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ECONOMIC RESILIENCE: A TWO-COUNTRY ANALYSIS

BY

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1 INTRODUCTION

Countries differ with regard to the structural characteristics of their economies. In the USA there is a more flexible labour market compared with Europe. This shows up in a number of ways. Real wages are more flexible and the structure of payments is less rigid. In addition, it is easier to fire workers in the USA than it is in Europe, which makes labour cheaper. On the other hand, entrepreneurs in the USA may be more inclined to take risks and to explore new combinations in a Schumpeterian sense. A more or less elaborate description of the economic resilience of systems is useful in its own right. In the present paper we aim at an analysis of the consequences of these differences, which calls for simplification and modelling.

In section 2 a two-country model is developed to study the impact of saving, capital accumulation and technological change. It seems fashionable nowadays to cast such models in terms of rational expectations, which in absence of stochastic components comes down to perfect foresight, as for instance in Lipton and Sachs (1983) and Buiter (1984). In this paper the hypothesis of perfect foresight is rejected because: (1) it is really a matter of taste whether one should prefer perfect foresight to the polar case of assuming static expectations, both alternatives being not fully realistic; (2) rational expectations are not easy to reconcile with imperfect markets.[1] For our analysis it is essential that at least the labour market does not clear instantaneously.

Even if the behaviour of producers and consumers is modelled in a traditional manner it could still be argued that agents have perfect myopic foresight in expectations of the inflation rate and the rate of change in the exchange rate. This route, which is chosen in several studies, builds on seminal work of Dornbusch (1976). A full-fledged example can be found in Camilleri, Nguyan and Campbell (1984). However, as we are not dealing with problems of the

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1 Models combining perfect foresight of agents and rationing in markets can be found in Blanchard and Sachs (1982), Bruno and Sachs (1985), Van de Klundert and Peters (1984).

business cycle the assumption of perfect myopic foresight with regard to portfolio selection is not introduced in the paper. Instead it is assumed that the market-clearing real interest rate is uniform across countries, which is more in line with the original contribution of Mundell and Fleming.[2]

The dynamics of the model is characterized by a fifth-order system of simultaneous differential equations, which cannot be solved analytically. Conclusions have therefore to be obtained by numerical simulations. Differences between countries can be related to asymmetrical shocks or to different parameters. To some extent both sets of factors may be related to what we have called the resilience of economies. For instance, a technological breakthrough (supply shock) may be the result of entrepreneurial activity absent in a more passive economy. On the other hand a relatively large coefficient of acceleration may indicate low real cost of adjustment or willingness to take risk. With this in mind the numerical experiments to be presented in section 3, are divided in three groups. Symmetrical shocks in a two-country setting with uniform structure serve as reference cases for other runs. Next, the impact of asymmetrical shocks is studied maintaining the assumption of a uniform structure. Finally, attention will be given to differences in structural parameters in an environment of equal growth impulses (shocks).

2 A TWO-COUNTRY MODEL

As analytical solutions are out of reach there is no need to be general. Functions will be specified according to well-known and simple rules. Production (x) in both countries is based on the Cobb-Douglas formula with as factors of production labour (l) and fixed capital (k). Indicating countries by subscripts 1 and 2 we can therefore write:

$$
\begin{aligned}
x_1 &= \varepsilon_1 l_1^{\alpha_1} k_1^{1-\alpha_1} \\
x_2 &= \varepsilon_2 l_2^{\alpha_2} k_2^{1-\alpha_2}
\end{aligned}
\tag{1}
$$

The real wage rate (w) adapts to a situation of excess demand on the market for labour with a certain time lag. Profit maximizing firms equate the marginal product of labour and the real wage rate with the stock of capital given at each point of time. Rewriting this relationship results in the demand for labour in both countries:

$$
\begin{aligned}
l_1 &= \left[\frac{\varepsilon_1 \alpha_1}{w_1}\right]^{1/1-\alpha_1} k_1 \\
l_2 &= \left[\frac{\varepsilon_2 \alpha_2}{w_2}\right]^{1/1-\alpha_2} k_2
\end{aligned}
\tag{2}
$$

2 An excellent survey of relevant theories can be found in Dornbusch (1980) pp. 193–213.

The real interest rate (r) is determined in the world market. It is assumed that financial claims (bonds) are perfect substitutes throughout the world ('capital mobility' assumption), so that the *expected* rate of return on both types of assets (home and foreign) must be the same. As shown in Lipton and Sachs (1983), Buiter (1984), Bruno and Sachs (1985) in case of perfect foresight this leads to the following equality in real terms:

$$r_1 = r_2 + \frac{\dot{p}}{p}$$

where p stands for the relative price of goods of country 2 in terms of goods of country 1. (A dot above a variable indicates a first derivative with respect to time.) As remarked before, we postulate static expectations of economic agents implying[3]:

$$r_1 = r_2 = r$$

The desired level of the capital stock (k^*) is now obtained from the equality of the marginal product of capital and the gross rate of return:

$$\begin{aligned} k_1^* &= \left[\frac{\varepsilon_1(1-\alpha_1)}{r+\delta_1}\right]^{1/\alpha_1} l_1 \\ k_2^* &= \left[\frac{\varepsilon_2(1-\alpha_2)}{r+\delta_2}\right]^{1/\alpha_2} l_2 \end{aligned} \tag{3}$$

The stock of capital is adapted to its desired level in the course of time, because there are costs to the installation of new equipment. In addition, one could imagine that in a world of uncertainty firms may be more or less inclined to exploit opportunities for investment to the margin of profitability. The propensity to invest depends upon a number of factors, which are taken as exogenous in the present analysis. Net investment is a fraction of the gap between the desired stock of capital and the actual stock of capital. The reciprocal of this fraction is of course the number of years it takes to close the gap. Depreciation of capital is exponential at a rate δ. The level of gross investment (i) is determined by the following equations:

3 The equality of real interest rates holds also under the 'law of one price.' Our approach differs fundamentally from this case because the terms of trade may change. The assumption of static expectations facilitates the dynamics of the system to a considerable extent. Under perfect foresight p is a non-predetermined variable (or jump variable) which raises the problem of suitable starting values.

$$\frac{i_1}{k_1} = \beta_1\left[\frac{k_1^*}{k_1} - 1\right] + \delta_1$$
$$\frac{i_2}{k_2} = \beta_2\left[\frac{k_2^*}{k_2} - 1\right] + \delta_2 \tag{4}$$

Consumers in their turn cannot look into the future, but they save to spread consumption over time. Consumption expenditure (c) is divided between purchase of home goods (c^d) and imported goods (c^m). Recalling that p stands for the terms of trade of country 2, whereas the terms of trade of country 1 equal $1/p$, we may write:

$$c_1 = c_1^d + p\ c_1^m$$
$$c_2 = c_2^d + c_2^m/p$$

The decision problem is supposed to be separable.[4] First, households decide upon total expenditure (and saving). Next, with total consumption demand and relative prices given households choose between domestic and foreign goods. To take account of the intertemporal character of consumption decisions it is assumed that consumption expenditure depends on current real income (y) as well as on real nonhuman wealth (a). Intertemporal substitution effects are dealt with by introducing the real interest rate as an explanatory variable. The intertemporal decision problem under perfect foresight is extensively treated in Barro (1984). To simplify linear consumption functions are assumed:

$$c_1 = \gamma_1 y_1 + v_1 a_1 - \varphi_1 r$$
$$c_2 = \gamma_2 y_2 + v_2 a_2 - \varphi_2 r \tag{5}$$

Real income is defined as the proceeds from production plus the interest paid by foreigners on claims held by domestic residents[5]:

$$y_1 = x_1 + rb$$
$$y_2 = x_2 - r\frac{b}{p} \tag{6}$$

The variable b indicates the amount of real claims on country 2 held by residents of country 1 and expressed in commodities of the latter country. Real

4 The implications of this assumption are discussed among others in Deaton and Muellbauer (1980).

5 It is of course possible to deflate GNP by a properly defined consumer price index. In the present analysis there is no need for this because all quantities are expressed in terms of domestic commodities.

nonhuman wealth is equal to the sum of the capital stock and real claims on the rest of the world:

$$\begin{aligned} a_1 &= k_1 + b \\ a_2 &= k_2 - \frac{b}{p} \end{aligned} \tag{7}$$

Households choose between domestic and foreign goods by maximizing an instantaneous utility function subject to a budget constraint based on derived consumption expenditure and given terms of trade. For a Cobb-Douglas type of utility function we get:

$$\begin{aligned} c_1^d &= \mu_1 c_1 \\ c_2^d &= \mu_2 c_2 \end{aligned} \tag{8}$$

$$\begin{aligned} c_1^m &= (1 - \mu_1)\,\frac{c_1}{p} \\ c_2^m &= (1 - \mu_2)\; c_2 p \end{aligned} \tag{9}$$

The goods market clears by assuming flexible prices. This implies that total demand equals supply at every instant of time. Assuming that investment goods are supplied by the home country we may write:

$$\begin{aligned} x_1 &= c_1^d + i_1 + c_2^m \\ x_2 &= c_2^d + i_2 + c_1^m \end{aligned} \tag{10}$$

This concludes the static part of the model. The dynamic features of the model relate to capital accumulation, a lagged response of real wage rates to excess demand in the labour market and accumulation of foreign assets. Capital accumulation is by definition equal to:

$$\begin{aligned} \dot{k}_1 &= i_1 - \delta_1 k_1 \\ \dot{k}_2 &= i_2 - \delta_2 k_2 \end{aligned} \tag{11}$$

It is supposed that the relative change of the real wage rate depends linearly on the rate of unemployement:

$$\begin{aligned} \frac{\dot{w}_1}{w_1} &= \omega_1 \left[\frac{l_1}{l_1^s} - 1\right] \\ \frac{\dot{w}_2}{w_2} &= \omega_2 \left[\frac{l_2}{l_2^s} - 1\right] \end{aligned} \tag{12}$$

The coefficient ω is a measure of the degree of flexibility on the labour market.

An inflexible labour market should be characterized by an asymmetrical response pattern. In case of unemployment the real wage rate would adapt slowly, whereas in case of overemployment the real wage rate would rise fast. Such a situation could be taken care of by assuming nonlinearity. In our numerical exercises an adequate choice of parameter values will do the same job. A more general wage equation taking account of demand and supply factors is derived in Layard and Nickell (1985). Search intensity and willingness of the unemployed to work are dealt with by introducing so-called 'push' variables. In the present paper all factors relating to rigidities in the labour market are captured by assigning numerical values to the parameter ω.[6] More specifically, in the next section we shall analyse situations of overemployment (actual unemployment falls short of the natural rate of unemployment). If the labour market is flexible it may then be easy for firms to attract additional labour in one form or the other (overtime, new participants, *etc.*). In this case it would not be necessary to increase real wages substantially (ω would be relatively low). On the other hand, if there are strong rigidities it may be necessary to raise real wages fast in order to attract some additional labour. Our approach implies that rigidities have no effect on the natural rate of unemployment. However, this does not seem a great disadvantage because what matters most are developments in the short run and in the medium run.

The accumulation of foreign assets is governed by the balance of payments on current account in both regions:

$$\begin{aligned} \dot{b} &= y_1 - c_1 - i_1 \\ -\dot{b} &= (y_2 - c_2 - i_2)p \end{aligned} \tag{13}$$

The second equation of (13) is redundant by Walras's law. The model contains 25 equations and the same number of variables. For given values of the state (stock) variables k_1, k_2, w_1, w_2 and b the rate interest (r) and the terms of trade (p) account for a simultaneous equilibrium on the markets for goods. The resulting solutions for the flow variables together with the given values of the stock variables determine subsequently the changes in the latter variables according to the dynamic equations (11) through (13). Eventually the system may attain a stationary equilibrium with $\dot{k}_1 = \dot{k}_2 = \dot{w}_1 = \dot{w}_2 = \dot{b} = 0$.

The model is calibrated by choosing reasonable values for the parameters from an empirical point of view. There is no intention to model a particular economy, one reason being that we want to start with a symmetrical structure as is not unusual in this kind of analysis. The parameters chosen are presented below:

6 Cost of adjustment with regard to hiring and firing of labour can be dealt with in different ways. As shown by Mortensen (1970) and Nickell (1984) instead of introducing these costs explicitly one could argue that monopsonist firms use the current wage to adjust the labour force. In the latter case cost of adjustment take the form of changes in the wage rate.

Technical parameters:
$\varepsilon_1 = \varepsilon_2 = 1,\ \alpha_1 = \alpha_2 = 0.75,\ \delta_1 = \delta_2 = 0.03125$

Producer behaviour:
$\beta_1 = \beta_2 = 0.1$

Consumer behaviour:
$\gamma_1 = \gamma_2 = 0.6,\ \nu_1 = \nu_2 = 0.1,\ \varphi_1 = \varphi_2 = 80,\ \mu_1 = \mu_2 = 0.5$

Market behaviour:
$\omega_1 = \omega_2 = 0.3$

Normal labour supply:
$\underline{l}_1^s = \underline{l}_2^s = 16$

The steady state solutions can easily be found:

$x_1 = x_2 = 25.1$	$i_1 = i_2 = 3.0$
$k_1 = k_2 = 96.9$	$c_1 = c_2 = 22.1$
$k_1^* = k_2^* = 96.9$	$c_1^d = c_2^d = 11.0$
$l_1 = l_2 = 16$	$c_1^m = c_2^m = 11.0$
$a_1 = a_2 = 96.9$	$y_1 = y_2 = 25.1$
	$w_1 = w_2 = 1.2$

$p = 1$
$r = 0.034$
$b = 0$

3 DIFFERENT ROUTES TO A HIGHER WELFARE

A higher level of welfare can be attained in several ways. Here we consider two possibilities, *i.e.* an increase in overall productivity as measured by the constant ε and an increase in the savings rate, generated by a decline in the parameter γ. As already explained in section 1 both causes of accumulation and economic expansion are applied to three different situations. In section 3.1 it is assumed that both regions have an identical structure and that the shocks are equal. This might be seen as an uninteresting case, but the results may serve as a reference to facilitate the interpretation of the more complicated cases. Section 3.2 is devoted to an analysis of unilateral autonomous changes in the relevant parameters. It will be assumed that country 1 (the USA) is more eager to promote economic growth than country 2 (Europe), but there are supposed to be no differences with regard to the model parameters. Finally, in section 3, differences in economic structure are introduced. In this case shocks to the system are uniform across regions in order to isolate the pure effect of a difference in structure.

3.1 *A World of Symmetry*

The effects of an autonomous increase in productivity of 5% in both countries are presented in Table 1. The figures are relative deviations (percentages) from the initial steady state as given in section 2. For the sake of convenience the same notation for variables in relative deviations is maintained as for absolute values. Periods relate to ends of years. The new steady state (last column) proves to be a stable equilibrium.[7] Because of the assumed symmetry the results are equal in both regions. The figures given in Table 1 therefore apply to country 1 as well as to country 2.

The relative price of goods 2 in terms of goods 1 does not change ($p = 0$), because the increase in the volume of exports corresponds exactly to the rise in the volume of imports ($c_1^m = c_2^m$). For the same reason there is no accumulation of foreign debt ($b = 0$) and the volume of nonhuman wealth equals the stock of capital ($a = k$).[8] The solution resembles that of a closed economy. The higher level of productivity raises the marginal productivity of both factors labour and capital. As a result of the increase in the marginal productivity of labour employment rises on the short and the medium run. This induces higher real wage rates, which eventually restore equilibrium in the market for labour. The increase in the marginal productivity of capital leads to a boost in invest-

TABLE 1 – UNIFORM PRODUCTIVITY INCREASE; SYMMETRICAL CASE

	Period				
	1	2	4	10	Steady State
x	10.9	7.3	6.1	6.2	6.4
l	7.1	2.1	0.4	0.1	0
k	1.4	2.2	3.0	4.2	5.5
k^*	11.8	7.5	5.9	5.6	5.5
i	34.6	19.0	12.3	8.7	5.5
y	10.9	7.3	6.1	6.2	6.4
a	1.4	2.2	3.0	4.2	5.5
c	7.7	5.7	5.3	5.9	6.6
c^d	7.7	5.7	5.3	5.9	6.6
c^m	7.7	5.7	5.3	5.9	6.6
w	3.6	5.0	5.7	6.1	6.4
r	3.2	2.1	1.7	1.7	1.7
p	0	0	0	0	0
b	0	0	0	0	0

$\varepsilon_1 = \varepsilon_2 = 1.05$

7 The five roots of the dynamic system are all negative: −1.34, −1.32, −0.11, −0.11, −0.09.

8 The relative deviation of the variable b is expressed in terms of the initial capital stock k.

ment. At the same time consumption is pushed up by a higher income. In order to maintain equilibrium in the product markets the real rate of interest must increase in the short run. As the gap between the desired capital stock and the actual capital stock gradually closes, the rate of investment slows down. The rate of interest falls slightly below the ultimate equilibrium level in the medium run. (This is not visible in Table 1, because of rounding errors.) Such a cyclical movement in the rate of interest mirrors the development of real consumption expenditure. The change in consumption is determined by opposing forces. Whereas real income (y) reaches its equilibrium value from above, real nonhuman wealth approaches its long-run value from below. As appears from equations (5) both variables have a positive influence on real consumption expenditure.

The long-run results of an increase in productivity need little comment. There is more of everything except for labour, the supply of which – although elastic in the short run – is determined exogenously.

The effects of a decline in the propensity to consume from 0.6 to 0.55 are given in Table 2. Again the new equilibrium is a stable one.[9] Because of the symmetry the terms of trade are constant ($p = 0$) and the current account of the balance of payments does not show any surplusses or deficits ($b = 0$).

TABLE 2 – UNIFORM INCREASE IN SAVINGS; SYMMETRICAL CASE

	Period				
	1	2	4	10	Steady State
x	0.6	0.9	1.2	1.7	2.2
l	0.5	0.7	0.6	0.3	0
k	0.8	1.6	3.2	6.2	9.3
k^*	10.0	10.1	10.0	9.6	9.3
i	30.2	28.7	25.0	17.3	9.3
y	0.6	0.9	1.2	1.7	2.2
a	0.8	1.6	3.2	6.2	9.3
c	−3.5	−2.9	−2.0	−0.4	1.3
c^d	−3.5	−2.9	−2.0	−0.4	1.3
c^m	−3.5	−2.9	−2.0	−0.4	1.3
w	0.1	0.2	0.6	1.4	2.2
r	−12.6	−12.5	−12.5	−12.5	−12.4
p	0	0	0	0	0
b	0	0	0	0	0

$\gamma_1 = \gamma_2 = 0{,}55$

9 The relevant roots are: −1.1, −1.09, −0.11, −0.11, −0.08.

In the short run the real rate of interest decreases to restore equilibrium in the goods markets after a deflationary impulse. As a result investment rises and the stock of capital starts to grow. The higher stock of capital leads to additional production. With real wages lagging there is also some increase in employment. As time passes the new long-run equilibrium values are approached gradually. In the long run consumption increases, as should be the case provided that the rate of return on capital exceeds the rate of depreciation (δ).[10]

3.2 *Unequal Shocks*

The main results of an increase in productivity in country 1 alone are presented in Table 3.[11] A comparison with the figures in Table 1 shows that the outcomes for the dynamic country are *grosso modo* the same as in the case of a uniform productivity rise. In the short run technical progress induces a substantial

TABLE 3 – PRODUCTIVITY INCREASE IN COUNTRY 1

	Period				
	1	2	4	10	Steady State
x_1	11.0	7.4	6.2	6.3	6.6
l_1	7.2	2.2	0.4	0.1	0
k_1	1.6	2.4	3.3	4.7	6.1
i_1	38.6	21.2	13.8	9.8	6.1
c_1	7.9	5.8	5.3	5.9	6.5
c_1^m	1.0	0.5	0.2	0.1	−0.2
w_1	3.6	5.1	5.7	6.1	6.6
x_2	−0.1	−0.1	−0.1	−0.1	−0.1
l_2	−0.1	−0.1	−0.0	−0.0	0
k_2	−0.1	−0.2	−0.3	−0.4	−0.6
i_2	−3.4	−2.0	−1.3	−0.9	−0.6
c_2	−0.2	−0.1	−0.1	−0.0	0.1
c_2^m	6.6	5.2	5.0	5.8	6.8
w_2	−0.0	−0.0	−0.1	−0.1	−0.1
r	1.6	1.0	0.8	0.8	0.8
p	6.9	5.3	5.1	5.9	6.7
b	−0.2	−0.3	−0.4	−0.7	−1.1

$\varepsilon_1 = 1.05$

10 The difference between the gross rate of return on capital and the rate of depreciation is of course equal to the real interest rate, which remains positive.

11 Stability is again assured as appears from the relevant roots: −1.33, −1.1, −0.11, −0.11, −0.08.

increase in production. In the long run the development is supported by capital accumulation, whereas the level of employment returns to its equilibrium value. The real rate of interest rises in the short run to check expenditure in country 1. As a result investment in country 2 declines. The stock of capital falls and production as well as employment slows down. Consumption in the passive country 2 decreases under influence of a lower income from production and a higher interest rate. The terms of trade move against the dynamic region. The expansion in country 1 fosters imports from country 2, but the goods from the latter country are in short supply. Therefore the price of goods 2 in terms of goods 1 rises from the very beginning. This facilitates the export from country 1 to country 2 as appears from Table 3. Despite this positive feature the dynamic country runs a deficit on the balance of payments on current account ($b<0$). The growth in country 1 is therefore partly financed by country 2, which thus becomes a creditor country.

The position of country 2 as a creditor country results in a stream of interest payments flowing from country 1. This leads in due course to a higher income compared with the initial situation. Along with it real nonhuman wealth increases. Both factors have a positive effect on consumption in country 2. As

TABLE 4 – INCREASE IN SAVINGS IN COUNTRY 1

	Period				
	1	2	4	10	Steady State
x_1	0.3	0.5	0.6	0.9	1.1
l_1	0.3	0.3	0.3	0.2	0
k_1	0.4	0.8	1.6	3.1	4.6
i_1	15.0	14.2	12.4	8.6	4.6
c_1	−4.3	−3.7	−2.7	−0.8	1.7
c_1^m	−4.3	−3.7	−2.7	−0.8	1.7
w_1	0.0	0.1	0.3	0.7	1.1
x_2	0.3	0.5	0.6	0.9	1.1
l_2	0.3	0.3	0.3	0.2	0
k_2	0.4	0.8	1.6	3.1	4.6
i_2	15.0	14.2	12.4	8.6	4.6
c_2	0.9	0.9	0.8	0.5	−0.4
c_2^m	0.9	0.9	0.8	0.5	−0.4
w_2	0.0	0.1	0.3	0.7	1.1
r	−6.5	−6.5	−6.5	−6.4	−6.4
p	0	0	0	0	0
b	0.5	1.1	2.1	4.2	7.3

$\gamma_1 = 0.55$

shown in Table 3 total consumption expenditure rises after a while and on the long run there is even a substantial rentier effect. Consumption increases despite a fall in capital accumulation and production on the long run. To maintain full employment in country 2 the real wage rate has to decline.

The outcomes in case of an unilateral increase in savings in country 1 are presented in Table 4.[12] It is interesting to compare these with the figures from Table 2. Because the increase in world savings is now only half of that in case γ diminishes in both countries the change in the real rate of interest is roughly half of that in case of a uniform increase in savings. The fall in the rate of interest induces an increase in investment in both countries to the same extent. Consequently the stock of capital, production and employment show the same development in both regions. Compared with the results in Table 2 the changes are again about a factor of two lower.

Whereas production results are equal across countries consumption is certainly not. In the short run and in the medium run consumption expenditure is below the initial steady state level in country 1. After a certain time consumption demand becomes positive as a result of capital accumulation on the one hand and the accumulation of foreign assets on the other hand. Part of the additional savings in region 1 are invested abroad. This induces a flow of interest receipts which along with the increase in the wealth component stimulates consumption. In country 2 the reverse situation holds. On the medium run consumption expenditure goes up as production and income rise. After a while this effect is counterbalanced by the interest payments on foreign debt. In the long run there is a moderate decline of real consumption. For the same reason country 1 now envisages a long-run gain in consumption compared with the situation described in Table 2.

Finally, it should be observed that the terms of trade do not change. The reason is that in the present case excess demand (*ex ante* as well as *ex post*) in both markets is equal. This can be easily checked. Changes in supply are related to a uniform mutation in the real rate of interest. Total consumption expenditure differs between countries, but preferences for both goods are the same ($\mu = 0.5$). Therefore, the effect of unequal demand is spread evenly on both markets.

3.3 *Differences in Structure*

In this section it is supposed that country 1 is more dynamic than country 2. Firstly, entrepreneurs react more strongly if new investment opportunities arise ($\beta_1 = 0.3$). One could maintain that they are less pessimistic and more inclined to take risk than their colleagues in the other country. Secondly, hiring and firing of workers may be more easily accomplished and there may be a greater willingness to work. In our model a greater flexibility in the market for labour can be dealt with by the parameter ω. For country 1 we

12 The roots in this case are: -1.1, -1.09, -0.11, -0.11, -0.08.

assume $\omega_1 = 0.1$, which implies a more elastic supply in case of overemployment, as explained in section 2.

To isolate the effect of a difference in dynamic structure the impulses studied in this section are uniform across regions. In Table 5 the effects of an equal productivity increase of 5% are given. In the present example there are conjugate complex roots, but all real parts are negative. The system of differential equations is therefore stable, but there may be oscillations.

The results in Table 5 could be compared with those in Table 1. Such a comparison learns that the long-run results are the same in both cases. This should be obvious as the assumed differences in structure relate to parameters which only influence the path towards a new steady state. In the short run the general picture in the less dynamic country 2 is more or less the same in both situations. An important exception is, however, investment demand which is now much lower. The rate of investment in this region is depressed by the relatively high increase of the real interest rate on the world market. The rise in the interest rate in its turn can be explained by a host of activities in country 1. In this more dynamic region there is a very strong increase in investment. At the same time the rise in production is facilitated by the easy situation in the

TABLE 5 – UNIFORM PRODUCTIVITY INCREASE; DIFFERENT STRUCTURE

	Period				
	1	2	4	10	Steady State
x_1	19.3	16.9	12.8	6.9	6.4
l_1	17.4	13.2	7.1	−0.1	0
k_1	3.0	5.7	8.5	7.8	5.5
i_1	104.2	73.5	29.8	−5.8	5.5
c_1	12.2	11.8	10.5	7.3	6.6
c_1^m	15.2	9.7	4.9	3.6	6.6
w_1	1.6	3.2	5.4	7.0	6.4
x_2	10.3	6.5	5.5	6.1	6.4
l_2	6.5	1.6	0.2	0.3	0
k_2	0.6	0.8	1.0	3.3	5.5
i_2	8.1	2.2	9.4	14.4	5.5
c_2	6.0	4.5	4.9	6.3	6.6
c_2^m	3.3	6.5	10.5	10.1	6.6
w_2	3.5	4.8	5.2	5.8	6.4
r	14.9	10.3	4.7	0.4	1.7
p	−2.6	1.9	5.3	3.5	0
b	−0.9	−1.8	−2.6	−1.4	0

$\varepsilon_1 = \varepsilon_2 = 1.05$; $\beta_1 = 0.3$; $\omega_1 = 0.1$

labour market. Consumption and imports are stimulated forcefully and there results a deficit on the balance of payments on current account. The terms of trade of country 1 nevertheless improve at the end of the first year, which can be attributed to the very high demand for investment goods.

The investment boom in country 1 leads to overinvestment and overshooting of the long-run equilibrium values. As capital accumulation proceeds investment opportunities diminish. At the end of year 10 the rate of investment is even lower than in the initial steady state. The terms of trade of the dynamic country deteriorate in the medium run (from $t = 2$ to $t = 6$). This contributes to the deficit on the balance of payments over the same period. Foreign debt increases until imports decline sufficiently in the course of the downturn and the situation with regard to the current account is reversed. As may be expected a high accelerator induces cyclical movements in the economy. The relatively low value of ω may have a stabilizing effect. Excess demand for labour induces real wage increases and results ultimately in unemployment, but the process of adjustment passes off slowly. At the turning point in the labour market investment demand has already recovered.

Although there are some fluctuations in the less dynamic country 2 the overall picture shows a rather smooth development. After the initial impulse the labour market approaches equilibrium step by step. There are fluctuations with regard to investment as a result of diminishing opportunities on the one hand and a fall in the real rate of interest on the other hand. On the whole the effect of a more turbulent development in country 1 on the course of events in country 2 is moderate.

Table 6 shows the results of a uniform increase in savings behaviour in case of the same structural differences between countries as assumed before. The long-run effects are of course the same as in Table 2.[13] In the short run the rate of interest falls less than in the symmetrical case, because of heavy investment activities in country 1. Consequently, investment in country 2 is lower than in the case presented in Table 2. This leads to a lower rise of production in region 2 in comparison with region 1 and also in comparison with the case of complete symmetry. The terms of trade of region 1 improve in the short run as a result of high domestic demand for investment goods. Because country 2 is relatively cheap for consumers in country 1 imports of the latter region increase, whereas imports of the former region strongly decrease. Country 1 runs a deficit on the balance of payments on current account. Foreign debt of country 1 increases for some time to come. The corresponding interest payments have a favourable impact on consumption in country 2. It takes a rather long time to redress the situation, but on the long run there can be no foreign debt either or both ways.

The investment boom in the dynamic country leads also in this example to an overshooting with regard to the stock of capital and the real wage rate.

13 Inspection of the roots shows that stability is assured in this case too.

However, the cyclical movement seems to have a longer phase and a smaller amplitude than in the simulation run presented in Table 5. The overshooting with regard to the variables mentioned above is not even visible during the ten-year period chosen for presentation in Table 6 (and all other tables).[14]

4 CONCLUSIONS

As the simulation runs show the model leads to a number of more or less familiar results. Although useful for our understanding of reality we want to emphasize here the role of a dynamic nation (USA) *vis à vis* a more passive economic region (Europe). Differences in dynamics may relate to autonomous changes in parameters (shocks to the system) or differences in parameters between regions. In reality the relative position of the USA may be characterised by a number of factors operating simultaneously. In the paper we have analysed these factors separately to facilitate the interpretation of results.

TABLE 6 – UNIFORM INCREASE IN SAVINGS; DIFFERENT STRUCTURE

	Period				
	1	2	4	10	Steady State
x_1	1.2	2.3	3.4	3.2	2.2
l_1	1.1	2.1	2.7	1.2	0
k_1	1.3	2.8	5.5	9.3	9.3
i_1	52.2	50.2	41.7	16.2	9.3
c_1	−3.7	−2.6	−0.9	0.8	1.3
c_1^m	0.2	0.1	−0.6	−1.5	1.3
w_1	0.0	0.2	0.7	1.9	2.2
x_2	0.3	0.5	0.8	1.4	2.2
l_2	0.3	0.4	0.4	0.4	0
k_2	0.4	0.9	1.9	4.8	9.3
i_2	17.3	17.2	17.7	18.6	9.3
c_2	−4.2	−3.5	−2.5	−0.3	1.3
c_2^m	−8.0	−6.1	−2.9	2.0	1.3
w_2	0.0	0.1	0.4	1.1	2.2
r	−7.5	−7.7	−8.8	−11.7	−12.4
p	−3.9	−2.6	−0.4	2.3	0
b	−0.4	−0.8	−1.5	−1.9	0

$\gamma_1 = \gamma_2 = 0.55$; $\beta_1 = 0.3$; $\omega_1 = 0.1$

14 The stock of capital rises to 9.6 at $t = 16$, whereas the real wage rate attains a maximum of 2.3 at $t = 18$.

A productivity increase in the USA leads to a higher rate of interest on the world market and an increase in foreign debt, because the expansion is partly financed by Europe. On the short run the interest effect dominates and economic growth in Europe is retarded. After a certain time the rentier effect becomes dominant and Europe shares to some extent in the expansion of the USA. This development is reinforced by an improvement in the terms of trade of Europe.

A more dynamic response to technical shocks in the USA has similar effects on the short and medium run. In addition there is a tendency to overinvestment and overshooting of long-run equilibrium values. The inevitable recession in the USA has, however, a rather mild impact on economic development in Europe.

A rise in US savings is favourable for Europe on the short and medium run, because investment is stimulated by a lower rate of interest. In the longer-term future increasing foreign debt becomes an important burden for Europe. In our example there is no terms-of-trade effect.

In case of a world-wide increase in savings a more dynamic response in the USA leads to crowding-out effects in Europe. However, temporary rising foreign debt in the USA changes the picture in this respect after a while. The favourable effects on the European economy are then reinforced by a declining investment rate in the USA to correct for overaccumulation.

The simulation runs give insight into the dynamic interactions between regions, but they lack generality. More effort should therefore be invested in the calibration of models not only with respect to parameter values, but also with respect to relevant exogenous shocks. This indicates a direction for further research.

APPENDIX

LIST OF VARIABLES

endogenous

a = nonhuman wealth
b = foreign debt of country 2 in terms of goods 1
c = real consumption expenditure
c^d = consumption of domestic goods
c^m = consumption of foreign goods (imports)
i = gross investment
k = stock of capital
k^* = desired stock of capital
l = employment
p = price of goods country 2 in terms of goods country 1
r = real rate of interest on the world market

w = real wage rate
x = volume of production
y = real income

exogenous
l^s = normal supply of labour

Variables with a country index are expressed in terms of domestic goods. (Labour is of course measured in man-hours).

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Summary

ECONOMIC RESILIENCE: A TWO-COUNTRY ANALYSIS

Countries differ with regard to labour-market flexibility and 'animal spirits' of entrepreneurs. The paper aims at an analysis of the consequences of these differences in a climate favourable to economic growth. For that purpose a two-country model is presented in section 2. Although wealth variables are taken into account, expectations are assumed to be static. Despite this simplification the model cannot be solved analytically. The role of a dynamic region (USA) versus a more passive region (Europe) is therefore studied by working through numerical examples.