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Short and medium run effects of fiscal policy in an economic and monetary union. The case of a small country[1]

Abstract: We analyze the effectiveness of fiscal policy in an economic and monetary union. On the basis of a simple static and dynamic Mundell-Fleming model, we show that expansionary fiscal policy is very effective in the short run, but in the medium run all positive effects are "exported" abroad due to impaired competitiveness. These results are illustrated by numerical simulations. High short-run effectiveness of fiscal policy may have contributed to excessive deficits in many EMU countries.
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Introduction

By joining an economic and monetary union (EMU), a small country gives up a large part of its economic sovereignty. From this moment fiscal policy is in fact the only stabilization tool that remains in its hands. Nevertheless, the member states of the EU agreed to impose certain constraints on fiscal policy, embedded in the Stability and Growth Pact (SGP). The SGP rules are usually justified by various political and economic arguments [i.e. Eichengreen & von Hagen 1996; Woodford 1996; Beetsma 2001; Faini 2006; Wyplosz 2006 and references therein]. A common currency may lead to over-expansionary fiscal policy, which could result in a non-sustainable level of public debt in some member countries. The high and increasing cost of servicing public debt may in such case lead to pressure on the ECB to keep interest rates low (the so-called ex-ante bailout), which could undermine the union-wide stability of prices. The consequences of non-sustainable fiscal policies of a few member countries would hurt all EMU members. In an extreme case of a default of one country,

[1] This is an extended and updated version of the article published in Polish in: [Konopczyński 2006].

others could in fact be forced to bail out. The high cost of such operation, coupled with its obvious unfairness would be a powerful weapon in the hands of euro-skeptics, and may eventually endanger the very existence of a common currency. The SGP fiscal rules serve as the first line of defense against such danger.

On the other hand, (before economic crisis) prominent economists have argued that external fiscal constraints make no sense, and might even be harmful. For example Buiter [2006], de Grauwe [2007] and Wyplosz [2006] have claimed that there is no risk of a direct bailout, because Art. 103 of the Maastricht Treaty contains the no-bailout clause, which fully shields all the EU institutions and governments. Also, an indirect bailout (the ECB's interest rates cut in order to lower the cost of debt servicing, at the cost of a higher union-wide inflation) is highly unlikely, because the ECB is strongly independent of governments. De Grauwe argues that external fiscal constraints are redundant, because market forces are strong enough to discipline governments. There is also a serious question of the economic costs of external fiscal constraints. Fiscal policy is the only stabilization policy that remains after the adoption of the euro. Therefore, any further constraints must seriously limit the authorities' ability to cope with economic downturns.

To our best knowledge, the dispute between opponents and supporters of external fiscal constraints is far from ended. Naturally, since the economic crisis struck the Eurozone, and economic situation rapidly deteriorated in Greece, Spain and several other countries, supporters of fiscal constraints or even fiscal union seem to outnumber opponents [see for example: Auerbach 2011; Bordo, Jonung & Markiewicz 2011; Henning & Kessler 2012; Marneffe et al. 2010; Mathieu & Sterdyniak 2012 and references therein]. When the situation calms down, the voice of opponents will resurface again. Due to the vast abundance of literature and huge volume of various voices in the lively debate, we do not expect to provide any new arguments. Our aim is different. The majority of scientific work related to fiscal rules rests on complex mathematical models based on advanced techniques such as (stochastic) optimal control, game theory, DSGE models etc. Hence the scientific literature generally remains beyond grasp of most interested readers, e.g. policy-makers. Therefore we aim at describing the issue ASAP ("as simply as possible").

It is worth stressing that we only take into account the so-called Keynesian effects of fiscal policy, i.e. we assume that an increase in the budget deficit (a decline in public saving) leads to an increase in domestic output, at least in the short run. Technically speaking, we assume that short-run fiscal multipliers are positive. Some researchers claim that in certain circumstances fiscal multipliers may be negative; see for example Giavazzi and Pagano [1996], Barry [2001]. These cases are labeled 'expansionary fiscal contractions'. Empirical data indicate, however, that fiscal multipliers are more often positive, especially in the short run.[2]

[2] A thorough review of empirical research regarding fiscal multipliers is provided by [Hemming et al. 2002]. For the latest empirical data see e.g. [Burriel et al. 2010].

Our analysis rests on the following general assumptions. An EMU is a group of countries integrated by a common market (free flow of goods, services, capital and labor) and a monetary union with the common currency and centralized monetary policy. The most prominent example of such EMU exists in Europe, but it is not the only one.[3] More restricting is the next assumption: a country (state) is small in economic terms with respect to the entire EMU. Whatever happens in the small country, has negligible influence on EMU as a whole. Finally, we treat EMU as a closed economy, and neglect the rest of the world. Therefore the terms "foreign" or "abroad" refer to "other members of EMU".

The rest of the paper is organized as follows: in Section 1 based on the static Mundell-Fleming model, we derive the simplest static model[4] of a small economy in EMU. In the next Section we show that fiscal policy is very effective in the short run. In Section 3 we expand the model to include a flexible price level, and in Section 4 we demonstrate that the effects of expansionary fiscal policy vanish with the rising price level. Hence in the medium run (and probably in the long run) the short-run fruits of fiscal expansion are effectively "exported" abroad due to impaired competitiveness. The most demanding element of the presentation (though still very simple, if compared to the above-mentioned scientific literature) is a dynamic version of the middle-run model presented in Section 5, which is used to prove the (local asymptotic) stability of the equilibrium. This proof is however necessary, for if the equilibrium was unstable, the entire analysis of the steady-state properties of the economy would be pointless. Finally, in Section 6 we present a numerical simulation illustrating the dynamic consequences of a fiscal expansion.

1. The static model of a small economy in EMU

The short-run model can be derived from the standard textbook Mundell-Fleming model with a fixed exchange rate[5]. It can be summarized by the following equilibrium conditions:

$$\begin{aligned} &\text{(IS)} \quad Y = A^{P}(Y, T, R) + G + H(A, A^{\star}, e), \\ &\text{(LM)} \quad M/P = L(Y, R), \\ &\text{(BP)} \quad H(A, A^{\star}, e) \quad K(R) \quad 0, \end{aligned} \tag{1}$$

[3] Even some large federal states with decentralized fiscal policy satisfy our general assumptions, e.g. the U.S., Canada, Brazil, Argentina, India, Australia. There are also other EMU's around the world, see [Eichengreen & von Hagen 1996; Bordo et al. 2011].

[4] Due to extreme simplicity, these models can be used in teaching, even at the introductory level economics.

[5] A detailed exposition of the Mundell-Fleming model is provided by Gandolfo [2002].

where Y is the domestic output (GDP), T and G – government revenues and expenditures, respectively, R is the interest rate;[6] M is the domestic money supply; P is the domestic price level. The sum $A^P(Y, T, R) = C(Y, T, R) + I(Y, T, R)$ represents the private sector absorption (consumption and investment). The current account balance is approximated by the foreign trade balance, and represented by the function $H(A, A^*, e)$, where A is the domestic absorption ($A = A^P + G$) and A^* is the foreign absorption. The real exchange rate $e = EP^*/P$, where E is the nominal exchange rate (fixed), and P^* is the foreign level of prices. The real demand for money is represented by the function $L(Y, R)$, and the balance on capital account by $K(R)$. By assumption, all the functions are differentiable. The standard assumptions about the signs and magnitudes of the first derivatives are:[7]

$$0 < A_Y \leq 1,\ A_T < 0,\ A_R < 0,\ -1 < H_A < 0,\ H_{A^*} > 0,\ H_e > 0,\ L_Y > 0,\ L_R < 0,\ K_R > 0\,. \quad (2)$$

Some of the above assumptions require comment. The inequality $0 < A_Y \leq 1$ implies that a unit-increase in domestic output (which is approximately equal to income before tax) results in a less-than-unit increase in domestic absorption. Similarly, the inequality $-1 < H_A < 0$ implies that a unit-increase in domestic demand worsens the trade balance by less than a unit. Simply put, additional demand is satisfied at least in some part by domestic products. Finally, by assuming $H_e > 0$ we assert that a real

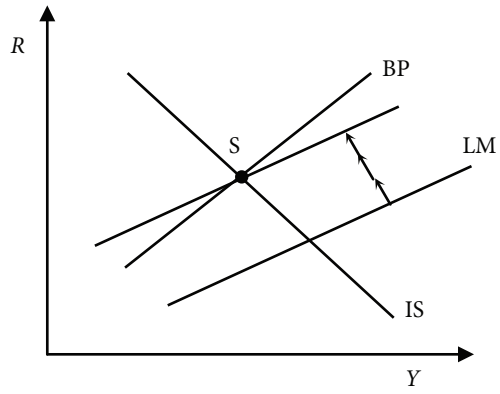

Figure 1. The equilibrium in the Mundell-Fleming model under a fixed exchange rate, mobile capital and no sterilization

[6] The standard Mundell-Fleming model describes an open economy in the short run, i.e. under fixed prices. Until this assumption is relaxed, there is no need to distinguish between real and nominal interest rates.

[7] For clarity, we use simplified notation for partial derivatives, e.g. instead of we write.

devaluation (an increase in) improves the trade balance, i.e. the so-called Marshall-Lerner condition is satisfied [for example Gandolfo 2002, p. 84].

Under fixed exchange rates and free capital mobility monetary policy is subjected to the sole target of exchange rate stabilization. Hence, the central bank cannot efficiently control the money supply – it is endogenous.[8] The remaining two endogenous variables are domestic output Y and interest rate R. The three equilibrium conditions (1) are usually depicted with the three curves[9] in Figure 1. The important thing is that the LM curve is inherently mobile. Any disequilibrium in the balance of payments forces the central bank to intervene in the foreign exchange market in order to defend the pegged exchange rate. Hence the equilibrium lies at the intersection point of the IS and the BP curves, whereas the LM curve shifts endogenously towards the equilibrium point. This endogenous movement is symbolized by arrows in Figure 1.

After entry into EMU the balance of payments loses importance because of a common currency. The balance of current account has repercussions for the stock of foreign liabilities, but does not matter for foreign currency reserves.[10] Hence the BP equation can be safely omitted. Moreover, a common currency facilitates fast convergence of nominal interest rates, hence in equilibrium the domestic interest rate is equal to the foreign (union-wide) rate: $R = R^*$. Therefore the equilibrium conditions (1) can be written as

$$\begin{aligned} &\text{(IS)} \quad Y = A^P(Y, T, R) + G + H(A, A^*, e), \\ &\text{(LM)} \quad M/P = L(Y, R), \\ &\text{(R)} \quad R = R^*, \end{aligned} \tag{3}$$

with the same endogenous variables: Y, R, M. Obviously $e = P^*/P$, and both price levels are measured in the same currency. In equilibrium (only!) the system of equations (3) reduces to a single equation. It is demonstrated graphically in Figure 2. In the beginning the three curves representing (3) do not intersect at the same point. Let us assume for simplicity that the economy initially lies at point A, where the IS and the LM_0 curves intersect.

[8] This fact is known as the "inconsistent trinity" or the "impossible trilogy". In the long run an open economy can maintain only (any) two out of the three attributes: a free capital movement, a fixed exchange rate, and an independent monetary policy. See for example [Wyplosz 1997]. In practice, the money supply can be controlled by sterilizing foreign exchange intervention, but it is impossible in the long run. Anyway, since sterilization is irrelevant in a monetary union, hereafter we neglect this issue.

[9] For simplicity we draw straight lines, which can be interpreted as the linearization around the equilibrium.

[10] Under our simplifying assumptions (EMU as a closed economy) there is no foreign currency.

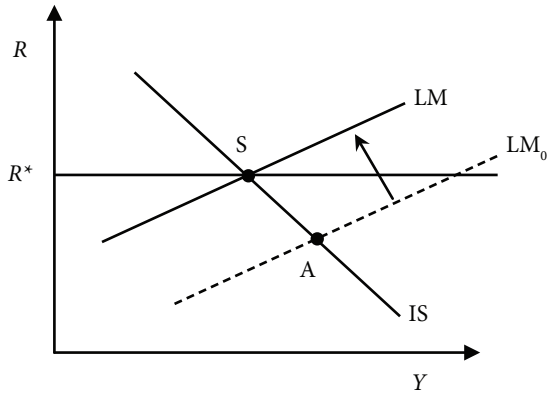

Figure 2. The equilibrium in a small country in EMU (point S)

At point A, the domestic interest rate is lower than foreign rate ($R < R^*$), which induces an outflow of money. The domestic money supply shrinks, and the LM curve moves upwards, until the difference disappears. Hence, the static model (3) can be reduced to a single condition defining an equilibrium in the domestic product market with exogenous (fixed) interest rate, i.e.

$$Y = A^P(Y, T, R) + G + H(A, A^*, e). \tag{4}$$

2. The short-run effectiveness of fiscal policy

The effectiveness of fiscal policy can be investigated by means of the so-called comparative statics, i.e. by comparing two equilibrium states corresponding to different values of decision parameters (G and T). It is most easily done by differentiating (4) with respect to Y and G (Y and T). For the first pair we get

$$dY = A_Y^P dY + dG + H_A[A_Y dY + dG].$$

By taking into account that $A_Y^P = A_Y$, after rearranging we get

$$\frac{dY}{dG} = \frac{1 + H_A}{1 - (1 + H_A)A_Y} > 0. \tag{5}$$

Analogously, differentiation of (4) with respect to Y and T yields

$$\frac{dY}{dT} = \frac{(1 + H_A)A_T}{1 - (1 + H_A)A_Y} < 0. \tag{6}$$

Notice that under the assumptions (2) dY/dG is positive, and dY/dT is negative. Therefore an autonomous increase in budgetary spending and/or a tax cut results in a higher level of domestic output (in the short-run equilibrium). The intuition behind this result is straightforward, if we look at Figure 3.

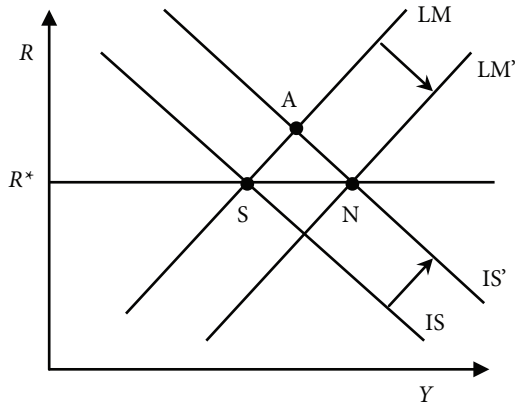

Figure 3. The results of a fiscal expansion in the short run

An increase in budget deficit instantly raises demand for domestic products, which shifts the IS curve upwards. As a result, the economy moves to point A, with a higher level of output. A resulting increase in the demand for money for transaction purposes raises its price *R* (provided that the money supply is unchanged). In a small open economy with a fixed exchange rate the short-run reactions end at this point. In a monetary union, however, further reactions occur immediately. The difference between the domestic and the foreign interest rates provides an opportunity for economic agents. For example, domestic firms now prefer credits in foreign banks, and foreign savings flow in. The resulting increase in the domestic money supply shifts the LM curve downwards, and the interest rate *R* returns to its initial level. Finally, the economy reaches a new equilibrium at point N. The speed of that movement depends obviously on the speed of convergence of interest rates, which is in turn positively correlated with the level of integration of financial markets. Under (theoretically possible, but in practice controversial) perfect capital mobility the movement between point S and point N takes place horizontally.

As demonstrated above, the short-run effectiveness of expansionary fiscal policy is much higher in EMU than in other conditions (in particular in a fixed exchange rate system).[11] The reason is simple. Before countries adopt a common currency,

[11] It can easily be proved by calculating the short-run fiscal policy multipliers for the Mundell-Fleming model under fixed or flexible exchange rates. Under the assumptions (2), these multipliers are smaller (in absolute values) than (5).

interest rates differ due to (among others) two factors: exchange rate risk and anticipated changes in exchange rates.[12] With a common currency both obstacles disappear, so the process of interest rates convergence gains speed.

It is important to stress that the extraordinary effects of a fiscal expansion are obtained at the cost of other EMU members. To illustrate this problem, let us assume for a moment that the EMU consists of two identical countries, indexed by the numbers 1 and 2. The initial equilibrium illustrated in Figure 4 lies at point S. A fiscal expansion in country 1 boosts its economy, but also raises its interest rate. This induces a flow of money from country 2 into 1, which lasts until interest rates converge to the level. As a result, country 2 suffers from a higher cost of capital, whereas country 1 reaps additional benefits of a fiscal stimulus.

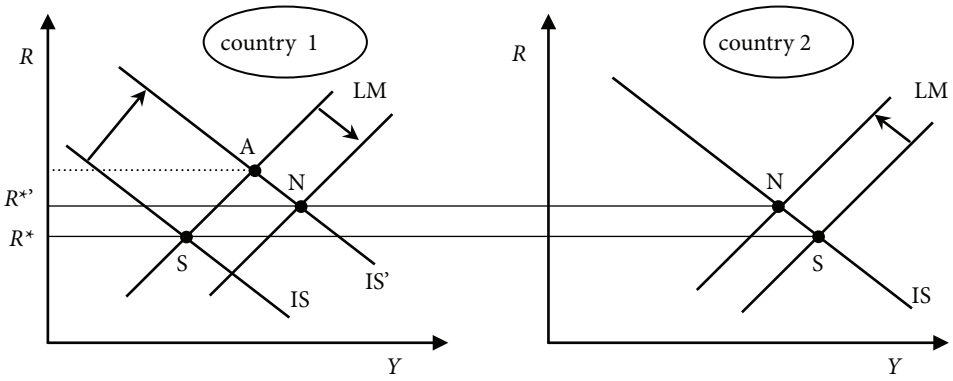

Figure 4. A fiscal expansion in country 1 at the cost of country 2

We can imagine that the central bank reacts to this situation. There are two possibilities. If it tries to ease the situation of country 2 by expansionary monetary policy, as a result country 2 may return to its initial situation, whereas country 1 reaps even more benefits. So it does not change the conclusion: country 1 reaps benefits at the cost of country 2. It is also possible that a central bank reacts in the opposite direction, in order to ease the pressure on union-wide prices.[13] A monetary contraction will then hit both countries, and country 2 will face even more severe recession, whereas country 1 will somewhat cool down. So regardless of the central banks' reaction, country 1 reaps benefits at the cost of country 2.

Obviously, every EMU member can reap (short-run) benefits at the cost of all other countries. Therefore there is a potential risk that individual member coun-

[12] The interest rate parity; see [Gandolfo 2002, pp. 43–51].

[13] This sort of central bank's reaction is politically dangerous, because country 2 expects the opposite.

tries will try to conduct a beggar-thy-neighbor fiscal policy.[14] According to this model, one can even envisage a race of competitive fiscal expansions (an analogue to the pre-war race of competitive devaluations). This race may take the form of either raising of budgetary spending, which is routinely criticized by economists, or lowering of taxes, which is generally approved. So the above-mentioned risk could materialize in the form of competitive tax cuts, while budgetary expenditures will remain more or less unchanged.

As a result, the overall level of budget deficits and public debts in EMU rises. The long-run consequences for the entire EMU are certainly negative. To mention just a few most important: an increase in public debt and deficit raises the cost of capital not only for governments but also for private sectors. Permanently higher interest rates result in lower union-wide stock of (physical) capital, and therefore lower output and employment. Another negative effect of high interest rates is the appreciation of the union currency vis-à-vis other world currencies, which impairs the competitiveness of EMU, and has a negative impact on external balances of EMU.

To summarize, all governments in EMU face a strong temptation to boost their individual economies at the cost of other member countries. The power of temptation, however, strongly depends on the level of short-sightedness (myopia) of decision-makers. In the next part of the paper we argue that positive effects of a fiscal expansion last only for a short period of time. In the medium run (after 5–10 years) all benefits vanish and may in fact turn into losses. This proposition will be demonstrated by generalizing the short-run model so as to take into account the variability of prices (in point 3) and the convergence of prices in EMU (point 4).

3. The effectiveness of fiscal policy under flexible prices

So far we have assumed that the domestic price level is constant. Now we allow domestic prices to vary freely: $P \neq \text{const}$ and $P \neq P^* = \text{const}$. (Foreign prices serve as a benchmark, or a numeráire). Since inflation is now not zero, the real interest rate may differ from the nominal interest rate, i.e. $r \neq R$. Just like before, nominal interest rates across EMU equalize in equilibrium. i.e. $R = R^*$. Since consumption and investment demand depend on the real rather than nominal interest rate, the IS equation has the following form:

[14] Probably Levin [1983] was the first to warn about the beggar-thy-neighbor effect of fiscal policy in a monetary union. His finding was, however, crucially dependent on the assumption of price rigidity (the same as in the model presented above). Other researchers found that if this assumption is relaxed, the outcome becomes indeterminate; see for example Sauernheimer [1984] and Carlberg [1999]. We also go along this path in point 2 and point 3, but we find that flexible prices only slightly weaken the short-run beggar-thy-neighbor effect.

$$\text{(IS)} \qquad Y = A^P(Y, T, r) + G + H(A, A^*, e) \tag{7}$$

The assumption $H_e > 0$ implies that a real devaluation (an increase in) improves the foreign trade balance. Hence any increase in the domestic price level will (ceteris paribus) shift the IS curve downwards. Under EMU the LM curve will follow, due to an outflow of money, which lasts until nominal interest rates converge. Therefore, the higher the level of domestic prices, the lower the equilibrium level of output. This negative relation yields the so-called aggregate demand (AD) curve (see Figure 5), which consists of all pairs of Y and P that guarantee equilibrium in the domestic product market and the money market.

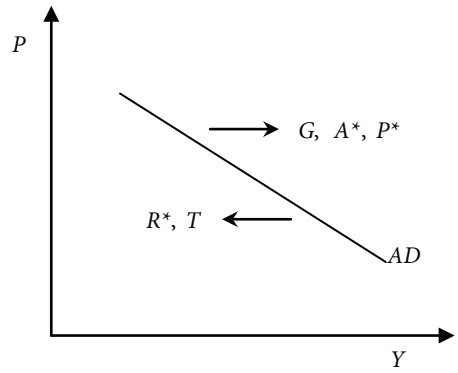

Figure 5. The AD curve and its movements associated with an autonomous increase in exogenous variables

If any of exogenous variables changes, the AD curve shifts. Differentiation of (7) with respect to Y and R^* (holding P fixed) yields $dY/dR^* < 0$. Hence an autonomous increase in R^* shifts the AD curve downwards. Similarly one can show that an increase in G or A^* or P^* shifts the AD curve upwards, whereas an increase in T moves it downwards.

The model is closed with another relation between Y and P known as the aggregate supply (AS) curve. Since this is a standard textbook concept, we do not go into details.[15] Recall that the AS curve combines all pairs of Y and P which are optimal from the point of view of domestic firms (they maximize profits in the short run, under fixed stock of physical capital and fixed wages). Under standard assumptions[16] the slope of the AS curve is positive (Figure 6), and it can be written in the following form:

[15] A detailed description of the AS curve is provided by Romer [1996, pp. 214–222].

[16] It is enough to assume that the production function of the representative firm exhibits constant returns to scale, and marginal products of all inputs (labor and capital) are positive, but decreasing.

$$\text{(AS)} \qquad Y = S(P)\,. \tag{8}$$

The static model consists of two equilibrium conditions (7) and (8), and the following assumptions:

$$0 < A_Y \leq 1,\ A_T < 0,\ A_r = A_R < 0,\ -1 < H_A < 0,\ H_{A^*} > 0,\ H_e > 0,\ S_P > 0\,. \tag{9}$$

The equilibrium point lies at the intersection of the AD and the AS curves (Figure 6). Under the assumptions (9) there exists exactly one such point.[17] It corresponds to the intersection of the IS curve and horizontal straight line $R = R^*$ illustrated in Figure 2. In equilibrium prices are constant, and $R = R^*$, so real interest rate is equal to nominal: $R = r^*$. Hence in a comparative statics analysis inflation can safely be neglected, because it influences the economy only in the transition period between two equilibria. Things will be different in a dynamic version of the model (see point 5).

Differentiating (7) and (8) with respect to Y, P and G, after some algebraic manipulation we get

$$\frac{dY}{dG} = \frac{(1+H_A)}{1-(1+H_A)A_Y - H_e e_P / S_P} > 0 \tag{10}$$

where $e_P = -P^*/P^2 < 0$. It is straightforward to show that under the assumptions (9) this multiplier is smaller than the multiplier (5) derived under the assumption of fixed domestic prices.[18] Analogously

$$\frac{dY}{dT} = \frac{(1+H_A)A_T}{1-(1+H_A)A_Y - H_e e_P / S_P} < 0 \tag{11}$$

and likewise this multiplier is smaller (in absolute terms) than its counterpart derived under fixed prices. Hence, under flexible prices, an increase in budget deficit boosts the economy in the short run, but it is partially offset by induced domestic inflation. The anatomy of a fiscal expansion is illustrated in Figure 6.

An increase in budget deficit raises domestic demand, and shifts the AD and the IS curves upwards, to their new positions AD' and IS^A. Under fixed prices the economy would land at point A. However, this point does not lie on the AS curve, which

[17] Strictly speaking, the assumptions (9) guarantee that there is no more than one such point, because upward sloping AS and downward sloping AD curves may not intersect at all. For the clarity of the exposition we neglect this case.

[18] The numerator is the same, but the denominator is positive and bigger than in the case of the fixed price model, because it contains an additional element $-H_e e_P S_P$, which is positive under the assumptions (9).

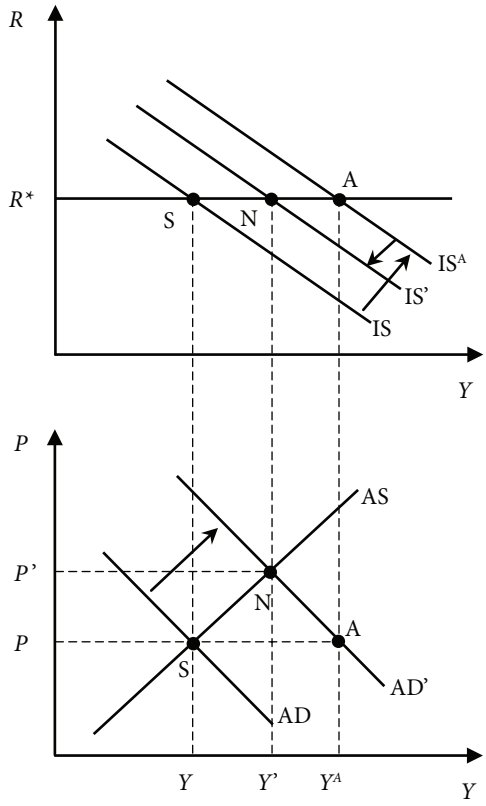

Figure 6. A fiscal expansion under flexible prices

means that it is not a profit maximizing combination of *P* and *Y*. To put it simply, an unexpected increase in demand induces firms to raise prices and increase production to a certain extent, so as to remain on the AS curve and obey profit maximization rule. Therefore the new equilibrium lies at point N. An increase in prices to the new level impairs domestic firms' competitiveness. As a result foreign trade balance worsens, which is reflected in a downward shift of the IS curve – to its final position IS'.

The above analysis suggests that flexible prices reduce the effects of a fiscal expansion through its influence on domestic firms' competitiveness. But the main conclusion still holds: in a monetary union fiscal policy is more powerful than without common currency. Any increase in taxes and/or a cut in budgetary spending cools the economy down to a bigger extent than without common currency. It makes the current fiscal stance in Europe (high deficits in most countries) understandable and rational. As we will see in the next point, however, this kind of policy makes sense only in the short run.

4. A complete futility of fiscal expansion in the medium run[19]

So far we have assumed that domestic prices are flexible (in the short run), and independent of foreign prices. The latter will now be waived. A common currency facilitates the process of economic integration, makes competition more intense, and allows easier price comparisons for buyers. Hence any substantial price level divergences across EMU members are bound to disappear.[20] This thesis is intuitively obvious with respect to the so-called tradables, but may be disputable in the case of non-tradables (for example, real estate). For simplicity, we will not differentiate these two groups of products. We will simply assume that in the medium term, price levels converge and in equilibrium are equal, i.e. $P = P^*$. We admit that a full convergence may take many years, perhaps even dozens of years.[21]

If we take into account the convergence of prices, the situation depicted in Figure 6 will evolve further. A fiscal stimulus which moved the economy from point S to point N, also causes domestic prices to raise above the union-wide level P^*. The competitiveness of the economy is therefore impaired, and consequently export shrinks, whereas import raises. The trade balance worsens steadily, the economy cools down and prices deflate until they reach the equilibrium level P^*. The IS' and the AD' curves thus steadily move back to their initial positions (in Figure 6 labeled IS and AD). In the medium term (perhaps after several years) all positive effects of a fiscal stimulus vanish completely, and the economy is back at the starting point S. Hence both fiscal policy multipliers (dY/dG and dY/dT) are zero in the medium term.

To summarize, the policy of boosting growth by fiscal expansion is extraordinarily effective in the short run, because it is a beggar-thy-neighbor policy – it imposes certain immediate costs on other EMU members through higher interest rates and lower output. In the case of a very small economy, these externalities are negligible from the point of view of the large EMU members, but they sum up to a figure big enough to allow the small economy to boost significantly. However, in the medium run, and probably in the long run, a fiscal expansion is completely futile – all fruits are effectively "exported" abroad. Other EMU members take advantage of the impaired competitiveness of the economy that executed a short-run fiscal boost. There is only one, though bitter, "fruit" of a fiscal expansion – the higher public debt.[22]

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[19] Although it is tempting to use the term „long run", we feel that it would be a misuse. Any long-term model has to take into account the accumulation of physical and financial stocks, for example capital, public debt, foreign liabilities etc.

[20] Abundant empirical work documents the ongoing convergence of price levels in the EU [e.g. Sosvilla-Rivero & Gil-Pareja 2004; ECB 2005; Wolszczak-Derlacz 2010].

[21] The problem of convergence has become one of the central issues in the applied growth theory.

[22] However, if the economy in question is large enough, it will retain some of the positive effects. This case can be traced out by means of a 2-country diagram, like in Figure 4.

Therefore, there are good reasons to ask whether the opposite policy is better. A fiscal consolidation (a cut of budget deficit) triggers a similar chain of events, but in the opposite direction. Initially, a small economy experiences a relatively sharp recession, but it curtails domestic prices, thus improving competitiveness. Lower domestic prices improve foreign trade, and the economy steadily returns to the initial level of output and employment. Although the medium-run equilibrium is the same, there is (at least) one significant difference – now the public debt is lower. Therefore one can argue, that in a monetary union a fiscal consolidation, though painful in the short run, is very effective in the medium run, since it is performed partially at the cost of other EMU members.

5. The stability of the medium-run equilibrium

In points 3 and 4 the analysis was based on the method of comparative statics, which allows to compare different equilibria, corresponding to different sets of exogenous parameters. But this static analysis does not allow to assess whether the state(s) of equilibrium are stable, and what the transition process looks like. Moreover, one can only guess how the effects of a fiscal expansion (contraction) are dispersed over time. In order to investigate these questions, we formulate a dynamic version of the model, consisting of three differential equations, describing economic agents' reactions to disequilibrium.

As we noticed in point 4, if domestic prices are higher than P^*, the foreign trade balance worsens, and vice versa. It can be formalized by the following equation:[23]

$$\dot{H} = \varepsilon_1 \cdot [1 - P/P^*] \tag{12}$$

where $\varepsilon_1 > 0$ reflects the speed of reaction of the foreign trade balance to the difference in price levels. The magnitude of ε_1 is positively correlated with the level of economic integration, intensity of international competition, share of tradables in the total foreign trade, etc. It is also presumably negatively correlated with the size of the economy.

We assume that, faced with an unexpected increase in demand, firms immediately raise prices (this can be done easily and virtually instantly), and only after some time they raise output (it requires a timely adjustment). Thus we adopt the following behavioral equation:

$$\dot{P} = \varepsilon_2 \cdot [A^P(Y, T, r) + G + H - Y] \cdot P \tag{13}$$

[23] Dotted variables refer to their time derivatives, for example $\dot{H} = dH(t)/dt$.

where $\varepsilon_2 > 0$ describes the strength of firms' reaction. Recall that the aggregate supply function $S(P)$ relates the optimal (profit maximizing) output with the price level. If, at any moment, the actual output is suboptimal, firms strive to raise it, which is described by

$$\dot{Y} = \varepsilon_3 \cdot [S(P) - Y], \text{ where } \varepsilon_3 > 0. \tag{14}$$

The system of equations (12)–(14) constitutes the medium-run dynamic model of a small economy in EMU. For simplicity, the reaction parameters ε_i and the exogenous variables R^*, T, G, P^* are constants. Due to perfect mobility of financial capital, nominal interest rates are uniform across all EMU countries, i.e. $R = R^*$ for all t. By definition, $r = R^* - \dot{P}/P$. All other assumptions regarding the signs and magnitudes of certain partial derivatives are unchanged, i.e.

$$0 < A_Y \leq 1, A_T < 0, A_r < 0, S_P > 0. \tag{15}$$

Let $(\overline{H}, \overline{P}, \overline{Y})$ be the equilibrium values of the endogenous variables. In equilibrium all dynamics vanishes, hence $(\dot{\overline{H}}, \dot{\overline{P}}, \dot{\overline{Y}}) = 0$. We assume that there exists an equilibrium.[24] Under the assumptions (15), it is unique and has the following characteristics:

1. The price levels are identical in all EMU countries, i.e. $\overline{P} = P^*$.
2. The demand for domestic products is equal to supply, i.e. $A^P(\overline{Y}, T, \overline{r}) + G + \overline{H} = \overline{Y}$.
3. Firms maximize profits, i.e. $\overline{Y} = S(\overline{P})$.

Since the system of equations (12)–(14) is generally nonlinear, it is only possible to prove local asymptotic stability (LAS) of the equilibrium. An intuitive definition of LAS may look like this: the equilibrium is LAS if the economy converges towards the equilibrium as time increases, provided it starts in a certain neighborhood of the equilibrium. The LAS can be proved by approximating a nonlinear system with linear equations, and demonstrating the (global) asymptotic stability of the linear system. Notice that the right-hand sides of the equations (12)–(14) are functions of the variables H, P and Y. Let us denote them with symbols f^i (i = 1, 2, 3). These nonlinear functions can be approximated around the equilibrium point by using the following relationship (based on the Taylor series expansion):

$$f^i(H, P, Y) \cong f^i(\overline{H}, \overline{P}, \overline{Y}) + \left.\frac{\partial f^i}{\partial H}\right|_E \cdot (H - \overline{H}) + \left.\frac{\partial f^i}{\partial P}\right|_E \cdot (P - \overline{P}) + \left.\frac{\partial f^i}{\partial Y}\right|_E \cdot (Y - \overline{Y}), \tag{16}$$

where $f^i(\overline{H}, \overline{P}, \overline{Y}) = 0$ (i = 1, 2, 3). Therefore, the linear approximation of the system (12)–(14) can be written in the following matrix form:

[24] See note 19.

$$\begin{bmatrix} \dot{\mathcal{H}} \\ \dot{\mathcal{P}} \\ \dot{\mathcal{Y}} \end{bmatrix} = J \begin{bmatrix} \mathcal{H} \\ \mathcal{P} \\ \mathcal{Y} \end{bmatrix}, \tag{17}$$

where $\mathcal{H} = H - \overline{H}$, $\mathcal{P} = P - \overline{P}$, $\mathcal{Y} = Y - \overline{Y}$ and J denotes the Jacobian matrix of the system (12)–(14), i.e. the matrix of first-order partial derivatives of functions f^i calculated in equilibrium. It can be shown that:

$$J = \begin{bmatrix} 0 & -\varepsilon_1 / P^* & 0 \\ \varepsilon_2 \overline{P}(1 + A_{\bar{r}} r_{\bar{H}}) & \varepsilon_2 \overline{P} A_{\bar{r}} r_{\bar{P}} & \varepsilon_2 \overline{P}(A_{\bar{Y}} - 1 + A_{\bar{r}} r_{\bar{Y}}) \\ \varepsilon_3 & \varepsilon_3 S_{\bar{P}} & -\varepsilon_3 \end{bmatrix}. \tag{18}$$

The signs of almost all partial derivatives in the above matrix are determined by the assumptions (15). However, we need to determine the signs of $r_{\bar{H}}$, $r_{\bar{P}}$ and $r_{\bar{Y}}$. Notice that

$$r = R^* - \dot{P}/P = R^* - \varepsilon_2 \cdot [A^P(Y, T, r) + G + H - Y]. \tag{19}$$

Thus $r_{\bar{P}} = -\varepsilon_2 A_{\bar{r}} r_{\bar{P}}$. Since by assumption is any positive real number, the only solution to this equation is $r_{\bar{P}} = 0$. Differentiating (19) with respect to H (in equilibrium) yields $r_{\bar{H}} = -\varepsilon_2 A_{\bar{r}} r_{\bar{H}} - \varepsilon_2$, or

$$r_{\bar{H}} = \frac{-\varepsilon_2}{1 + \varepsilon_2 A_{\bar{r}}}. \tag{20}$$

From this moment on we assume that is small enough to satisfy the following condition:

$$1 + \varepsilon_2 A_{\bar{r}} > 0. \tag{21}$$

Thus $r_{\bar{H}} < 0$. Finally, differentiating (19) with respect to Y (in equilibrium) yields $r_{\bar{Y}} = -\varepsilon_2 A_{\bar{Y}} - \varepsilon_2 A_{\bar{r}} r_{\bar{Y}} + \varepsilon_2$, or after rearranging:

$$r_{\bar{Y}} = \frac{\varepsilon_1 (1 - A_{\bar{Y}})}{1 + \varepsilon_1 A_{\bar{r}}}. \tag{22}$$

This derivative is positive under the assumptions (15) and (21). Let denote the elements of the Jacobian matrix (18). The equilibrium is LAS if and only if the following conditions are satisfied:[25]

[25] These are the Routh-Hurwitz conditions for stability of the differential systems [see Gandolfo 1997, pp. 251–252].

(a) tr $J < 0$,
(b) det $J < 0$,
(c) det $R < 0$, where $R = \begin{bmatrix} a_{11}+a_{22} & a_{23} & -a_{13} \\ a_{32} & a_{11}+a_{33} & a_{12} \\ -a_{31} & a_{21} & a_{22}+a_{33} \end{bmatrix}$.

It is straightforward to verify that all of the above conditions are satisfied under the assumptions (15) and (21). Indeed, $\operatorname{tr} J = -\varepsilon_3 < 0$, and $\det J = \frac{-\varepsilon_1\varepsilon_2\varepsilon_3}{1+\varepsilon_2 A_{\bar{r}}} < 0$, whereas $\det R = \varepsilon_2\varepsilon_3{}^2\bar{P}S_{\bar{P}}(A_Y - 1 + A_{\bar{r}}r_{\bar{Y}}) < 0$. Therefore the assumptions (15) and (21) guarantee (at least) local asymptotic stability of the equilibrium. It is worth stressing that if (21) is not satisfied, then $J > 0$, and so the equilibrium is unstable. It means that under the assumptions (15) the equilibrium becomes unstable if ε_2 is large enough, i.e. if prices react too sharply to disequilibrium in the product market.

6. Short- and long-run effects of a fiscal expansion – a numerical illustration

The results obtained in points 2–4 will now be illustrated by a numerical simulation, based on very simple assumptions. This is not a forecast for any particular country – it is just an illustration of the model dynamics. We assume linear functions of the private sector absorption and the aggregate demand:

$$A^P(Y,T,r) = \tilde{A} + a_1(Y-T) - a_2 r, \quad \tilde{A}, a_2 > 0, \quad 0 < a_1 \leq 1,$$

$$S(P) = s_1 P, \qquad s_1 > 0.$$

Solving the model (12)–(14) for equilibrium yields:

$$\bar{P} = P^\star,\ \bar{r} = R^\star,\ \bar{Y} = s_1\bar{P},\ \bar{H} = \bar{Y} - \tilde{A} - a_1(\bar{Y}-T) + a_2\bar{r} - G. \tag{23}$$

We assume the following values of parameters and exogenous variables:

$$\tilde{A} = 10, a_1 = 0{,}85, a_2 = 30, R^\star = 4\%, P^\star = 1, G = T = 40, \varepsilon_1 = 3, \varepsilon_2 = 0{,}01, \varepsilon_3 = 0{,}5 \tag{24}$$

which yield:

$$\bar{P} = 1, \bar{r} = \bar{R} = 4\%, \bar{Y} = 100, \bar{H} = 0{,}2. \tag{25}$$

The equilibrium is LAS, because the condition (21) is satisfied:
$1+\varepsilon_2 A_{\bar{r}} = 1-\varepsilon_2 \cdot a_2 = 1-0{,}3 = 0{,}7 > 0$. In this example the stability condition is breached for ε_2 bigger than 1/30.

For simplicity, calculations are based on the discrete version of the model, i.e.

$$\begin{cases} H_{t+1} = H_t + \varepsilon_1[1 - P_t / P^*], \\ P_{t+1} = P_t \cdot \left(1 + \varepsilon_2[\tilde{A} + a_1(Y_t - T_t) - a_2 r_t + G_t + H_t - Y_t]\right), \\ Y_{t+1} = Y_t + \varepsilon_3[s_1 P_{t+1} - Y_t]. \end{cases} \qquad (26)$$

The real interest rate is defined by the formula: $r_t = R^* - \Pi_t$, where $\Pi_t = \dfrac{P_t - P_{t-1}}{P_{t-1}}$ is the rate of inflation.

Let us assume that initially (at $t = 0$) the economy is in equilibrium (25) corresponding to (24). If all values in (24) remain constant over time, the economy will stay in equilibrium forever. To illustrate the effects of a fiscal expansion, let us assume that in the first three periods (for $t = 1, 2, 3$) the budgetary expenditures are equal to 41 (instead of 40). Since $T = 40$ and $\overline{Y} = 100$, the size of a fiscal expansion is equal to about 1% of GDP. After this short period (for $t \geq 0$), budgetary spending is reduced back to 40. Nothing else is changed. The results are graphed at Figures 7–9, and the table below contains the results of calculations for the first 10 periods.

An increase in the budget deficit lasting for 3 periods boosts the economy. However, the positive effects vanish very fast – as soon as in the 5th period the economic growth turns into recession, and in the 10th period the level of domestic output sinks below its initial level of $\overline{Y} = 100$. It takes another 13 periods for the output to climb back to this level. The entire trajectory of output can be described as cyclical ups and downs (around equilibrium) with a diminishing amplitude.

It is interesting to investigate into the mechanisms responsible for these results. An increase in budgetary spending raises the domestic demand (consumption and investment), through the Keynesian multiplier effect. Initially the supply stays behind, hence firms respond by raising prices. Due to a common monetary policy

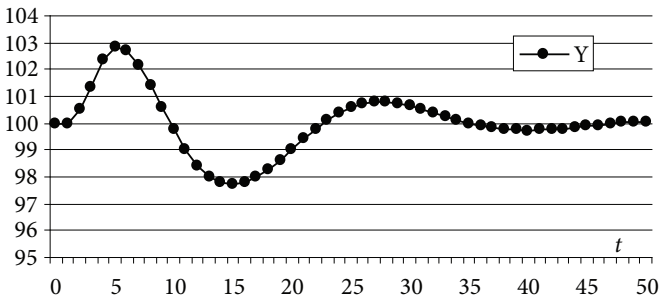

Figure 7. The trajectory of the domestic output

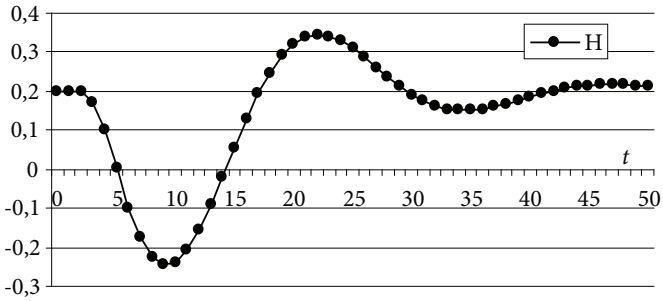

Figure 8. The trajectory of the foreign trade balance

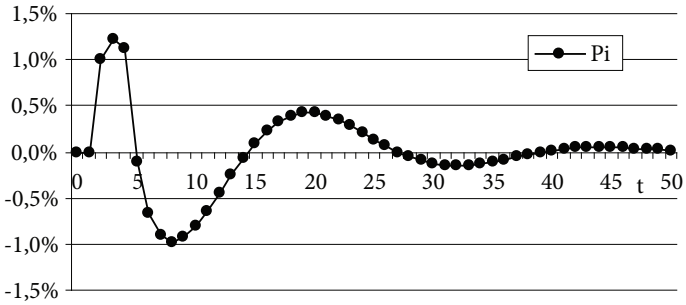

Figure 9. The trajectory of the inflation

The short-run fiscal expansion – the results of a numerical experiment

t	*G*	*R* (in %)	*r* (in %)	*C*	*I*	*P*	*Π* (in %)	*H*	*S*(*P*)	*Y*	$\hat{Y}$ (in %)
0	40	4.0	4.0	51.8	8.0	1.00	0.0	0.20	100.00	100.00	
1	**41**	4.0	4.0	51.8	8.0	1.00	0.0	0.20	100.00	100.00	0.0
2	**41**	4.0	3.0	52.2	8.3	1.01	1.0	0.20	101.00	100.50	0.5
3	**41**	4.0	2.8	52.8	8.5	1.02	1.2	0.17	102.24	101.37	0.9
4	40	4.0	2.9	53.5	8.6	1.03	1.1	0.10	103.39	102.38	1.0
5	40	4.0	4.1	53.8	8.4	1.03	–0.1	0.00	103.28	102.83	0.4
6	40	4.0	4.7	53.7	8.2	1.03	–0.7	–0.10	102.60	102.71	–0.1
7	40	4.0	4.9	53.3	8.1	1.02	–0.9	–0.18	101.67	102.19	–0.5
8	40	4.0	5.0	52.8	8.0	1.01	–1.0	–0.23	100.68	101.44	–0.7
9	40	4.0	4.9	52.2	7.9	1.00	–0.9	–0.25	99.74	100.59	–0.8
10	40	4.0	4.8	51.6	7.8	0.99	–0.8	–0.24	98.93	99.76	–0.8

and perfect arbitrage in financial markets, the nominal interest rate remains constant, equal to R^*. Hence the accelerating inflation reduces the real interest rate, and the falling cost of money provides additional boost to private demand. Thanks to a monetary union the standard Keynesian effect is reinforced by cheap money (the crowding-out effect is essentially exported abroad). At the same time, however, higher domestic prices cause a mild fall in foreign trade balance.

After a few periods government returns to the balanced budget policy, and producers finally catch up with demand. Almost instantly the economy sinks into recession. In the first phase the situation is made even worse by high prices which are rigid and need time to fall back to a competitive level. The falling domestic and foreign demand makes firms react by cutting prices and production. Inflation turns into deflation, which raises the real interest rate, and further reduces the private sector demand. As a result, recession is deep and lasts for a long period. Only after about 10 periods the economy hits the bottom and a slow recovery begins. It is worth stressing that although finally the economy returns to the same equilibrium, the fiscal loosening leaves painful scars – a higher public debt, and the usual costs of economic cycle (inflation/unemployment).

Conclusions

An economic and monetary union makes expansionary fiscal policy very effective, but only in the short run. As time passes, all positive effects of a fiscal expansion vanish, because the economy becomes less competitive. Increasing prices worsen the trade balance, and slow the economy down. (In the simple model presented in our paper it even sinks into recession). In effect, all fruits of a fiscal expansion are "exported" abroad. Therefore, though very effective in the short run, a fiscal expansion is completely futile in the medium run (and presumably in the long run).

Despite that, many members of the European Monetary Union are carrying high budget deficits, in many cases far exceeding the SGP limit of 3% of GDP. Of course, there are certain objective causes of high deficits, e.g. rich welfare systems, demographic problems (aging), costly structural reforms, and most of all the 2009 financial crisis. However, it seems that the "political business cycle" also plays an important role – politicians care mainly about the next election, and – as demonstrated above – it is possible to improve the economic situation in such a short period by beggar-thy-neighbor fiscal expansion.[26] In our view, there exists a significant risk of unsustainable fiscal policies union-wide, which might in the extreme case lead

[26] The existence of the political business cycle in Europe is documented by Buti and van den Noord [2004].

to the race of "competitive deficits" – an analogue of the early 20-th century race of "competitive devaluations", and endanger the very existence of the monetary union.

The long-run consequences of unsustainable fiscal policies must certainly be negative for the entire EMU. To mention just a few most important[27]: an increase in public debt and deficit raises the cost of capital not only for governments, but also for the private sector. Permanently higher interest rates result in a lower union-wide stock of (physical) capital, and therefore a lower long-run output and employment. Another negative effect of high interest rates is an appreciation of the union currency vis-à-vis other world currencies, which impairs the competitiveness of the EMU, and has a negative impact on external balances of the EMU. In the long run it may lead to an increasing share of foreign ownership in the EMU, and growing repatriation of profits, which may further reduce investment and act as an additional brake to economic growth. Meanwhile, low economic growth (and high unemployment) are arguably the most serious problems of Europe. Unsustainable fiscal policies could only deepen these problems.

Final remarks

Throughout the paper we assumed that the economy is small, i.e. it has a negligible influence on the entire EMU. This assumption is certainly valid in the case of all 12 "new member states". However, in the case of large economies (e.g. Germany, France) the results and conclusions should be modified. A substantial fiscal expansion in a large country could significantly influence other EMU members. For example, a significant tax cut in Germany raises its domestic demand not only for home-produced goods, but also for imports. This lead to a significant price hikes not only in Germany, but in the entire EMU. Hence, as a minimum, the impact of internal fiscal expansion on union-wide demand (A^*) and price level (P^*) should be taken into account. The Union-wide inflationary pressure might in turn induce a tightening of monetary policy by the ECB, which should also be incorporated in the model.

It is worth emphasizing that the Mundell-Fleming model presented in the paper is based on very general assumptions, hence they apply to any country (state) being a member of any economic and monetary union. However, every stick has two ends. Due to this universality and simplicity, conclusions are very general – they only tell us something about relative magnitudes and directions, but do not allow to establish more precise results for specific countries. Moreover, in recent years, macroeconomic theories are (almost by custom) constructed on the basis of the

[27] An excellent survey of the consequences of high budget deficits is provided by Ball and Mankiw [1995].

so-called micro-foundations, with 'representative economic agents', which form rational expectations, behave optimally in the infinite horizon etc. We do realize that all these elements are important, but including any of them would make the model far more complex mathematically. As indicated in the Introduction, our aim was to describe the issue of expansionary fiscal policy so simply, that (hopefully) our text should be clear even for someone with basic economic education. Therefore, our presentation serves above all didactic purposes.

References

Auerbach, A.J., 2011, *Fiscal Institutions for a Currency Union*, Paper prepared for a conference on Fiscal and Monetary Policy Challenges in the Short and Long Run, sponsored by the Deutsche Bundesbank and the Banque de France, Hamburg, May 19–20.

Ball, L., Mankiw, G., 1995, *What Do Budget Deficits Do?*, NBER Working Paper, no. 2046.

Barry, F., 2001, *Fiscal Policy in EMU*, in: Pentecost, E.J., van Poeck, A. (eds.), *European Monetary Integration: Past, Present and Future*, Edward Elgar.

Beetsma, R., 2001, *Does EMU need a Stability Pact?*, in: Brunilla, A., Buti, M., Franco, D. (eds.), *The Stability and Growth Pact. The Architecture of Fiscal Policy in EMU*, Palgrave.

Bordo, M., Jonung, L., Markiewicz, A., 2011, *A Fiscal Union for the Euro: Some Lessons from History*, NBER Working Paper, no. 17380.

Buiter, W., 2006, *The 'Sense and Nonsense of Maastricht' Revisited: What Have We Learnt about Stabilization in EMU?*, Journal of Common Market Studies, vol. 44, p. 687–710.

Burriel, P., Castro, F., Garrote, D., Mora, E.G., Paredes, J., Perez, J.J., 2010, *Fiscal Multipliers in the Euro Area*, Bank of Italy Occasional Paper.

Buti, M., van der Noord, P., 2004, *Fiscal Discretion and Elections in the Early Years of EMU*, Journal of Common Market Studies, vol. 42.

Carlberg, M., 1999, *European Monetary Union: Theory, Evidence and Policy*, Physica-Verlag.

ECB, 2005, *Monetary Policy and Inflation Differentials in a Heterogenous Currency Area*, ECB Monthly Bulletin, no. 5.

Eichengreen, B., von Hagen, J., 1996, *Federalism, Fiscal Restraints, and European Monetary Union*, American Economic Review, vol. 86, pp. 134–138.

Faini, R., 2006, *Fiscal policy and interest rates in Europe*, Economic Policy, vol. 21, pp. 443–489.

Gandolfo, G., 1997, *Economic Dynamics. Study Edition*, Springer.

Gandolfo, G., 2002, *International Finance and Open-Economy Macroeconomics*, Springer.

Giavazzi, F., Pagano, M., 1996, *Non-Keynesian Effects of Fiscal Policy Changes: International Evidence and the Swedish Experience*, Swedish Economic Policy Review, vol. 3, pp. 67–103.

de Grauwe, P., 2007, *Economics of Monetary Union*, 7th edition, Oxford University Press.

Hemming, R., Kell, M., Mahfouz, S., 2002, *The Effectiveness of Fiscal Policy in Stimulating Economic Activity – A Review of the Literature*, IMF Working Paper, no. 208.

Henning, C.R., Kessler, M., 2012, *Fiscal Federalism: US History for Architects of Europe's Fiscal Union*, Peterson Institute for International Economics Working Paper, no. 1.

Konopczyński, M., 2006, *Skuteczność polityki fiskalnej w unii gospodarczej i walutowej*, Ekonomista, no. 5, pp. 619–646.

Kowalski, P., Kowalski, T., Wihlborg, C., 2007, *Poland. The EMU Entry Strategy vs. the Monetary Issues*, Poznań University of Economics Review, 2007, vol. 7, no. 2, pp. 59–88.
Levin, J.H., 1983, *A Model of Stabilization Policy in a Jointly Floating Currency Area*, in: Bhandari, J.S, Putnam, B.H. (eds.), *Economic Interdependence and Flexible Exchange Rates*, Cambridge University Press, pp. 329–349.
Marneffe, W., Van Aarle, B., Van Der Wielen, W., Vereeck, L., 2010, *The Impact of Fiscal Rules on Public Finances: Theory and Empirical Evidence for the Euro Area*, CESifo Working Paper Series, no. 3303.
Mathieu, C., Sterdyniak, H., 2012, *Do we Need Fiscal Rules?*, Documents de Travail de l'OFCE 2012–08, Observatoire Francais des Conjonctures Economiques (OFCE).
Mundell, R., 2011, *The European Fiscal Reform and the Plight of the Euro*, Poznań University of Economics Review, vol. 11, no. 1, pp. 7–22.
Romer, D., 1996, *Advanced Macroeconomics*, McGraw-Hill.
Sauernheimer, K.-H., 1984, *Fiscal Policy in Einer Wechselkursunion*, Finanzarchiv, vol. 42, pp. 143–157.
Sosvilla-Rivero, S., Gil-Pareja, S., 2004, *Price Convergence in the European Union*, Applied Economics Letters, vol. 11, pp. 39–47.
Wolszczak-Derlacz, J., 2010, *Does One Currency Mean One Price?*, Eastern European Economics, M.E. Sharpe, Inc., vol. 48(2), pp. 87–114, March.
Woodford, M., 1996, *Control of the Public Debt: A Requirement for Price Stability?*, NBER Working Paper, no. 5684.
Wyplosz, Ch., 1997, *EMU: Why and How It Might Happen*, Journal of Economic Perspectives, vol. 11, pp. 3–22.
Wyplosz, Ch., 2006, *European Monetary Union. The Dark Sides of a Major Success*, Economic Policy, vol. 21, pp. 207–261.