (6) in our model provides a link between output growth and unemployment and gives us a rather more satisfactory opportunity to distinguish the two sources of asymmetry. The Okun curve has been subject to quite extensive analysis in recent years[28] and Harris and Silverstone (1999) find asymmetry of some form for Australia, Japan, New Zealand, the UK, US and West Germany over the period 1978 to 1999. However, the finding is not universal and they cannot reject the null hypothesis of symmetry for Canada over the same period. Haltiwanger and Schuh (1999) introduce sector specific factors to help explain the lack of symmetry.

Following Laxton *et al.* (1999) and Pyyhtiä (1999) we apply our threshold model to (6) in terms of output growth

$$\Delta U = c_0 + c_1 \Delta y^{+}(\tau) + c_2 \Delta y^{-}(\tau) + c_3 \Delta pop + c_4 \varepsilon_{-1} + \eta_t \qquad (11)$$

using an error correction format. Here Δy is the growth rate in GDP, *pop* the population of working age and ε the error correction term (lagged one period) and τ a threshold value for the asymmetry. Prachowny (1993) inter alia argues that some scaling of the labour variable in (6) is required so we include population of working age in our formulation.

As we noted in Section 1 there are two alternative ways of incorporating the asymmetry. The

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27 The Phillips curve is also asymmetric in a different sense in the Ball (1993) Mayes and Chapple (1995) discussion of the 'sacrifice ratio'. Here the gains in terms of extra output when the output gap is positive are more than offset by the losses when a negative output gap has to open to return inflation to its previous level. In this case the relationship is not merely a curve but its shape depends upon whether the output gap is falling or rising.

first, following Kim and Nelson (1999) is to assume that although the function itself is linear, we should treat potential output more in the form of a frontier, very much along the lines of frontier production functions (Aigner *et al.*, 1977; Mayes *et al.*, 1994; Mayes, 1996). This provides a direct extension to Prachowny's (1993) production function basis for the Okun curve. Here the errors in the relationship can be decomposed into a symmetric term e and a non-symmetric term v, which permits a longer tail of values when the economy is operating inside the frontier.[29]

Our results, reported in Table 5, show estimates of (11) for the EEA countries from 1961 to 1997.[30] Only in the case of the UK do we find that there seems to be little relation between output and unemployment when using a linear formulation. Once we introduce the asymmetry, most countries produce the positive and negative segments with different slopes and show the expected asymmetry very clearly. If we separate out the data according to whether or not the economy is in recession,[31] cols. 1 and 2 in Table 5, in 12 of the 16 cases the coefficients are larger when the growth rate is negative. In other words unemployment rises more when the economy contracts than it falls when the economy expands. This fits with our expectations about hysteresis. However the differences are not in general significant. Of the four cases that do not conform to this pattern, Finland shows no asymmetry, while Greece and Italy have perversely signed coefficients for the negative segment. However, in each case the likelihood ratio test does not lead us to reject the symmetric relationship. Symmetry is also rejected in the case of the UK but here the negative segment also has a perverse coefficient.

If on the other hand we split the relationship at the point which maximises the likelihood function then only three cases show coefficients where the effect on unemployment is smaller (less negative) below the threshold (cols. 3 and 4 in the Table). Italy and Finland now follow the majority but Spain now shows perversity.[32] Only in the case of the UK was the coefficient for the negative segment significantly different from zero at the 5% level and here the threshold value, at –0.53%, was very much out of line with the rest of the sample. Most thresholds lay in the range 2.3 to 4.3% and all cases the restriction that the two GDP coefficients be equal was rejected.[33] When we apply the model to our quarterly panel data (Table 6), using an HP trend to try to take account of the

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[28] Attfield and Silverstone, 1998; Harris and Silverstone, 1999; Kaufman, 1988; Moosa, 1997, Palley, 1993, Prachowny, 1993 and Weber, 1995, for example.

[29] Thus in the case of (6) the error term η in the estimated version of (6) would be composed $\eta = v + e$, with $e \sim N(0, \sigma^2_e)$ and $v \sim M(\mu, \sigma^2_v)$ where M is a nonsymmetric distribution. Kim and Nelson (1999) assume that M is half Normal, Mayes *et al*. (1994) also consider the more general case of a truncated normal.

[30] We have used both a longer data series and a wider range of countries than Harris and Silverstone (1999). While we did experiment with a split error correction term it appeared that incorporating the asymmetry into the coefficients of the equation was a rather better determined approach. Different speeds of adjustment alone had lower explanatory power and added little when the output coefficient split was already present. In part this may be due simply to the use of annual rather than quarterly data. For an application of the model to 21 OECD countries see Mayes and Virén (2000).

[31] i.e. if GDP falls.

[32] We were unable to produce estimates for Germany because of the overwhelming effect of unification.

longer-run path in unemployment over the sample seems to be the least favourable to the nonlinearity hypothesis (cols 4-6), while using a constant (cols. 1-3) gives the strongest support. The finding of nonlinearity is clearly dependent on model specification, variable transformation and the sample period chosen. As Table 1 illustrates for the full model, nonlinearity is present after 1992. While we have by no means explored every possibility there appears to be enough evidence to take the hypothesis of nonlinearity very seriously.

Use of these aggregate models in some senses only provides a description of the stylised facts and not an explanation of why the asymmetry may be occurring. This becomes clearer at the disaggregated level. In discussing regional disaggregation of the Phillips curve we suggested that it was the tightest labour markets that contributed to inflation and hence that we needed to consider the spread of unemployment across markets and not just the level in order to understand the nature of the problem. In the case of the Okun curve Haltiwanger and Schuh (1999) demonstrate that it is necessary to understand the dynamics of the labour market at the plant level to get an appreciation of asymmetry. They show that a further term should be added to our formulation of the Okun curve, which reflects the degree of 'job reallocation'[34] both within and between sectors. For all of the five different measures they use there is a clearly significantly positive effect on unemployment from increased rates of job reallocation. However, Haltiwanger and Schuh (1999) go even further and estimate determinants of job reallocation. Here not surprisingly it is downturns in the overall economy that help, including the lagged influence of monetary policy. Relative price shocks also provide an explanation so supply as well as demand shocks have a role to play. The problem also shows considerable persistence. Thus in downturns unemployment is more than symmetrically large than in upturns and takes longer to fall than it did to rise.

3.4 Monetary Policy

One of the difficulties about measuring the three foregoing relationships is that in practice the observations that we have are 'policy inclusive'. Over the period governments have sought to stabilise the economic cycle with some combination of monetary and fiscal policy, partly through 'automatic stabilisers' and partly through discretionary action on each occasion. Laxton *et al.* (1993) argue that this will tend to reduce our ability to observe the curvature of the relationship. Not only does it inhibit the variance but it reduces the impact of the underlying relation. However, the impact of policy could be even more distorting if policy is itself not symmetric or linear. Economists typically ex-

[33] Harris and Silverstone (1999) also encounter the problem of perversity but only a limited scale and for a partly different group of countries. However their estimates are well determined.
[34] We describe this as 'churning' in Mayes (1996).

press loss functions in quadratic terms implying that policy will respond more than proportionately as expected outcomes deviate from their targets. However, they tend to make them symmetric (Taylor, 1993). It is perhaps a little more realistic to consider the 'opportunistic' approach to policy (Orphanides and Wilcox, 2002) where 'favourable' outcomes such as more rapid recoveries, balance of payments improvements etc. than expected are accepted and not offset, whereas less favourable outcomes stimulate further policy responses.[35] A more general asymmetric loss function is used in Koskela and Virén (1990) and Virén (1993) drawing on the work of Waud (1970) and Hosomatsu (1970). This also applies the threshold model approach that we have used in this paper. However, here we experiment by introducing a policy reaction function directly into the model.

It is difficult to decide on a form for the monetary policy reaction function as the EU countries were following different regimes during the period. The Bundesbank used a form of enhanced money targeting (Issing *et al.*, 2001), many of the other central banks were targeting the exchange rate within the ERM, while others including the UK, Sweden, Finland and Spain had periods of inflation targeting. However, as Collins and Siklos (2002) demonstrate, a simple Taylor Rule of the from of (7) where interest rate smoothing is included provides a reasonable representation of the behaviour of most modern regimes including the US, despite the fact that their ostensible objectives are different. It even embraces the 'speed limit' interpretation of US policy (Walsh, 2001, Woodford, 1999), although for some small open economies it might make sense to include the exchange rate. What is particularly interesting is that even though monetary policy is firmly forward-looking in the eyes of central banks including forecasts of inflation and the output gap in (7) does not alter the performance markedly. The position can change somewhat if the rule itself is forward-looking and targets forecast inflation as in Svensson (1997), Schaling (2002) and Corrado and Holly (2003).

In view of the high level of endogeneity we only estimated the reaction function as part of the whole system (see the last three rows of coefficients in Table 1). It is immediately apparent that the results are dependent on the data period chosen. The problem lies with the breakdown of the ERM in 1992. If estimation is restricted to the post 1992 period (cols. 5 and 6) then we observe the expected result. The weight on inflation is about twice that on the output gap and there is a large element of smoothing in policy. If 1992 is included in the data period then the weights are equal.

However, these results involve a symmetric reaction function. It is clear from Table 7 that the reaction function is itself asymmetric. The authorities appear to have responded more vigorously when inflation has been above 2 percent a year than when it is below it.[36] This asymmetry also seems to apply to the output gap. The interest rate response has been clearly stronger when output

[35] Monetary authorities may seek to offset the asymmetries in the inflationary process, while governments may be more concerned to combat high unemployment or take advantage of periods of higher growth (the 'inflation bias' discussed clearly in Walsh (1995) *inter alia*.)
[36] Shown at the quarterly rate of 0.005 in the Table.

has been above trend than when it was below it.

We wondered whether this asymmetry was in fact somewhat misleading as the Eurosystem's target for price stability is for *in*flation not exceeding 2 percent over the medium term. Thus, if this were followed we would expect to see disproportionate reactions to inflation above 2 percent and to *de*flation. Rather than impose our own view of where the different regimes should lie we searched for the maximum likelihood estimates for rounded intervals. Here it appears that deflation is tackled even more vigorously than inflation above the target range (Table 8). The lowest weight is for inflation in the range zero to 4 percent a year. This somewhat wider range for milder action than that implied by the Eurosystem target is probably accounted for by the fact that most of the data period is before the ECB was set up. A similar set of results is obtained for the output gap, with larger coefficients outside a corridor 2 percent either side of zero. However, it was not possible to obtain significant coefficients for the output gap above the corridor. Indeed trying to include the output gap poses considerable convergence problems for the model.[37] This result compares well with the approach of Corrado and Holly (2003) who show not merely that the Phillips curve can be approximated by a three piece function, similar in concept to this corridor approach, but that a three piece feedback rule for monetary policy provides an appropriate characterisation for policy. Here again, responses are greatest above the upper threshold and lowest between the two thresholds both for the UK and the US.[38]

3.5 The Joint Effect

Taking the Phillips curve, Okun curve, IS curve and monetary reaction function results together gives us a somewhat better insight into the nature and causes of both asymmetry and nonlinearity in macroeconomic behaviour. Although, of course, some of the picture is still omitted. It is clear that the variations across regions in labour markets and across sectors in product markets lead to impor-

[37] We have undertaken some limited experiments in estimating 'corridor' Taylor rules with monthly data for the 15 EU member states, which show similar results. Responses to output gaps of less 2% are weaker and generally of low significance in the period 1993.1-1998.12. Responses to output gaps above the corridor were however stronger than to those below it but in both cases the results were clearly significant at the 1% level. The inflation target could be represented by the German inflation rate. Within the 2% difference corridor, responses were not significantly different from zero, while outside it they were, with upside inflation having a coefficient three times as large as that for the downside. Monthly models create severe problems not just for data but with the timing of monetary policy decisions. At a monthly level there is clear inertia in decision-making, which is not so evident from quarterly data. There is a clear relationship between the number of policy rate changes in a given year and both the inflation differential with Germany and the size of the output gap. Thus the larger the gaps, the more policy rate changes are required to close them.

[38] Gerlach (2000*a*) explores the idea that policy makers are asymmetric in their concerns over positive and negative output gaps. He suggests that there is evidence from the period 1960-79 in the US that the Federal Reserve reacted more strongly to negative than positive output gaps (thereby giving an inflationary bias to policy). Surico (2002) suggests that this asymmetry has become sharper since 1979, particularly with respect to the output gap – the policy preference for inflation puts a higher weight on correcting inflation when it is above the target rather than below, thus tending to offset the output gap asymmetry. (Since Surico's responses are quadratic, bigger deviations receive a more than proportionate response than do small ones.) Gerlach and Smets (1999) provides one of the best known assessments across the euro area.

tant deviations in aggregate behaviour. When combined with the different national and sectoral responses to monetary policy, whether through the exchange rate or interest rates, this permits substantial departures from linearity. The asymmetries in the Phillips that we have explored appear to be primarily cyclical in character. The asymmetries in the Okun curve, on the other hand are more complex, reflecting not just cyclical factors but the degree of sectoral and regional mismatch in the operation of the labour market. There is thus not just a nonlinear underlying relationship but asymmetric departures from it. As the average level of unemployment falls so the scope for regional and sectoral disparities also falls as there is a lower bound. It seems likely therefore that there is more than one source of asymmetry. The structural mismatch in the labour market appears to be an additional cause to the traditional Phillips *curve* result.

The asymmetries are likely to interact. The asymmetric nominal rigidities implicit in the Phillips curve are likely to contribute to the asymmetric labour demand effects revealed in the Okun curve. Downward rigidities in prices and wages would tend to increase the variance of unemployment. The different sectoral responses to monetary policy will be a reflection of this. Asymmetric shocks will interact with the nonlinear responses and asymmetric processes themselves. When combined with the policy reaction this generates a considerable identification problem (as explained by Blinder and Solow (1973) in the case of fiscal policy and Haldane and Quah (1999) for monetary policy.)

We therefore estimate the four equations (4), (11), (9) and (7) as a system using SUR for the period 1985Q1 to 2001Q3. The estimates of the coefficients from the individual equations are stacked in that order in Table 1. Columns 1, 3 and 5 use the deviation of unemployment from its Hodrik-Prescott filtered trend in the Phillips curve, while the other three columns show the results for the output gap. The results are similar to those obtained when estimating the equations separately. The asymmetry appears to be concentrated in the Phillips curve (asymmetry due to unemployment dispersion in the Okun curve could not be included with these quarterly data) when using this full sample. However, if we confine the estimation to the period after the ERM crisis (cols. 5 and 6) then there is asymmetry in the Okun curve as well. Including the years when the euro area was in operation does not appear to have a major effect. We have used rolling regressions to test for other sources of instability. We therefore proceed with the 1993-2001 estimates as being more informative about recent and likely future behaviour in the euro area.

Our model is only illustrative and we can increase the effects by using larger shocks, altering their timing to affect when the regime switches or adding the asymmetric version of the reaction function. If instead of using the panel data model we were to allow different parameter values for each individual country, then we would observe a much bigger variety of timing and size of regime shifts even under a single monetary policy reaction function.

Our analysis does not offer much scope for a discussion of the causes of asymmetry. In their tests of causes of asymmetry in the Phillips curve Dupasquier and Ricketts (1998) are able to isolate some evidence for the hypotheses of costly adjustment, capacity constraints and misperception (of aggregate and relative price shocks). The nominal wage resistance hypothesis was not obviously sustained, a result consistent with Yates (1998). Although to some extent these causes should be separable the results from their joint inclusion were not well determined. Eliasson's (1999) finding that the Phillips curve, using unemployment not an output gap as the determining variable, shows different sources of nonlinearity in Sweden and Australia is also helpful. In the Swedish case it is the rate of change of inflation expectations that is important, while for Australia it is the rate of change of unemployment.[39] The former case will have particularly important implications for the conduct of monetary policy. Moreover the fact that the sources of nonlinearity differ for these two countries and are not found in the case of the US in contrast to Laxton *et al.* (1997) emphasises the potential problem of aggregation that we have outlined for the euro area.

We have only explored some forms of asymmetry across the cycle. Lo and Piger (2002) offer a more complex analysis by using a regime-switching model for the US, which does not seek to explain why the regime changes but just the nature of the asymmetries. They find that policy actions are more likely to lead output changes in a downturn than an upturn and that large or contractionary policy actions are more likely to lead output changes than those that are small or expansionary. Unfortunately the problems of adjusting to policy under EMU will be long in the past before there is an equivalent 45 years of quarterly data to use in similar estimation for the European countries.

4 Asymmetry from Fiscal Policy and the Role of the Public Sector

Ideally we would incorporate the last two aspects of asymmetry into the same model as the first four but much of the fiscal relationships are better represented in an annual framework. We therefore take each relation in turn. However, we can note at the outset that the asymmetries revealed thus far make it very clear why fiscal policy needs to be exercised at a disaggregated level in the light of the local needs and the characteristics of the single monetary policy. We can see equally clearly how the asymmetries in inflationary pressures and the development of unemployment place asymmetric pressures on fiscal policy, encouraging relatively strong action in downturns both to head off the heavy re-employment costs of any 'unnecessary' job losses and discouraging the creation of further inflationary pressure when the output gap is positive. A natural reaction to this might be to try to increase the role of the public sector in combating unemployment but to maintain fiscal

[39] Buxton and Mayes (1986) also made this finding for the importance of the rate of change of unemployment in the case of the UK.

prudence by raising or at least not cutting taxes. Such an action would encounter the next facet of asymmetry we consider.

4.1 Limits to Increasing the Public Sector Share in the Economy

It is a feature of many macro-models that increasing public sector consumption will reduce the overall level of economic activity in the economy, primarily because it will increase the share of lower productivity activity in the economy; see the Bank of Finland's EDGE model for example (Kortelainen and Mayes, 2001). This is of course a contentious finding (see Koskela and Viren (2000) for a short survey of the literature) as both positive and negative effects have been found in empirical studies. In this section, following Koskela and Viren, we argue that the relationship is nonlinear with a positive effect of increased public sector employment on overall activity at low levels of public sector employment and a negative effect at high levels. Increased public expenditure on the physical, technical and human capital infrastructure will tend in particular to be of aggregate benefit, as the private sector tends to deliver suboptimal quantities when unaided. The assumption of the negative effect in Kortelainen and Mayes (2001) reflects the finding that the euro area as a whole is in the negative section of the relationship. Hence the policy implication is that a switch to greater public spending as a route out of current difficulties may well not be successful. Indeed a cut may be desirable for some member states. Hughes-Hallett and Weymark (2002) suggest that there may be a trade-off between 'equity' and growth, for example.

The implications for using extra public spending to attempt to solve problems of unemployment thus face a prima facie difficulty. If this spending is not abnormally productive it will tend to result in a net loss to society, which may in itself tend to increase unemployment. Indeed the general wealth of the economy might be increased by a shift towards less public spending. It would depend on the nature of the redistributive process both in incomes and employment whether this diminished or increased unemployment, social exclusion or some other measure of social deprivation - a point not amenable to macroeconomic analysis but central to explaining why societies may not choose wealth or employment maximising strategies.

Using annual data for 22 OECD countries for the period 1960-96, it is possible to show (Table 9) first of all that a nonlinear model can represent the relationship between private sector output and public employment and secondly that over the relevant range the relationship is negative. The equation fitted is a simple application of the Granger and Teräsvirta (1993) threshold model. Denoting private sector output by D and public sector employment by L_g, we can divide the observations on the variables in (12)

$$\Delta \log D_t = \alpha + \beta \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + u_t, \qquad (12)$$

into two groups according to whether they are on/above or below a particular threshold for the share of the public sector in GDP. Here we consider government consumption, G, as a share of GDP at current prices, Y, (G/Y) as the threshold variable, although Koskela and Viren also consider labour shares and consumption shares. However, the results in those two cases are similar so we do not pursue them here. The hypothesis is that the parameter β differs according to whether G/Y is above or below the threshold value $(\hat{G}/\hat{Y})$

$$\Delta \log D_t = \alpha + \beta_1 \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + e_t \quad if \quad G/Y \le (\hat{G}/\hat{Y}), \tag{13a}$$

$$\Delta \log D_{tt} = \alpha + \beta_2 \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + e_t \quad if \quad G/Y > (\hat{G}/\hat{Y}). \tag{13b}$$

We expect to find $\beta_1 > 0 > \beta_2$. It is clear from Table 9 that, the coefficient of β_1 is positive except for a couple of cases and in all cases larger than the coefficient β_2. β_2 is negative except for Australia, France, Italy and Norway and in these cases the β_2 coefficients are not significant. The estimation and test procedures made use of a GAUSS routine, available on Bruce Hansen's homepage: http://www.ssc.wisc.edu/, which searches for the value that gives the smallest residual variance. According to the estimation results the threshold value of the public sector (output) size varies between 10 and 30 percent. Koskela and Viren (2000) report that the threshold value is higher with the public sector share of total consumption and lower with the public sector share of total employment. With all threshold variables, the threshold values are very similar for all countries suggesting that there is some invariance across countries.

The results are of course rather tentative owing to the very small sample size for each country. This can to some extent be eased by pooling the data and estimating the panel of 22 countries by SURE, as is shown in Table 10. In addition to linear and threshold models Koskela and Viren also estimated a multiplicative specification of the following from:

$$\Delta \log D_t = \alpha + \beta \Delta \log L_{g,t-1} + \gamma \Delta \log D_{t-1} + \phi H_t \cdot \Delta L_{g,t-1} + e_t \tag{14}$$

where H denotes the threshold variable (G/Y). According to this specification public employment effect depends on the interaction term $H_t \cdot \Delta L_{gt-1}$ and thus on the size of the government sector. According to our hypothesis ϕ should be negative. Using this specification we can compute the critical (or, in a sense 'threshold') value of this variable at which public sector employment growth has zero effect on private sector output growth.

The results with panel data conform with the results from individual country data. With a linear model there is no relationship between public sector employment and private sector output, while with the threshold model quite a clear relationship is obtained. There is a similar relationship using the multiplicative specification (14) in which the public sector employment effect depends on the size of the public sector. When the size of the public sector increases, the employment effect diminishes and, after some critical value, becomes negative. The implied critical values are, in fact, quite close to the average threshold values in the context of threshold model estimation.

There is other evidence to support these findings. Karras (1996) has estimated the optimal government size by exploring the role of public services in the production process. As the theoretical framework he takes the analysis by Barro (1990), according to which government services are optimally provided when their marginal product equals unity (the so-called 'Barro rule'). He finds for a data set of 118 countries over the period 1960 to 1985 that in some cases government services are over–provided, in some cases under-provided and in many cases optimally provided. The optimal government size in the Barro sense is 23 percent (±2 percent) for the average country, which number, however, masks important differences across regions. Interestingly, this number is not very far away from the value of the thresholds shown in Tables 9 and 10. Our analysis is less ambitious in the sense that we do not study the welfare issues. The key conclusion from this section in the context of current European macroeconomic policy is that it supports the current inclination to try to cut taxation of labour as part of the Lisbon strategy to increase growth and employment.

4.2 How Sensitive is the Budget Balance to Cyclical Fluctuations in the EU?

In this section we turn directly an aspect of fiscal policy that is subject to constraint under the SGP, namely whether the current rules impose excessive constraints on the running of deficits. If fluctuations round a prudent longer-term policy would exceed the 3 percent limit without themselves being destabilising then prima facie the constraint is too tight. To permit such fluctuations in difficult years a country might have to move quite strongly into surplus in normal years, such that it would be effectively repaying its debt as a proportion of GDP. For the euro area as a whole that of course is precisely what is required at present. Indeed for some countries, Finland, for example, there is no contradiction in needing to run a surplus in normal times, as the government wants to run the debt ratio down substantially, both to leave room to act in the event of another serious shock like the banking crisis at the beginning of the 1990s and to cover unplanned difficulties with the ageing of the population for the funding of pensions or provision of services. However, at some point this fortunate co-incidence between the need to consolidate and the constraints of the excessive deficit procedure may not exist. The current British government clearly does not feel it applies to them, with debt levels well below the 60 percent target.[40]

Views vary as to whether output shocks have substantial effects on the fiscal balance. If 'automatic' stabilisers are important then the balance will move in a strongly counter-cyclical manner (Buti *et al*, 1998). The effects may be particularly strong if buffer funds are used, as exist in Finland

[40] We do not pursue here the debate about the appropriateness of alternative simple rules for maintaining prudence, as practised inter alia by the UK. A rule that only permits borrowing for investment by the public sector is not necessarily stable since the return on many public investments are not purely financial and may not necessarily pay for themselves. Direct required rates of return may not reflect the appropriate valuation of the social benefits from the investment.

(Mayes and Suvanto, 2002) or are suggested in Sweden (Johansson, 2002). However, given discretionary behaviour by governments the effects may be attenuated (Melitz, 1997). For example, when revenues rise governments may be tempted to be somewhat more lax in their fight against rising expenditures or may take the opportunity to cut taxes. However, the process may not be symmetric, as cutting expenditures or raising taxes in downturns tend not to be attractive electorally.

There is considerable debate over how to measure the appropriate balances and Virén (2000) computes the results for a wide range of definitions as well as for the expenditure and revenue components separately. Here we deal with just three definitions using the common specification

$$d/y^* = b_0 + b_1\, d/y^* + b_2\, t + b_3\, \Delta y^- + b_4\, \Delta y^+ + b_5\, r + b_6\, D/y + u \qquad (15)$$

where d refers to the measure of the deficit, D refers to debt y to GDP, * indicates the trend value, t a time trend, r the nominal rate of interest and u an error term. Δ denotes a growth rate and -/+ whether the growth rate is below or above the threshold (normally zero). Using data for the period 1960-99 from the EUROSTAT databank for the 14 EU countries (excluding Luxembourg) the country specific estimates with respect to $\Delta y^{-/+}$ are shown in Table 11. The three deficit measures, shown in the Notes to the table, are net lending, net lending less interest payments and the cyclically adjusted deficit according to the Commission of the EU.

The main implications are:

(1)Fiscal policy seems to respond to business cycles quite considerably. Thus, the deficit elasticities with respect to output growth appear to be around 0.2-0.3 for a one-year horizon (clearly more than obtained by Melitz (1997)).

(2) There appears to be strong evidence of asymmetric cyclical behaviour in government deficits. The output effects on deficits seem to differ depending on the business cycle regime: they appear to be much strong in depressions (output falling) than in booms. The hypothesis of equal coefficients for these regimes can be rejected quite clearly.[41]

(3) Asymmetries mainly relate to the structural deficit. Thus, the cyclical component of the government deficit seems to behave more or less symmetrically in terms of output fluctuations. This means that when output decreases structural deficits increase but when output increases structural deficits also tend to increase (surpluses decrease). The problem thus lies with discretionary behaviour rather than with automatic stabilisation. In good times discretionary policy appears to have been perverse.

(4)The different cyclical effects show up in both revenues and expenditures. Revenues seem to be more sensitive to output growth in depressions than in booms. Thus, when output grows, the revenue/trend output ratio remains more or less constant, while in depressions it decreases quite

[41] The threshold estimated by the maximum likelihood procedure we describe was close to zero so the results using it are not reported.

markedly. Expenditures seem to increase in depressions and decrease in booms. This probably reflects changes in government transfers (e.g. unemployment benefits).

(5) The direct effect of interest rates on deficits can be clearly discerned. The effect is particularly strong with net lending but it also shows in primary deficits. Thus, an increase in interest rates leads to some loosening of fiscal policies, and vice versa. The net lending effect obviously reflects the direct expenditure effect on interest expenses but the primary deficit effect is a bit hard to be interpreted.

(6) More interestingly, the effect of government debt also turns out to be both significant and of 'correct' sign and magnitude. Larger debt leads to some correction in the form of lower deficits.

We do however have to be rather cautious in interpreting these results, as the reverse impact of the fiscal balance on output has not been taken into account in estimation on the grounds that it occurs with a lag (while the effect of growth on the deficit is contemporaneous). Virén (2000) therefore extends the analysis, first of all by estimating a simple VAR using Δy, rr, d/y and Δy^{OECD}, where rr denotes the real rate of interest and Δy^{OECD} the rate of growth in OECD as a whole. He then uses the NiGEM model to simulate how a 1 percent increase in GDP affects the deficit/GDP ratio as a comparison. Fig. 1 illustrates the EU average of the impulse responses of d/y to output shocks. The impact builds up quite quickly over the first two years before dropping away to zero after 10 years. The peak of 0.4 is similar to values derived from Table 11 for the individual countries.

The fact that deficits in EU countries appear to be quite sensitive to cyclical fluctuations is good news in the sense that it may help to solve problems caused by country-specific output shocks. If the elasticity of surplus/output ratio to GDP growth is of the magnitude 0.2 to 0.3, the lack of a federal budget may not be such a serious problem as it would be otherwise. Interestingly, the output growth effects on deficits seem to be more important in depressions than in 'normal times'. This seems to be because policies appear to be quite different in these two regimes. Examination of the cyclically adjusted deficits reveals that policy seems to be counter-cyclical in bad times but that the opposite holds in good times. Thus, output growth leads to smaller surplus/GDP ratios. This could be explained by tax cuts or discretionary increases in expenditures in boom periods. Given the data, it is rather difficult to say which of these mechanisms dominates for EU countries.

The explanation appears to lie on revenue side in the sense that the cyclically adjusted revenues (in relation to trend GDP) seem to decrease when output increases. On the expenditure side, the coefficient of $\Delta y|\Delta y > 0$ points in the same direction (i.e. to a procyclical output growth effect). In the case of depressions, cyclically adjusted expenditures seem to behave counter-cyclically, while the revenue side is quite passive. Thus in bad times fiscal policy operates mainly via increases in expenditure. And, as mentioned above, in good times discretionary action mainly affects taxes in the form of tax cuts.

From the viewpoint of counter-cyclical fiscal policy, the main problem appears to be behaviour in ‘good times’. Although automatic stabilisers seem to operate in this case as well, discretionary action does not seem to help to smooth the output growth path. Expenditures are not cut but instead taxes are lowered rather than increased.

Thus in many respects the SGP is quite well adjusted to the natural inclinations of the member states in setting fiscal policy. It needs to push then towards using discretionary policy in a more symmetric and sustainable manner. Thus the current emphasis on trying to operate in surplus or near balance would provide both countervailing pressure and not inhibit the operation of normal automatic stabilisers.

5 Concluding Remarks

The sources of asymmetry within the euro economy and the asymmetry of monetary policy set some clear challenges to fiscal policy. Policy needs to be asymmetric itself. Downward pressures on the economy create greater problems for unemployment and participation rates than subsequent upturns of the same size unwind. The limited impact of negative output gaps on inflation, while the positive gaps can have substantial effects, encourages the monetary authority to make sure that inflation does not take off, thereby imposing a limiting factor on the upside. Downside threats, however, permit and, indeed, require much stronger policy reactions and here the asymmetry in the behaviour of the monetary authorities suggests that their actions will be very much in tune with the fiscal authorities in that phase of the cycle. It is however here that the SGP would cut in as the extent of deficits is limited. This does not appear to be problem with automatic stabilisation but with discretionary actions. In good times taxes are cut more than symmetrically but not raised when there is budgetary pressure. Correspondingly governments do not cut back on expenditure in good times well enough to balance out the tax cuts are rather too ready to raise expenditure in the downturn compared to their reluctance to raise taxes. There is therefore a deficit bias across the cycle, a feature the SGP seems designed to help counter. The emphasis of the SGP and wider EU level macroeconomic policy at present on reducing the general level of debt also seems appropriate as the member states appear to have reached the point where the share of public spending is sufficiently great that it may impair the overall growth rate of the economy. There may therefore be tension between policies designed to offset the impact of downturns and those aimed at faster growth. Matching up the two would require a different balance to the pattern of tax cutting and expenditure increases over the course of the cycle. The SGP pushes in that direction in the down phase but some other pressure is needed to increase the pressure/incentives in the up phase.

This leads naturally to one issue that remains - the appropriateness of the penalty. Imposing financial penalties on those in difficulty makes their short-run position even worse, whether or not the penalty has to be levied. The chances are that the excessive deficits will only be triggered when a country is a downswing. Thus avoid the excessive deficit would involve a fiscal tightening exactly when the inclination would if anything be to do the exact opposite. Thus the economy would be pushed into more of a difficulty than it would otherwise. This problem is a good incentive structure for the time consistency problem. If the member state organises itself prudently under normal times then the chance of it being faced by unfortunate pressure to tighten in a downturn will be small. It is thus well motivated not to get into that sort of position. The problem then comes if a country has deliberately or through bad luck got to the point where it will have to apply unfortunate policy or face the fine. The temptation then must be to defy the rules. The better social outcome is probably to carry on with the mistake and then put it right later on when the economy is doing better (even though the results in Section 3 suggested that this tends not to occur). Downturns tend not to be very prolonged so the opportunity to correct the underlying balance (and pay the fine) would not necessarily be delayed for more than a few years.

Thus if anything the problem is that the SGP does not threaten effective enough 'sanctions', especially if the actual behaviour is going to be that the Council of Ministers will shy away from harsh implementation of the Pact once important member states get into difficulty. Some minor softening in the short run would be credible of member states had shown more willingness in the past to adjust without the sanctions. In the longer-term, however, when there is no particular call for consolidation, one might very well want to move a system that had a rather more sophisticated way of judging whether policy was prudent. Some greater incentives to avoid getting into the unfavourable range might also help rather than just penalties once the event occurs.

Even now it is necessary to address the issue of how to handle member states that are already well within the debt criterion. There is a second issue of stability here. If all the member states were simultaneously to switch to a much more expansionary stance this will have a much bigger effect on overall policy and the interaction with monetary policy, We have already seen that monetary policy reacts much more vigorously to substantial threats to price stability than to small ones. In part this will be in reaction to the observed behaviour of the fiscal authorities. If the individual member states are out of phase or there are asymmetric shocks then, even if individual governments make big swings in the fiscal policy stance this will have little impact on the overall fiscal balance of the euro area or on monetary policy. It is correlated actions that cause the difficulty. Clearly the SGP would have to become much more complex if its rules for each individual country were to be contingent on the general position of the EU. Since all countries could be trying to improve their own position compared to the others this would result in a very complex game to determine the overall outcome. It would be very understandable if the EU were to stick with rules that apply to each individual country and were contingent purely on that countries' actions and prospects. The more opaque or complex the rule and the more it is open to discussion before it is applied, then the more contentious will be the political debate on each occasion. Simple, hard and fast (but fair) rules seem a more likely prospect.

One anomaly remains. As a result of the formation of the euro area, each member state's debt faces similar prices. It is not clear that the risks are so similar, unless markets believe that a state in difficulty would be helped by the others or indeed constrained from taking the more extreme risks. In the United States no such similarity in the pricing of state and other regional debt exists. States, cities and counties can and do default. There is thus much less pressure in the euro area on member states with weak financial positions and consequentially less benefit for states with strong positions to perform even better. There are a number of ways this might be handled. The ECB for example could differentiate among the member states' debt in its collateral policy. The US Fed only deals with federal debt not state debt. One could create a similar debt category, not by issuing European level debt but by issuing mutual guarantees on some debt, say up to 30 percent of GDP. States would be on their own above that. In the same well the ECB could limit the collateral it will take from any one state, thereby increase the interest rate on the excluded debt. There would be a strong incentive to remain within the acceptable limits to avoid these extra costs.

No doubt there are other solutions but it would help to have at least some incentives for better prudence right across the board and not just for those countries in difficulty. That would at least act as a greater encouragement to stay out of the danger zone. There is a tendency in the current context to try to think of rules for constraining behaviour. Just letting market pressures operate a bit more effectively might also have a lot to recommend it.

Table 1 Simultaneous system estimation from panel data

	SUR	SUR	SUR	SUR	SUR	SUR
y_0	.0.031	.031	.033	.030	.072	.071
	(4.16)	(4.12)	(5.16)	(4.93)	(15.15)	(15.18)
∇y_{-1}	.759	.757	.767	.764	.714	.714
	(52.30)	(52.40)	(58.87)	(57.49)	(113.09)	(111.56)
$\nabla y_{oecd,-1}$	.181	.188	.195	.206	.184	.183
	(6.91)	(7.26)	(8.17)	(8.74)	(13.33)	(13.42)
Rs	-.191	-.195	-.156	-.156	-.299	-.299
	(5.58)	(5.72)	(5.78)	(5.85)	(39.13)	(38.08)
Re	-.034	-.032	-.035	-.033	-.077	-.078
	(4.00)	(3.95)	(5.02)	(4.78)	(14.87)	(14.91)
u_0	-.013	-.014	-.014	-.014	-.008	-.010
	(1.66)	(1.70)	(1.70)	(1.64)	(1.30)	(1.51)
u_{-1}	.743	.740	.743	.742	.677	.677
	(81.46)	(80.53)	(90.76)	(89.06)	(94.32)	(91.00)
y^-	-.169	-.171	-.173	-.174	-.205	-.206
	(19.11)	(18.87)	(21.32)	(20.82)	(31.90)	(30.19)
y^+	-.147	-.148	-.151	-.151	-.131	-.130
	(16.00)	(15.98)	(18.33)	(18.13)	(13.33)	(12.58)
Δpop_{-1}	.038	.031	.022	.017	.084	.085
	(2.17)	(1.79)	(1.40)	(1.15)	(3.63)	(3.61)
p_0	.003	.002	.003	.003	.003	.003
	(11.52)	(9.20)	(12.69)	(9.93)	(26.88)	(25.33)
Δp_{-1}	.254	.261	.263	.271	.097	.085
	(11.79)	(11.51	(13.17)	(12.69)	(9.84)	(8.24)
Δp_{-2}	.313	.329	.318	.337	.268	.259
	(15.12)	(15.14)	(16.45)	(16.32)	(27.56)	(25.51)
Δm	.019	.015	.033	.028	.028	.027
	(6.66)	(5.13)	(11.02)	(8.90)	(19.59)	(18.03)
Δm_{-1}	.018	.018	.027	.028	.023	.018
	(5.72)	(6.09)	(8.84)	(9.13)	(15.52)	(11.45)
x^-	-.115	-0002	-.111	.019	-.072	-.017
	(4.66)	(0.06)	(5.01)	(1.28)	(5.36)	(3.12)
x^+	.052	.105	-.082	.103	-.012	.041
	(2.25)	(7.27)	(4.00)	(7.78)	(1.66)	(5.09)
RS_{-1}	.853	.853	.834	.833	.772	.771
	(89.20)	(88.56)	(84.84)	(82.65)	(252.43)	(238.45)
Δp	.212	.212	.222	.219	.390	.391
	(8.27)	(8.12)	(8.68)	(8.37)	(66.80)	(65.89)
∇y	.214	.212	.230	.227	.159	.159
	(15.77)	(15.45)	(17.61)	(17.01)	(41.77)	(42.13)
Period	1985-2001	1985-2001	1985-1998	1985-1998	1993-2001	1993-2001
def. of x	∇u	∇y	∇u	∇y	∇u	∇y
λ	5.70	6.02	4.42	4.70	3.86	3.85
Wald $b_1 = b_2$	2.32 (.128)	2.31 (.124)	2.66 (.103)	2.88 (.089)	30.28 (.000)	.27.90 (.000)
Wald $c_5 = c_6$	2.74 (.098)	17.92 (.000)	0.74 (.389)	13.13 (.003)	11.54 (.001)	25.34 (.000)

y_0, u_0 and p_0 denote the constant terms of IS, Okun and Phillips curves, respectively. In the Taylor rule (last three rows of estimates), the intercept r_0 was allowed to vary from country to country. Number of observations 720.

Table 2 Estimates of the Expanded IS Curve with Panel Cross-country Data

	∇y	$\Delta \log y$
Y(-1)	.795	-.068
	(31.33)	(1.61)
Rr	-.013	-.033
	(1.26)	(3.20)
Re	.007	.014
	(2.42)	(4.76)
Yoecd	.112	.341
	(2.28)	(4.04)
Δhp	.043	.060
	(4.60)	(6.12)
Δsp	.002	.007
	(0.68)	(2.27)
R^2	.729	.246
100*see	.761	.825
DW	2.036	2.009
period	1985-2000	1985-2000
N/obs	11/540	11/540

Variables are as defined in the text , *y* is GDP, ∇y is the log output gap, *Y*(-1) denotes the lagged output variable and *Yoecd*, the output variable for the OECD as a whole, both defined compatibly depending upon whether the output variable is the output gap or the change in output as indicated by the column headings. *N* denotes the number of countries and obs the total number of observations in the regression

Table 3 Phillips curve estimates from the panel data

	OLS	GLS	SUR	OLS	GLS	SUR
Δp_{-1}	.199	.173	.147	.195	.178	.158
	(5.05)	(5.23)	(4.11)	(5.11)	(5.32)	(4.88)
Δp_{-2}	.249	.256	.208	.239	.247	.201
	(5.68)	(7.29)	(6.03)	(5.49)	(7.14)	(5.90)
Δm	.013	.007	.006	.019	.014	.009
	(1.46)	(2.00)	(1.26)	(2.12)	(2.69)	(1.96)
Δm_{-1}	.020	.013	.011	.020	.013	.015
	(2.54)	(3.95	(2.38)	(2.66)	(3.29)	(3.13)
∇x^-	-.022	-.034	.006	-.177	-.145	-.081
	(0.60)	(1.48)	(0.22)	(2.58)	(2.78)	(1.96)
∇x^+	.163	.159	.099	-.078	-.072	-.060
	(4.12)	(5.20)	(4.29)	(1.71)	(1.87)	(1.59)
R^2	.373	.373	.373	.365	.363	.355
SEE	.006	.006	.006	.006	.006	.006
DW	1.967	2.027	1.907	2.042	2.012	1.935
N	732	732	732	770	770	770
Wald	8.15	19.51	5.12	0.75	.084	.109
	(.004)	(.000)	(.024)	(.401)	(.357)	(.741)
Def. of ∇x	∇y	∇y	∇y	∇u	∇u	∇u

p denotes consumer prices, *m* import prices, ∇y the HP output gap for GDP, ∇u is the deviation of unemployment from the mean level of unemployment over the sample. The data period stretches from 1985.1 to 2001.3. t values in parentheses using heteroscedasticity consistent standard errors. Wald test for equality of coefficients on ∇x^- and ∇x^+ p-value in parenthesis.

Table 4 Estimates of the Phillips curve with regional EU data

	(1)	(2)	(3)	(4)	(5)	(6)
Δp^e	.655	.649	.513	.488		.522
	(12.42)	(10.17)	(12.72)	(11.77)		(13.76)
Δp(- 1)	.254	.214	.191	.143	.567	.187
	(5.72)	(3.92)	(5.26)	(3.66)	(23.89)	(5.31)
Δm	.058	.056	.063	.068	.085	.065
	(6.56)	(5.43)	(10.14)	(9.25)	(13.19)	(10.54)
U	-.053	-.003	-256	-248	-290	-306/-.260
	(3.36)	(0.23)	(10.06)	(12.84)	(11.82)	(11.66/12.00)
Umax-	.068		.147		.154	.130
Umin	(4.81)		(6.47)		(6.86)	(5.91)
Usd		.103		.192		
		(2.32)		(2.93)		
T	-.016	-.001	-.112	-.108	-.112	-.110
	(1.82)	(0.45)	(10.06)	(9.05)	(9.25)	(10.57)
R2	.868	.866	.914	.918	.885	.918
SEE	.963	1.073	.816	.878	.938	.797
DW	1.526	1.289	1.800	1.590	1.928	1.822
Dummies	No	No	yes	yes	Yes	Yes
Obs	153	143	153	143	153	153

SUR estimates. Δp^e denotes expected inflation (OECD forecasts), m import prices, Δp is inflation in consumption prices, *U* the aggregate unemployment rate, *Umax-Umin* the range of regional unemployment rates, *Usd* the corresponding standard deviation and *t* time trend. Column (6) is estimated using a threshold model specification and allowing the coefficient of the unemployment rate to vary depending on whether the rate is below (first coefficient) or above the 10.8% (second coefficient) threshold. The hypothesis that the coefficients are equal can be rejected with marginal probability of 0.0013% using the F test.

Table 5. Estimates of a nonlinear Okun curve

	$y^+(0)$	$y^-(0)$	$y^+(c)$	$y^-(c)$	F
Austria	–.039	–.512	–.050	–.075	14.53
	(3.76)	(–.047)	(5.03)	(3.93)	
Belgium	–.026	–.125	–.038	–.070	18.29
	(2.33)	(2.85)	(4.42)	(4.66)	
Denmark	–.022	–.451	–.030	–.392	18.45
	(1.03)	(3.36)	(1.48)	(3.52)	
Finland	–.071	–.070	–.066	–.079	16.82
	(5.29)	(3.07)	(6.15)	(6.28)	
France	–.019	–.050	–.028	–.080	15.75
	(1.15)	(0.43)	(2.00)	(2.48)	
Germany	–.096	–.135	–	–	–
	(4.56)	(0.93)			
Greece	–.023	.024	–.027	.038	21.67
	(3.03)	(0.67)	(3.58)	(1.19)	
Iceland	–.072	–.119	–.076	–.121	15.67
	(4.84)	(2.81)	(5.76)	(3.35)	
Ireland	–.019	–.088	–.025	–.050	5.20
	(2.17)	(0.35)	(3.31)	(2.86)	
Italy	–.026	.021	–.019	–.043	14.05
	(2.27)	(0.34)	(1.81)	(2.82)	
Netherlands	–.023	–.182	–.048	–.123	112.86
	(0.95)	(1.22)	(2.73)	(4.07)	
Norway	–.043	–.185	–.059	–.094	6.79
	(2.14)	(0.49)	(3.00)	(2.95)	
Portugal	–.044	–.250	–.055	–.094	16.11
	(2.47)	(0.71)	(3.19)	(3.60)	
Spain	–.019	–.062	–.026	–.013	29.24
	(3.49)	(0.79)	(5.09)	(1.61)	
Sweden	–.064	–.122	–.062	–.110	13.11
	(2.72)	(1.92)	(3.65)	(5.05)	
UK	–.032	.095	–.031	.102	21.08
	(1.50)	(1.83)	(1.51)	(1.97)	

Numbers in parentheses are t-ratios $y^+(0)$ and $y^-(0)$ denote estimates with zero threshold and $y^+(c)$ and $y^-(c)$ estimates with nonzero (estimated) threshold value. The parameters are derived from the following estimating equation $\Delta u_t = a_0 + a_1\Delta y^+_t + a_2\Delta y^-_t + a_3\Delta pop_t + a_4\varepsilon_{t-1} + e_t$, where *u* denotes the (log) number of unemployed, *y* the growth rate of output, *pop* the (log) working-age population, ε an error-correction term in terms of *u*, *pop* and time trend and *e* the error term. In the nonlinear case, *y* is replaced by y^+ and y^- so that y^+ corresponds to positive values of *y* and y^- to negative values. F is the F(1,31) test for the equality of the coefficients of y^+ and y^- in the case of nonzero threshold. Estimates are based on annual OECD data for 1961–1997.

Table 6 Okun curve estimates from the panel data

	OLS	GLS	SUR	OLS	GLS	SUR
U-1	.960	.960	.971	.739	.794	.782
	(82.33)	(134.31)	(154.46)	(27.62)	(56.51)	(51.10)
∇y^-	-.219	-.194	-.135	-.173	-.135	-.134
	(6.01)	(10.74)	(7.23)	(6.28)	(10.87)	(9.16)
∇y^+	-.007	-.025	-.040	-.150	-.131	-.137
	(0.20)	(1.51)	(2.20)	(5.64)	(9.79)	(9.35)
Δpop-1	.047	.046	-.026	.025	.037	-.032
	(1.17)	(1.47)	(0.80)	(0.66)	(1.17)	(1.15)
R^2	.990	.990	.990	.823	.822	.8722
SEE	.427	.427	.430	.344	.347	.346
DW	1.600	1.586	1.555	1.979	2.024	2.011
N	750	750	750	750	750	750
Wald	13.08	32.25	9.30	0.21	0.03	0.02
	(.000)	(.000)	(.002)	(.648)	(.865)	(.886)
Dep.var.	*u*	*u*	*u*	∇u	∇u	∇u

Dependent variable is either the unemployment rate *u* or the corresponding HP residual ∇u. ∇y^- (∇y^+) denotes the negative (positive) values of HP residuals in terms of log GDP. Wald denotes the Weld test statistic for the equality of the coefficients of ∇y^- and ∇y^+.

Table 7 Reaction function estimates

R_{t-1}	.771	.863
	(238.15)	(63.54)
Δp_t	.391	
	(65.89)	
$\Delta p_t \vert \Delta p_t$<.005		.281*)
		(2.30)
$\Delta p_t \vert \Delta p_t$>.005	.159	.164
	(42.13)	(3.30)
∇y_t		
$\nabla y_t \vert \nabla y_t$<0		.112*
		(2.65)
$\nabla y_t \vert \nabla y_t$>0		.381
		(5.72)

The Wald test result for the equality of the two respective coefficients is 927 (.009), Thus, the linrear model is rejected at the 1 per cent significance level with the chi-square distribution. All estimates are derived form the whole system of equations. Data period is 1993-2001.

Table 8 Corridor Reaction function estimates

Δpt| Δpt<0	.602
	(3.63)
Δpt| 0<Δpt<.01	.153
	(3.32)
Δpt| Δpt>.01	.230
	(6.60)
∇yt|∇yt<-.02	.249
	(9.32)
∇yt|-02<∇yt<.02	.074
	(3.80)
∇yt|∇yt>.02	.147
	(0.41)

Data period is 1993-2001, maximum likelihood, reaction functions only.

Table 9 Threshold model estimation results for the government size model

Country	$\hat{\beta}_1$	$\hat{\beta}_2$	SEE/DW	FHO	FHT	LM
Australia	.365	.049	.025	18.9	9.7	2.14
	(1.74)	(0.51)	(2.069)	(.051)	(.016)	(.154)
Austria	.580	−.568	.019	20.4	11.52	0.39
	(1.71)	(1.69)	(1.759)	(.046)	(.003)	(.538)
Belgium	.690	−.119	.023	36.7	7.5	0.120
	(2.34)	(0.48)	(2.159)	(.000)	(.119)	(.283)
Canada	.370	−.751	.027	4.9	4.3	2.86
	(1.57)	(1.26)	(1.714)	(.865)	(.663)	(.104)
Denmark	.113	−.700	.024	19.2	7.2	1.63
	(0.80)	(2.86)	(1.833)	(.046)	(.167)	(.212)
Finland	.458	−1.144	.032	10.6	3.6	1.25
	(1.68)	(2.25)	(1.648)	(.308)	(.876)	(.274)
France	1.417	.121	.017	12.9	8.7	.002
	(3.23)	(0.25)	(1.961)	(.270)	(.028)	(.966)
Germany	−.063	−1.537	.023	14.6	6.3	0.98
	(0.80)	(3.64)	(1.767)	(.138)	(.283)	(.331)
Greece	.933	−.354	.031	26.6	11.6	0.16
	(1.98)	(1.39)	(1.734)	(.007)	(.003)	(.696)
Iceland	.138	−1.021	.040	5.25	3.8	0.95
	(0.61)	(1.61)	(1.813)	(.862)	(.830)	(.338)
Ireland	−.109	−.941	.029	7.1	7.2	0.04
	(0.44)	(1.89)	(1.947)	(.697)	(.177)	(.845)
Italy	1.278	.293	.022	12.7	5.9	0.89
	(3.28)	(0.99)	(1.785)	(.221)	(.415)	(.354)
Japan	1.325	−.880	.024	24.3	6.8	2.74
	(2.16)	(2.55)	(2.366)	(.024)	(.237)	(.108)
Netherlands	.156	−1.617	.013	24.6	6.3	0.27
	(0.67)	(4.37)	(1.868)	(.040)	(.210)	(.605)
New Zealand	.418	−.697	.037	15.8	6.1	.04
	(1.06)	(1.69)	(2.047)	(.129)	(.360)	(.853)
Norway	.448	.159	.019	7.6	7.3	5.05
	(1.54)	(1.01)	(1.642)	(.663)	(.131)	(.033)
Portugal	.169	−.153	.032	7.7	3.5	0.28
	(1.37)	(1.23)	(2.076)	(.521)	(.935)	(.603)
Spain	.186	−.172	.020	17.6	5.8	0.31
	(1.14)	(1.57)	(2.272)	(.096)	(.359)	(.584)
Sweden	.330	−.123	.022	12.8	7.7	3.99
	(1.90)	(0.88)	(1.673)	(.222)	(.117)	(.055)
Switzerland	.325	−.904	.022	15.2	5.4	7.51
	(1.06)	(2.05)	(1.407)	(.106)	(.449)	(.010)
UK	.628	−.131	.024	7.9	4.6	12.41
	(1.74)	(1.04)	(1.488)	(.636)	(.681)	(.002)
USA	.551	−.008	.024	8.8	3.9	10.72
	(1.62)	(0.03)	(1.594)	(.491)	(.876)	(.003)

Numbers inside parentheses below the coefficient estimates are t-ratios. SEE is the standard error of estimate and DW the Durbin-Watson test statistic (which here suffers from the bias caused by lagged dependent variable). FHO denotes the LM (F) test for no threshold and FHT the corresponding test for threshold allowing for heteroscedastic errors. Numbers inside parentheses below the F statistics are bootstrap probability values. Finally, LM denotes a LM test for first-order autocorrelation of residuals (corresponding marginal significance levels are inside parentheses). When computing this LM test we have utilised Chan (1993), in which it is shown that the threshold parameter is superconsistent and can thus be treated as a known parameter.

Table 10 Estimation results of the government size model with panel data

	β/β_1	β_2	γ	ϕ	SEE/R^2	$\hat{H}$
Linear	–.020		.294		.028	–
	(0.12)		(8.59)		0.171	
G/Y	.131	–.058	.325		.027	0.157
Threshold	(2.64)	(1.35)	(9.35)		0.185	
Eq (3) with	.404		.281	–2.460	.028	0.164
H = G/Y	(5.55)		(8.35)	(5.85)	0.186	

All estimates are SUR estimates with panel data consisting of 736 data points. All equations also include country intercepts, which are not reported. The threshold models (columns 2–4) are estimated using the average values of the threshold variable from the single country models. With the multiplicative model (the last three set of estimates) the threshold values are derived from the estimates of β and ϕ.

(*Data sources for Tables 9 and 10*:

Y Gross Domestic Product at current or constant 1990 prices, OECD National Accounts, CD-ROM, OECD, Paris.

G Public consumption or public sector (i.e. producers of government services) production, both at current or constant 1990 prices, OECD National Accounts, CD-ROM, OECD, Paris.

L_g Public sector employment (thousands of persons). Employment in the Public Sector, OECD 1982, Paris; OECD National Accounts, CD-ROM, OECD, Paris; and some national sources. Data available from Viren upon request.

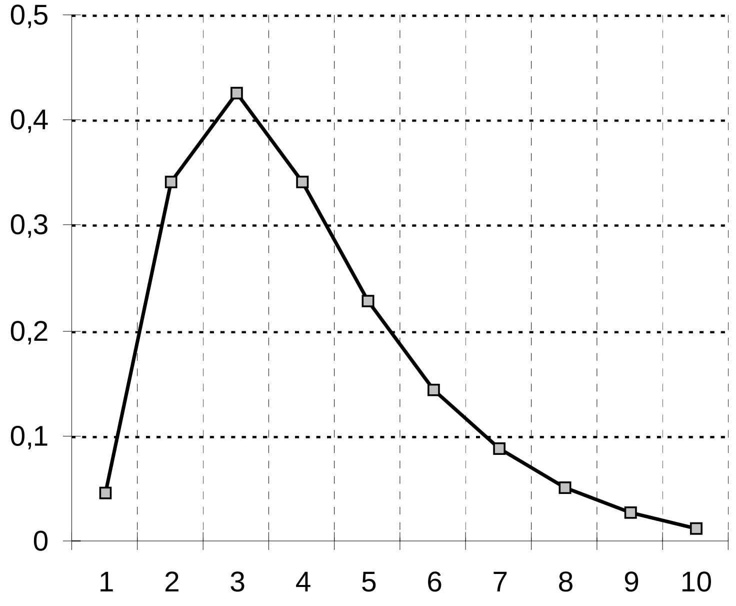
L_p Private sector employment (thousands of persons). (Data source as L_g.)

Table 11 Selected country-specific estimates of the deficit equation

	$\Delta y < 0$	$\Delta y > 0$	$\Delta y < 0$	$\Delta y > 0$	$\Delta y < 0$	$\Delta y > 0$
Austria	2.115	.140	1.166	.279	.864	-.032
	(1.04)	(1.21)	(0.60)	(3.10)	(0.40)	(0.33)
Belgium	1.115	.212	.816	.090	-.238	-.105
	(2.34)	(1.78)	(1.79)	(0.98)	(0.47)	(1.01)
Denmark	2.084	.381	2.006	.494	1.726	-.229
	(2.01)	(2.51)	(1.78)	(2.92)	(1.79)	(1.56)
Finland	1.158	.168	.897	.177	.554	-.359
	(6.01)	(1.55)	(5.66)	(2.33)	(3.17)	(4.31)
France	1.092	.368	1.329	.246	.628	-.060
	(2.17)	(3.62)	(3.07)	(2.97)	(1.33)	(0.62)
Germany	-	-	1.344	.106	1.168	-.321
			(1.86)	(1.05)	(1.52)	(3.02)
Greece	.021	.306	.168	.145	-.338	.061
	(0.09)	(2.51)	(0.79)	(1.90)	(1.47)	(0.75)
Ireland	-8.362	.048	-7.130	.041	-7.086	-.155
	(1.44)	(0.54)	(1.26)	(0.49)	(0.96)	(1.33)
Italy	.718	.149	.861	-.051	.258	-.179
	(1.82)	(1.69)	(1.80)	(0.41)	(0.66)	(1.75)
Nether-	.134	.241	.404	.187	-.293	-.301
lands	(0.15)	(1.54)	(0.48)	(1.38)	(0.32)	(2.05)
	.155	.298	.510	.210	-.143	.079
Portugal	(0.43)	(2.39)	(1.59)	(2.12)	(0.41)	(0.75)
	1.757	.182	1.217	.206	1.013	-.216
Spain	(2.67)	(2.67)	(1.94)	(3.12)	(1.45)	(2.88)
	3.112	.128	2.852	.059	2.314	-.634
Sweden	(5.36)	(0.49)	(4.74)	(0.22)	(3.84)	(2.29)
	-	-	-.424	.309	-.615	-.269
UK			(0.93)	(2.10)	(1.44)	(1.96)
Data	def	def	defp	Defp	defa	defa
	1972-99	1972-99	1961-99	1961-99	1961-99	1961-99

def denotes net lending, defp net lending excluding interest expenses, defa the structural deficit, defc the cyclical component of net lending. All of these are related to trend GDP. SUR estimates.

Fig. 1. An EU average of the impulse responses of d/y* to growth shocks



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