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How effective are automatic stabilisers? Theory and empirical results for Germany and other OECD countries

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Abstract:

Cyclically induced changes in taxes and government expenditures which tend to stabilise aggregate output are called automatic stabilisers. Using a small macro model, this paper reviews alternative methods of measuring the smoothing power of automatic stabilisers and discusses their relationship to the Ricardian Equivalence Theorem. Based on simulation exercises with the macroeconometric multi-country model of the Deutsche Bundesbank, the empirical part of the paper presents estimates of the smoothing power of automatic stabilisers for Germany and some other OECD countries. The results for Germany suggest that in the first year 15 to 20 per cent of an exogenous demand shock are absorbed by the automatic stabilisers. Similar results are obtained for France, Italy, the Netherlands, UK, Canada and the US.

Keywords: Fiscal policy, automatic stabilisers, smoothing power, compensation method

JEL-Classification: E62, H62, H30

Non-Technical Summary

EMU member countries do no longer have the instrument of a national monetary policy. Therefore, the need for fiscal policy to stabilise the economy has increased. At the same time the Maastricht Stability and Growth Pact requires a high degree of budgetary discipline, reducing the scope of fiscal policy. For this reason the German Council of Economic Experts (Sachverständigenrat 2003) points to the effectiveness of the automatic stabilisers.

Cyclically induced changes of taxes and government expenditures which tend to stabilise aggregate output are called automatic stabilisers. This paper investigates the effectiveness of automatic stabilisers within a small theoretical macro model and presents empirical simulation results for Germany and some other OECD countries obtained with the macroeconometric multi-country model of the Deutsche Bundesbank.

The theoretical model is a version of the P-star model, extended by aspects of fiscal policy. The model explains the goods market by an aggregate demand function and a Phillips-type relationship according to which inflation is driven by the price gap. Derived from a long-run money demand function, the price gap signals inflationary pressure if the output gap is positive, if interest rates are low, or if there is a monetary overhang. Monetary policy is described by a simple reaction function of the central bank in which interest rates respond to deviations from an inflation target. Aggregate equations for taxes, public expenditures and a definition of the budget deficit close the model.

Measuring the effectiveness of automatic stabilisers in response to a demand shock requires a benchmark calculation in which the automatic stabilisers are deactivated. The paper discusses alternative methods: exogenisation of the budget components (EX), revenue compensation (RC) and expenditure compensation (EC). It is found that EX yields the smallest smoothing power of automatic stabilisers and EC the largest.

From a Keynesian point of view the expansionary effects of increasing public expenditures are larger if they are debt-financed rather than by increasing taxes. By contrast, the Ricardian Equivalence Theorem postulates that economic agents - under

certain conditions - are indifferent with respect to the mode of financing public expenditures. The paper briefly discusses the effectiveness of automatic stabilisers under Ricardian Equivalence.

In the empirical part, the paper sketches the Bundesbank model and the structure of its public finance block. Then the design of the simulation exercises is described. First, the short-run multipliers of various budget components (public consumption, transfers, subsidies, direct taxes, indirect taxes) are calculated and then the effects of exogenous shocks to private demand, private investment and exports are simulated.

According to the results obtained for Germany, 14 (EX), 18 (RC) or 26 (EC) per cent of an exogenous shock to private consumption are absorbed through the automatic built-in stabilisers within the first year. In case of a shock to private investment or to exports the smoothing power is lower. On average, the effectiveness of automatic stabilisers is found to be 17 per cent (compared to 14 per cent obtained in similar experiments with the QUEST model of the EU Commission). For some other OECD countries (France, Italy, the Netherlands, UK, Canada and the US) similar smoothing effectiveness is found.

Nicht technische Zusammenfassung

Die Mitgliedsländer der Europäischen Währungsunion (EWU) verfügen nicht mehr über das Instrument einer eigenständigen Geldpolitik. Dadurch sind die Stabilisierungsanforderungen an die Fiskalpolitik größer geworden. Zugleich fordert der Stabilitäts- und Wachstumspakt von Maastricht ein hohes Maß an Haushaltsdisziplin, was den diskretionären Spielraum der Fiskalpolitik einschränkt. Der Sachverständigenrat (2003) verweist in diesem Zusammenhang auf die Wirksamkeit der automatischen Stabilisatoren.

Als automatische Stabilisatoren werden die zyklisch induzierten Veränderungen des Steueraufkommens und der Staatsausgaben bezeichnet, die sich stabilisierend auf das Sozialprodukt auswirken. Dieses Papier untersucht die Wirksamkeit der automatischen Stabilisatoren im Rahmen eines kleinen theoretischen Makromodells und präsentiert empirische Simulationsergebnisse für Deutschland sowie einige andere OECD - Länder, die mit dem makroökonometrischen Mehrländermodell der Deutschen Bundesbank ermittelt wurden.

Bei dem theoretischen Modell handelt es sich um eine Version des P-Stern - Modells, das um fiskalpolitische Aspekte erweitert wurde. Dieses Modell beschreibt den Gütermarkt durch eine aggregierte Nachfragefunktion sowie eine Phillips-Beziehung, bei der die Inflationsrate von der Preislücke getrieben wird. Die aus einer langfristigen Geldnachfragefunktion abgeleitete Preislücke signalisiert Inflationsgefahren bei hohem Auslastungsgrad des Produktionspotentials, niedrigen Zinsen sowie bei einer reichlichen Geldversorgung. Die Geldpolitik wird durch eine einfache Reaktionsfunktion für die Notenbank beschrieben, bei der die Zinsen auf Abweichungen vom Inflationsziel reagieren. Gleichungen für die öffentlichen Einnahmen, die Ausgaben sowie eine Definition des Haushaltsdefizits schließen das Modell ab.

Um die Wirksamkeit der automatischen Stabilisatoren bei einem Nachfrageschock zu messen, wird eine Vergleichsrechnung benötigt, bei der die Stabilisatoren außer Kraft gesetzt sind. In dem Papier werden verschiedene Verfahren diskutiert: Exogenisierung der Haushaltskomponenten, Einnahmenkompensation und Ausgabenkompensation. Es stellt sich heraus, dass die Exogenisierungsmethode die Wirksamkeit der automatischen Stabilisatoren am kleinsten ausweist, während sie bei der Ausgabenkompensation am größten erscheinen.

Nach Keynesianischer Sichtweise sind die expansiven Effekte einer kreditfinanzierten Erhöhung der öffentlichen Ausgaben größer als die einer steuerfinanzierten Ausgabenexpansion. Demgegenüber postuliert das Ricardianische Äquivalenz-Theorem, dass die Wirtschaftssubjekte - unter bestimmten Bedingungen - gegenüber der Finanzierungsart der öffentlichen Ausgaben indifferent sind. Das Papier geht kurz auf diese Diskussion und die Wirksamkeit der automatischen Stabilisatoren unter dem Ricardo Theorem ein.

Im empirischen Teil der Arbeit werden das Bundesbankmodell und die Struktur des Fiskalblocks skizziert. Anschließend wird der Aufbau der Simulationsrechnungen beschrieben. Zunächst werden die kurzfristigen Multiplikatoreffekte verschiedener Haushaltskomponenten (Staatsverbrauch, Transferzahlungen, Subventionen, direkte und indirekte Steuern) ermittelt und danach werden die Auswirkungen von exogenen Schocks auf den privaten Verbrauch, die privaten Investitionen und die Exporte simuliert.

Den Ergebnissen zufolge werden in Deutschland 14 (Exogenisierung), 18 (Einnahmenkompensation) bzw. 26 (Ausgabenkompensation) Prozent eines exogenen Konsumschocks durch die automatischen Stabilisatoren im öffentlichen Haushalt innerhalb des ersten Jahres eliminiert. Bei einem Investitions- und einem Exportschock sind die Glättungseffekte geringer. Im Durchschnitt ergibt sich eine Glättungskraft der automatischen Stabilisatoren von 17 Prozent (verglichen mit 14 Prozent in ähnlich angelegten Rechnungen mit dem QUEST-Modell der EU-Kommission). Für einige andere OECD-Länder (Frankreich, Italien, Niederlande, Großbritannien, Kanada und die USA) ergeben sich ähnliche Glättungseffekte.

Contents

List of Tables

How effective are automatic stabilisers?

Theory and empirical results for Germany and other OECD countries*

1. Introduction

EMU member countries no longer have the instrument of a national monetary policy. This has made it more difficult to stabilise the domestic economy in the case of asymmetric shocks. Hence, the role for stabilisation of fiscal policy (and wage policy as well) has increased. However, the Maastricht Stability and Growth Pact calls for a high degree of budgetary discipline, thereby restricting scope for discretionary measures.

The German Council of Economic Experts (2003, p. 375) points out that discretionary fiscal policy may possibly have an impact in the short run, but is too ineffective and untargeted. The Council argues that an active fiscal policy increases output volatility and reduces growth in potential output.[1] It is sceptical as to whether fiscal activism can succeed and draws attention to the automatic stabilisers. Automatic stabilisers are cyclically induced changes in tax revenues and government expenditures. This raises the question how effective automatic stabilisers are in absorbing asymmetric shocks to output and income.

Below, we discuss the smoothing power of automatic stabilisers, first in the context of a small theoretical macro model and then empirically, adopting simulation exercises with the Bundesbank´s macroeconometric multi-country model (BbkM). In section 2, we analyse the mechanism of automatic stabilisers in the P-star model. Section 3 discusses various methods for measuring smoothing power. Section 4 reviews the relationship between automatic stabilisers and Ricardo equivalence. Section 5 gives a short overview of the fiscal block in the BbkM and presents simulation results for

* The opinions expressed do not necessarily reflect the view of the Deutsche Bundesbank. We would like to thank Hans-Eggert Reimers (University of Technology, Business and Design, Wismar), Britta Hamburg, Christian Schumacher, Carsten Wendorff (Deutsche Bundesbank), the staff of the German Council of Economic Experts, Wiesbaden, as well as the participants in the IWH Workshop on Macroeconomics in Halle from 27-28 November 2003 for their helpful comments.

[1] Feldstein (2002) does not agree with this point of view. Calmfors (2003) believes that even if discretionary domestic fiscal policy were able to stabilise the economy, technically speaking, it could not do so given the prevailing institutional framework.

Germany. Section 6 contains simulation results with this model for some other OECD countries, compared to other recent studies. Some conclusions are drawn in section 7.

2. A small monetary macro model

We consider a simple version of the P-star model,[2] extended by fiscal policy aspects:

$$y_t = \alpha(y_t - e_t) - \lambda(i_t - \pi_t - i^*) + g_t + \varepsilon_t \tag{1}$$

$$\pi_t = \eta\, q_t + \upsilon_t \tag{2}$$

$$q_t = \beta y_t - \gamma(i_t - i^*) + u_t \tag{3}$$

$$i_t = i^* + \theta\, \pi_t \tag{4}$$

$$e_t = \tau_o + \tau y_t \tag{5}$$

$$g_t = \kappa_o + \kappa y_t \tag{6}$$

$$d_t = g_t - e_t \tag{7}$$

Equations (1-2) describe the goods market, (3-4) the money market and (5-7) fiscal policy. With the exception of the interest rate (i), the equilibrium interest rate (i*) and the inflation rate (π), all variables are denoted as natural logarithms. Potential output (y*) and the inflation target $(\hat{\pi})$ are normalised to zero to simplify notation. All parameters are positive.

Real demand (y) depends on income 'net of taxes' (y-e), the real interest rate (ie its deviation from equilibrium) (i - π - i*), government expenditures (g) and a demand shock (ε). Demand reacts to changes in income (y) and taxes (e) with the same elasticity $0 < \alpha < 1$. The inflation rate (deviation from the inflation target) depends on the price gap (q) and a price shock (υ). The price gap is an indicator of inflationary pressures. It is derived from a long-run money demand function (8), in which real money demand (m - p) depends on output (y), the nominal interest rate (i) and a money demand shock (u):

$$m_t - p_t = \beta y_t - \gamma i_t + u_t \tag{8}$$

$$p_t^* = m_t - \beta y_t^* + \gamma i^* \tag{9}$$

Thus in equation (9) the equilibrium price level (p*) is defined as the price level that would emerge in the long run at given current money balances (m) if both output and interest rates were in equilibrium (y = y*, i = i*). Combining equations (8) and (9) defines the price gap (3): $q \equiv p^* - p$. There is upward price pressure when capacity utilisation is high, interest rates are low and/or money holdings are higher than those desired in the long-run (ie when there is a monetary overhang u).[3] By contrast, the inflation rate in the New-Keynesian (NK-) type of models reacts only to changes in the output gap. As we want to focus on shocks to demand for goods, we neglect shocks to prices and to money demand ($\upsilon = u = 0$). We assume that demand shocks (ε) have zero mean, constant variance (σ_ε^2) and are not serially correlated.

Equation (4) is a simple monetary policy reaction function. The central bank raises the short-term interest rate by θ percentage points above its equilibrium value whenever inflation exceeds its target by 1 percentage point.

The budget deficit is defined as the difference between government expenditures and revenues: D = G - E. Expressing this in relation to revenues, ($D/E \equiv d$), we obtain: 1 + d = G/E, which is, in logarithmic terms, approximately equal to (7). Tax revenues (e) in (5) react with elasticity τ to changes in income, whereas government expenditures (g) in (6) display elasticity κ. Although expenditures contain countercyclical components such as unemployment insurance, the overall reaction is procyclical.

Solving the system for the endogenous variables (y, π, q, i, e, g, d), we obtain the reduced-form equation for output:

$$y_t = m(\kappa_o - \alpha\tau_o + \varepsilon_t) \tag{10}$$

$$m = \frac{1}{1-\alpha+\psi(\theta-1)+\alpha\tau-\kappa} \quad \text{with} \quad \psi = \frac{\lambda\eta\beta}{1+\eta\gamma\theta} \tag{11}$$

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[2] Tödter (2002) discusses the P-star model in detail.

[3] Alternatively, one could define the equilibrium money stock as the money stock demanded at the prevailing price level, if both output and interest rates were in equilibrium: $m^* = p + \beta y^* - \gamma i^*$. However, the resulting 'money gap' and the price gap are identical: $m - m^* = p^* - p$.

The multiplier (m) of output with respect to demand shocks depends on the behavioural parameters of the model (α, λ, η, β, γ), on monetary policy (θ) and on fiscal policy (τ, κ). The bigger the multiplier, the stronger the output fluctuations due to exogenous demand shocks:

$$\sigma_y^2 = m^2 \sigma_\varepsilon^2 \tag{12}$$

The reaction to exogenous shocks is dampened by a number of crowding-out effects. A low propensity to spend (α) and high interest-rate elasticity of demand (λ) have a stabilising effect. The same is true for a high income elasticity (β) and low interest-rate elasticity (γ) of money demand. A high flexibility of prices with respect to inflationary pressure (η) also has a stabilising effect. With the exception of α, these effects apply only if monetary policy obeys the Taylor principle, ie if the central bank reacts with $\theta > 1$ to deviations of inflation from its target.

Moreover, the multiplier reflects the stabilising influence of the tax system, whereas government expenditures per se are destabilising. The government sector overall exerts a stabilising influence when $\alpha\tau - \kappa > 0$, which we shall assume below:[4]

Positive demand shocks also lead to a higher inflation rate:

$$\pi_t = \frac{\eta\beta}{1+\eta\gamma\beta} m(\kappa_o - \alpha\tau_o + \varepsilon_t) \tag{13}$$

Given plausible parameter values, the reaction is smaller than that of output.

3. How do we measure the effectiveness of the automatic stabilisers?

In order to determine the effectiveness of automatic stabilisers in a macro-economic model it does not suffice to simulate a demand shock. Rather, a benchmark calculation is needed without stabiliser effects. The output effect of an exogenous demand shock (Δy) can then be related to the effect in the benchmark calculation ($\Delta y_K > 0$) and is expressed as a relative difference:

4 The NK model is nested in the P-star model as a special case. It is obtained by replacing the price gap (q) by the output gap (y) in equation (2). The multiplier $1/(1-\alpha+\lambda\eta(\theta-1)+\alpha\tau-\kappa)$ can be higher or lower than in the P-star model, depending on the parameter constellation.

$$ras = \frac{\Delta y_K - \Delta y}{\Delta y_K} \tag{14}$$

A value of unity indicates complete smoothing $(\Delta y = 0)$, whereas a value of zero signals the complete absence of any smoothing $(\Delta y = \Delta y_K)$.

However, the influence of the automatic stabilisers cannot be eliminated unambiguously. A frequently used method is to exogenise all endogenous components of the government budget. If the variables g and e of model (1-7) are exogenised by removing equations (5) and (6),[5] then we obtain the output effect of a demand shock $\Delta y_{KX} = m_{KX}\,\varepsilon$, where

$$m_{KX} = \frac{1}{1-\alpha+\psi(\theta-1)} \quad > m \tag{15}$$

As we can see by comparison with (11), fiscal stabilisers have disappeared. Hence this multiplier is larger than m. The relative effectiveness of the automatic stabilisers is thus:

$$ras_{KX} = m\ (\alpha\tau - \kappa) \tag{15'}$$

The smoothing power of the automatic stabilisers is stronger, the higher the multiplier, the more pronounced the expenditure propensity and tax elasticity and the smaller the expenditure elasticity.

Exogenisation is likely to imply a deep change of the structure of the model, as all behavioural equations explaining components of the budget are to be eliminated. An alternative is the compensation approach.[6] In this case, the automatic stabilisers remain active in the benchmark calculation. Instead, it is assumed that the cyclical effects of a shock on the budget are compensated by discretionary changes to revenues or expenditures. If the effects of a positive shock are eliminated in this way, we obtain a higher (notional) output effect (Δy_K), which can be compared to the output effect of the original model (Δy). Formally, the multiplier effect of a budget-compensated shock is obtained by extending model (1-7) by the equation

$$d = 0 \tag{16}$$

[5] The same effect is obtained when the coefficients τ and κ are set to zero.
[6] See Brunila et al. (2003).

To satisfy this condition, the budget can be compensated by adjusting revenues (revenue compensation) or expenditures (expenditure compensation). In the above linear model, the results do not depend on whether the autonomous revenues (τ_o) or the tax elasticity (τ) are changed, and the same holds for government expenditures (κ_o or κ). Using (16), we obtain the following expressions for the multiplier of a demand shock under revenue compensation (m_{KE}) and expenditure compensation (m_{KG}):

$$m_{KE} = \frac{1}{1-\alpha+\psi(\theta-1)+\alpha\kappa-\kappa} \tag{17}$$

$$m_{KG} = \frac{1}{1-\alpha+\psi(\theta-1)+\alpha\tau-\tau} \tag{18}$$

The relative effectiveness of the automatic stabilisers is thus:

$$ras_{KE} = m\,\alpha(\tau-\kappa) \tag{17'}$$

$$ras_{KG} = m(\tau-\kappa) \tag{18'}$$

In the case of an expenditure elasticity of $\alpha = 1$, all three concepts are identical, otherwise we have:

$$ras_{KX} < ras_{KE} < ras_{KG} \tag{19}$$

The methodology of measuring the effectiveness of the automatic stabilisers thus has a systematic and predictable influence on the result. Exogenisation always yields the lowest and expenditure compensation the highest smoothing power of automatic stabilisers.

A third method relies on the comparison of the shock-induced output variance for activated and deactivated automatic stabilisers.[7] This approach also requires a benchmark calculation eliminating the influence of the fiscal stabilisers. The output variance in the P-star model when stabilisers are active is given by (12). Output variance in case of deactivated stabilisers is represented as $\sigma_{\tilde{y}}^2 = m_K^2\,\sigma_\varepsilon^2$. Eliminating the stabiliser effects can be done using the exogenisation method or one of the two compensation approaches, ie $m_K = \{m_{KX}, m_{KG}, m_{KE}\}$. If we measure the smoothing power of the automatic stabilisers by the relative change in the standard deviations of output, the variance method in the linear model used here is identical to the other methods:

$$\frac{\sigma_{\tilde{y}} - \sigma_y}{\sigma_{\tilde{y}}} = \frac{m_K - m}{m_K} = ras_K \tag{20}$$

In the above analysis of the effectiveness of the automatic stabilisers it was assumed that the cyclical sensitivity of government revenues and expenditures is given. However, we can also pose the question: for a given tax system, how would expenditures have to react to output fluctuations to minimise the loss function of the fiscal policy authorities? In the loss function

$$L = (d - \kappa_o + \tau_o)^2 + \omega\, y^2 \tag{21}$$

fluctuations in the deficit and fluctuations of output (or capacity utilisation) are taken into account. The parameter ω represents the relative preference for the objective of output stabilisation. Optimisation with respect to κ results in

$$\kappa^* = \tau - \omega\, m_{KG} \tag{22}$$

where m_{KG} is defined in (18). This result is intuitively plausible: if only the objective of budget stabilisation is pursued ($\omega = 0$), expenditures and revenues have to react to changes in output with the same intensity. The higher ω, the more expenditure behaviour has to subordinate itself to the objective of output stabilisation, ie the expenditure elasticity has to decrease (or even become negative, ie countercyclical). But that would mean higher deficit fluctuations, which might well lead to a conflict with the fiscal policy requirements of the Stability and Growth Pact.

[7] In a small linear model this can be done analytically, otherwise by stochastic simulations, as in the study of Barrell and Pina (2003).

4. Automatic stabilisers and Ricardian Equivalence

Basically, there are two different views on the effects of fiscal policy on the business cycle. In the Keynesian tradition, characterised by the IS-LM-Phillips curve model, expansionary fiscal policy has positive demand effects when prices respond sluggishly. Recently, the impact of fiscal policy has been analysed increasingly using dynamic general equilibrium models, based on optimising agents with forward-looking expectations and flexible prices. In these models, fiscal policy has a negative demand effect, triggered by the negative wealth effect of a tax-financed increase in government expenditures.[8] Since Barro (1974) questioned whether economic agents perceive government bonds as being part of their net wealth, the Ricardo Equivalence Theorem (RET) has played an important part in discussions on the effectiveness of fiscal policy.[9]

RET clearly rests on a series of restrictive assumptions: there are no distortionary taxes, agents act on perfect markets, face no liquidity constraints, form rational expectations, have long planning horizons and behave altruistically towards future generations.[10] Assuming validity of the RET, the financing structure of government expenditure - through taxes or borrowing - does not influence private consumption. And a tax-financed change in government expenditure has the same effect on consumption as a debt-financed one. In the P-star model discussed above, this core statement of RET can be modelled by extending the aggregated demand function (Scarth 1987) to

$$y_t = \alpha(y_t - (e_t + \rho d_t)) - \lambda(i_t - \pi_t - i^*) + g_t + \varepsilon_t \qquad (1')$$

In this formulation, the tax burden felt by economic agents consists of tax payments (e) and the budget deficit (d). The deficit is perceived as a potential or future tax and is factored into current consumption decisions. Hence, when $\rho = 1$ consumers are indifferent to a tax or deficit financing of government expenditure, only when $\rho = 0$ they ignore the possible future burden originating in higher deficits. We obtain the following reduced form expression for output:

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[8] Linnemann and Schabert (2003, 2004) investigate the effects of fiscal policy in a model based on the new neoclassical synthesis with optimising agents and price rigidities.

[9] As O'Driscoll (1977) points out, Ricardo himself rejected the equivalence theorem named after him.

[10] Ricciuti (2003) analyses the various assumptions underlying the theorem and states that the burden of proof is upon those who impute validity to the RET.

$$y_t = m_\rho\,((1-\alpha\rho)\kappa_o - (1-\rho)\alpha\,\tau_o + \varepsilon_t) \tag{23}$$

where

$$m_\rho = \frac{1}{1-\alpha+\psi(\theta-1)+\alpha\tau-\kappa-\rho\alpha(\tau-\kappa)} \tag{24}$$

By comparison with (11) this multiplier has an additional term in the denominator, which exerts a destabilising effect. Assuming complete validity for the RET ($\rho = 1$), we find

$$m_{\rho=1} = \frac{1}{1-\alpha+\psi(\theta-1)+\alpha\kappa-\kappa} = m_{KE} \tag{24'}$$

which corresponds to the multiplier in the case of revenue compensation. This multiplier is higher than in the conventional model ($\rho = 0$), because under RET the stabilising effect of the tax system disappears but the destabilising impact of government expenditures is retained, albeit in attenuated form. Hence, when RET is valid the smoothing power of the automatic stabilisers will be smaller. It is indeed the case that the exogenisation method always gives a negative value for the relative effectiveness of the stabilisers, whereas as can be seen from (24') the revenue compensation always results in a value of zero, ruling out both methods as inappropriate under RET. Expenditure compensation gives rise to a positive value:

$$ras_{KG} = m(\tau-\kappa)(1-\alpha) \tag{25}$$

However, the relative effectiveness of the automatic stabilisers is smaller than in the conventional case by a factor of $1/(1-\alpha)$.[11] We thus obtain:

$$ras_{KX} < 0 = ras_{KE} < ras_{KG}\,. \tag{26}$$

[11] The optimal expenditure reaction under RET with loss function (21) is: $\kappa^* = \tau - \omega\, m_{KG}\,(1-\rho\alpha)$.

5. Simulation exercises with the Bundesbank model for Germany

Structure of the Bundesbank model: The Bundesbank model BbkM is an empirically estimated macroeconometric quarterly model for nine countries (G7, Belgium, Netherlands), with the focus (number of equations, disaggregation) clearly on modelling the German economy.[12] The dynamic equations are usually modelled by error-correction approaches. The long-run properties of the country models in BbkM can be described as neo-classical. Economic growth in the long run is determined by population growth and productivity progress. Potential GDP is estimated on the basis of a Cobb-Douglas production function with constant returns to scale. The central behavioural equations are derived from optimisation behaviour of economic agents. Wage and price rigidities dominate in the short and medium run. The long-run price level is determined according to the P-star approach. The expectation formation process of economic agents is usually backward-looking. In the financial sector expectations are assumed to be forward-looking. The short-term interest rate level in the euro area is explained using a monetary policy reaction function. The various country blocks are linked through bilateral exchange rates (purchasing power and interest rate parity) and by equations describing international trade.[13]

Private consumption depends on disposable income and real interest rates. The level of government debt and the budget deficit has no direct effect on the consumption and saving decisions of households, ie the RET is not implemented. However, it cannot be ruled out that such effects are reflected in the estimated coefficients, thereby weakening the effectiveness of the stabilisers.

Structure of the fiscal block: In the German block, on the revenue side, direct taxes are divided into wage tax and other direct taxes, and the indirect taxes into value-added tax and other indirect taxes. In the other country models, both direct and indirect taxes are not disaggregated. Tax revenues are calculated as average tax rate multiplied by the corresponding tax base.

On the expenditure side the budget components are government consumption, government investment, transfers to households, subsidies to private firms and interest payments. For the other countries, a distinction is drawn between government demand

[12] Deutsche Bundesbank (2000) contains a detailed description of BbkM.

for goods and services and transfers to households. Government demand, transfers and subsidies are explained by behavioural equations. Nominal government consumption is linked to wages. Government investment is assumed to be exogenous.[14] Transfers to households depend on wages, population of working age and the disequilibrium on the labour market. Subsidies to private firms are determined by GDP. The interest payments are derived by definition from the level of public debt and the evolution of long-term interest rates.

The subsidies are defined relatively narrowly in accordance with the national accounts framework. Government subsidies to private firms are by definition a component of indirect taxes, ie indirect taxes are net of subsidies to private firms. However, the assumption in the simulations is that only 30% is passed on, ie lowering subsidies only partly works like a rise in indirect taxes.[15]

Structure of the simulations: To investigate the smoothing power of automatic stabilisers with BbkM, the short-run multipliers of various budgetary components were first determined. Five alternative fiscal policy measures were calculated in a series of model simulations: reduction in (1) nominal government consumption, (2) transfers, (3) subsidies, increases in (4) direct taxes, (5) indirect taxes. A rise in direct taxation occurs as a combination of raising wage tax (82%) and other direct taxes (18%). Monetary policy is endogenous. The (permanent) shock is 1% of real GDP in each case in the baseline calculation, so that the relative output change yields an estimation for the multiplier ($\Delta Y/Y \approx \Delta y = m$).

Subsequently, the impact of exogenous shocks on (a) consumption, (b) investment and (c) exports was simulated. The shocks were determined such that GDP changed by 1%. Hence the change in the deficit ratio (government deficit as a percentage of nominal GDP) is an estimate of budget sensitivity (τ - κ). The effects given in Table 1 refer to the first year of the simulation in each case. The overall effects were determined using the weights reported in column 2.

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13 Within the euro area exchange rates are fixed.

14 Empirically, government investment tends to be procyclical. If this were factored into the model, the smoothing power of the automatic stabilisers would be (even) lower.

15 Because of the low weight of the subsidies, the assumption of a complete pass-through to prices in the model would, however, have only a minimal impact on the result.

Results: As the simulations show, the multiplier effects of various revenue and expenditure components differ. Increasing government consumption boosts GDP by 1.13% in the first year, increases in transfers and in subsidies raise GDP by 0.88% and by 0.15% respectively. On average, the resulting short-run multiplier for expenditures is 0.98. The multiplier effects for direct taxes (0.76) and indirect taxes (0.57) are on average one-third smaller.

The budget effects of various exogenous demand shocks also differ. A negative consumption shock of 1% of GDP (which impacts disposable income only via second-round effects) increases the budget deficit by 0.27% of GDP, whereas a corresponding shock to investment and exports increases the deficit only by 0.15% and 0.13% respectively. On average, the budget sensitivity is 0.21.

Table 1: Simulations with the Bundesbank model (BbkM)

Effects in the first four quarters

Shock to....	Weight	Budget sensitivity[1]			GDP[2]
		Expenditure	Revenue	Deficit	
Government consumption	0.52	0.56	-0.21	0.77	1.13
Transfers	0.44	0.64	-0.12	0.76	0.88
Subsidies	0.04	1.01	0.12	0.89	0.15
Expenditure	*1.00*	-	-	*0.77*	***0.98***
Direct taxes[3]	0.48	-0.30	-1.16	0.86	0.76
Indirect taxes[4]	0.52	-0.01	-0.67	0.66	0.57
Revenue	*1.00*	-	-	*0.76*	***0.66***
Consumption[5]	0.52	0.41	0.14	**0.27**	-1.00[6]
Investment	0.15	0.38	0.23	**0.15**	-1.00[6]
Exports	0.33	0.36	0.23	**0.13**	-1.00[6]
All three shocks	1.00	-	-	**0.21**	

1) Per cent of GDP
2) As per cent of the baseline
3) Change occurring in wage tax (82%) and for other direct taxes (18%).
4) Change occurring in VAT (100%).
5) A direct shock on consumption was simulated, ie disposable income changes only owing to indirect effects, so that the effects of the consumption shock upon revenues are low.
6) Specification: size of the shock is 1% of GDP.

The smoothing effects of the automatic stabilisers of the three above-mentioned demand shocks can be worked out from these results. Table 2 shows that the smoothing effects derived by the method of expenditure compensation are roughly a third higher than those for revenue compensation. The expenditure and revenue system absorbs consumption shocks much more strongly than investment and export shocks. Calculated for all three shocks and averaged across revenues and expenditures, the overall result is an absorption efficiency in Germany of 17% of the initial shock. By comparison, the average smoothing capacity for Germany obtained by the QUEST model is 14%.

Table 2: Effectiveness of automatic stabilisers in BbkM

Shock to....	Budget sensitivity	Multiplier Expenditure/ Revenue	Smoothing power	*Memo item: Smoothing power with QUEST[1)]*
Consumption	0.27	0.98	**0.26**	*0.24*
		0.66	**0.18**	*0.10*
Investment	0.15	0.98	**0.15**	*0.13*
		0.66	**0.10**	*0.06*
Exports	0.13	0.98	**0.13**	*0.14*
		0.66	**0.09**	*0.06*
On average:				
Revenue comp.	*0.21*	*0.98*	*0.20*	*0.19*
Expenditure comp.	*0.21*	*0.66*	*0.14*	*0.08*
Total	*0.21*	*0.82*	***0.17***	*0.14*

1) Calculated according to the compensation method. Source: European Commission (2001)

In case of the consumption shock, the calculations were also run using the exogenisation method. Consistent with the theoretical inequality relationship (19) the relative effectiveness is 0.14, compared with 0.18 for the revenue compensation and 0.26 for the expenditure compensation method.

6. Results for some other OECD countries

The results of various empirical studies using macroeconometric models show that fiscal policy multipliers are small but positive (Hemming et al. 2002). The effects of expenditure changes are generally larger than those of tax changes. The short-run expenditure multipliers are in the range 0.6 to 1.5, whereas the tax multipliers are in the range 0.3 to 0.8.[16] Empirical evidence for the existence of significant effects of the RET is extremely weak.

The analysis below covers the countries included in BbkM: Belgium, France, Italy, Netherlands, United Kingdom, Japan, Canada and the US. We restrict the simulations to a shock in consumption. The differentiation by different fiscal policy measures is kept, but on the expenditure side only government consumption and transfers to households are simulated. Column 2 of Table 3 reports the reaction of the deficit ratio to a consumption shock which again was calculated such that GDP changed by 1%. The budget reaction is somewhat bigger in most other countries than in Germany. The other columns in Table 3 show the multipliers of changes in the expenditure and revenue components by the amount of 1% of GDP. From these results Table 4 is obtained.

Table 3: Simulation results for countries in BbkM (consumption shock)

Effects in the first four quarters

	Budget sensitivity	Multipliers			
		Government consumption	Transfers	Direct taxes	Indirect taxes
Germany	***0.27***	***1.13***	***0.88***	***0.76***	***0.57***
Belgium	0.41	0.51	0.11	0.12	0.07
France	0.32	1.11	0.40	0.53	0.29
Italy	0.26	1.06	0.34	0.42	0.28
Netherlands	0.36	0.74	0.27	0.33	0.18
United Kingdom	0.29	1.42	0.59	0.69	0.60
Japan	0.38	1.76	0.66	0.80	0.50
Canada	0.30	1.06	0.43	0.54	0.32
US	0.32	1.19	0.44	0.54	0.37

[16] As Table 1 shows, the multipliers for Germany using BbkM (except subsidies) are also in this range.

In the countries under consideration the effectiveness of the automatic stabilisers measured on the revenue side is on average only half that on the expenditure side. For France, the average smoothing power is 0.19 (revenue and expenditure compensation) and is thus similar to that for Germany. The results for Italy, the Netherlands and for Belgium especially are markedly lower. Whereas the smoothing power for Japan is very high (0.35), the results for the United Kingdom, Canada and the USA are in line with those obtained for Germany.

Table 4: Relative effectiveness of automatic stabilisers with BbkM

Effects of a consumption shock in the first four quarters

	Expenditure[1)]	Revenue[2)]	Average
Germany	*0.27*	*0.18*	*0.23*
Belgium	0.13	0.04	0.08
France	0.24	0.13	0.19
Italy	0.18	0.09	0.14
Netherlands	0.18	0.09	0.14
United Kingdom	0.29	0.19	0.24
Japan	0.46	0.25	0.35
Canada	0.22	0.13	0.18
US	0.26	0.15	0.20
Average (ex Germany)	*0.25*	*0.13*	*0.19*

1) Government consumption and transfers aggregated with a weight of 0.5.
2) Direct and indirect taxes aggregated with a weight of 0.5.

Comparison with other studies: Below, the BbkM results are compared with those from other studies showing a similar country selection.[17] As the study by Hemming et al. (2002) shows, the simulation results for the effectiveness of automatic stabilisers depend on the underlying structure of the models and on assumptions about expectation formation and price and wage formation mechanisms. But comparability is also impaired by different shocks having been simulated in some instances.

In the study of Brunila et al. (2002) with the QUEST model the effectiveness of the automatic stabilisers is estimated by a similar procedure as in this study. Conversely,

[17] Analyses on the basis of single-equation estimates are not included here, as they ignore significant interdependencies.

Barrell and Pina (2004) calculate the effectiveness of the automatic stabilisers with the NiGEM global model adopting the exogenisation method. The results of van den Noord (2000) are based on a simulation analysis with the OECD INTERLINK model. In principle, he uses the exogenisation method, ie in the simulations, revenue and expenditure are kept at their 'structural levels.' For BbkM and the QUEST model the simulated consumption shocks are reported. The figures for NiGEM are based on an export shock originating in the US. In the INTERLINK model, an unspecified demand shock was simulated. It should be noted that QUEST and INTERLINK are largely calibrated, ie non-econometrically estimated, structural macro-models.

As Table 5 shows, the results of NiGEM (on average 0.12) are in most cases under, and those of INTERLINK (on average 0.26) mostly above those of BbkM (on average 0.17). The results of BbkM and the QUEST model are quite close for Germany, France and United Kingdom, whereas the differences for Italy, the Netherlands and Belgium especially are larger. But, as mentioned above, the results carry only limited comparability.

Table 5: Comparison of various studies

	BbkM[1)]	QUEST[2)]	NiGEM[3)]	INTERLINK[4)]
Germany	0.23	0.17	0.20	0.31
Belgium	0.08	0.24	0.10	0.22
France	0.19	0.23	0.07	0.14
Italy	0.14	0.21	0.10	0.23
Netherlands	0.14	0.20	0.11	0.36
United Kingdom	0.24	0.18	n.a.	0.30

1) Consumption shock
2) Consumption shock; European Commission (2001)
3) Export shock from the USA, with adaptive expectations (backward mode); Barrell and Pina (2003)
4) Unspecified demand shock; van den Noord (2000)

7. Conclusions

The shock absorption capacities of the government revenue and expenditure system in Germany are relatively modest. Calculations with the Bundesbank model suggest that between 9 and 26% of an exogenous shock are smoothed out by the automatic stabilisers. For consumption shocks the absorption is higher than for investment and export shocks. On average across all three shocks approximately 20% of an exogenous shock is smoothed by the effect of the automatic stabilisers in the government budgets when the expenditure compensation method is applied. Using the revenue compensation method it is only 14%. (The exogenisation method results in even smaller values.) Using the Bundesbank model, an average of 17% of an exogenous shock are absorbed by the automatic stabilisers, compared to an average smoothing capacity of 14% in the European Commission's QUEST model.

With the budget effects of automatic stabilisers being so low, it is difficult to explain an overshooting of the deficit ceiling defined in the Stability and Growth Pact during a recession. Thus it would need a negative demand shock of approximately 5% of GDP (distributed across the expenditure components) to produce an induced budget deficit of 1% of GDP.

The smoothing powers for the other eight countries contained in BbkM (excluding Japan) are similarly low in the simulations performed. On average, the QUEST model gives rise to comparable effects, whereas the simulation results with NiGEM are mostly somewhat lower and the INTERLINK ones slightly higher. Generally speaking, these results permit the conclusion that the smoothing power of automatic stabilisers in the OECD countries under observation (except Japan) is relatively weak. When high budget deficits occur during cyclical downturns, this is arguably more an indication of structural disequilibria than a result of automatic stabilisation effects.

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