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Nikolai Zoubanov

Uneven Growth in a Monetary Union: on the Possible Implications for its Slow-Growing Members

W a r s a w , N o v e m b e r 2 0 0 3

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Abstract

An attempt is made to explore the basic implications of differences in productivity growth rates in countries within a monetary union and tailor them to the case of the EU new member countries running up to the EMU. By using the mathematical model of Harrod-Balassa-Samuelson effect and linking productivity and relative price dynamics with monetary policy, it is shown that: 1) productivity growth in faster-growing countries (FGC) leads to either inflation there, or union-wide exchange rate appreciation, or both in certain proportions, depending on the monetary policy stance taken by the union, but does not cause increase in inflation in slower-growing countries (SGC) by itself, unless the union's monetary authorities take pro-inflationary policy; 2) because of presence of FGC, the SGC do not become less competitive in the world, and can benefit from increased export of their goods to FGC, provided their labour markets are flexible enough; 3) the real challenge for SGC posed by FGC is not inflation, but rather loss of jobs and export revenues, if their labour markets are not flexible enough to adjust under tight union-wide monetary policy aimed at keeping the union-wide overall price level unchanged, or the labour productivity increase in FGC is not met by adequate improvement in labour productivity in SGC. It should be noted, however, that this 'adequate improvement' is enough to constitute only a fraction of the productivity growth in FGC.

Introduction[1]

The issues raised by the accession to EMU of new, fast growing, members reflect a much larger problem: that of uneven growth between regions of similar size within a monetary union. One can easily imagine a situation in which one region of EMU (say France and Spain) grows fast, while another (say Germany and Italy) of about the same size grows very slowly. What will be the effects of such a situation on the slow-growing region?

Although there are other factors influencing inflation and the external exchange rate in a monetary union, we focus on assessing the role of the Harrod-Balassa-Samuelson (H-B-S) effect in fast-growing countries (FGC) for slow-growing countries (SGC) and the whole union. Having introduced a few assumptions to build the mathematical model on, the most important conclusions we arrive at are:

1. Faster productivity growth in FGC will lead to either inflation there, or union-wide exchange rate appreciation, or a mixture of both, depending on the monetary policy stance taken by the union's monetary authorities (in the case of the EMU by the ECB). However, it will not cause increased in inflation in SGC, unless the union's monetary authorities take an accommodating policy stance.
2. The SGC will not become less competitive in the world, and indeed will be able to export more of their goods to their faster-growing monetary union partners, provided their labour markets are sufficiently flexible.
3. The real challenge for SGC posed by FGC is not inflation, but rather loss of jobs, which may happen if their labour markets are not flexible enough to adjust under a tight union-wide monetary policy aimed at keeping the union-wide overall price level unchanged.

This paper is organized as follows: the starting point provides a brief introduction to the problem. Section 1 presents a mathematical model of the H-B-S effect in one country (not in a monetary union), and derives implications for the exchange rate and for inflation in FGC outside a monetary union, assuming tight monetary policy stances. Section 2 augments the model with the case of two countries in a monetary union with uneven growth rates (faster- and slower-growing), and derives the implications of productivity growth in the FGC for the SGC. An outline of policy implications following from theoretical discussion is offered in the Concluding remarks.

[1] I would like to thank Prof. Jacek Rostowski for extensive comments and guidance in interpreting the modeling in this paper.

The starting point: uneven productivity growth and inflation differentials

If the exchange rate is fixed, the FGC will experience higher inflation than will the SGC. To illustrate this, consider the following model[2]. There are two countries in a monetary union, *A* and *B*, producing tradable and non-tradable goods. Tradable goods are easy to export, so their prices tend to be equal in both countries. Non-tradable goods, though, have such large trade costs that they never enter international trade, hence their prices may vary from country to country. It is further assumed that the share of non-tradable goods in total output is *a* (so that (1-*a*) is the share of tradables), and these shares are equal in the two countries, and the wage level is the same in both sectors (although not necessarily the same in both countries).

The inflation rate (π) in *A* and *B* is defined as follows:

$$\pi_A = (1-\alpha)\pi_{TA} + \alpha\pi_{NA}$$
$$\pi_B = (1-\alpha)\pi_{TB} + \alpha\pi_{NB} \quad (1)$$

where subscripts *T* and *N* stand for tradables and non-tradables, respectively. Because of the existence of a single currency, inflation rates in tradables are equal across countries. At the same time, inflation in each sector should be equal to differences between the growth rates of wages and of labour productivity in respective sectors, that is:

$$\pi_{TA} = \hat{w}_A - \hat{q}_{TA}$$
$$\pi_{NA} = \hat{w}_A - \hat{q}_{NA}$$
$$\pi_{TB} = \hat{w}_B - \hat{q}_{TB}$$
$$\pi_{NB} = \hat{w}_B - \hat{q}_{NB}$$

where $\hat{x} = d\log x$ is the rate of change in relative terms. We can now derive non-tradable inflation as a function of tradable inflation and productivity in both sectors:

$$\pi_{NA} = \pi_{TA} + \hat{q}_{TA} - \hat{q}_{NA}$$
$$\pi_{NB} = \pi_{TB} + \hat{q}_{TB} - \hat{q}_{NB}$$

By substituting these back to equation (1), we get:

$$\pi_A = (1-\alpha)\pi_{TA} + \alpha(\pi_{TA} + q_{TA} - q_{NA})$$
$$\pi_B = (1-\alpha)\pi_{TB} + \alpha(\pi_{TB} + q_{TB} - q_{NB})$$

which implies

[2] Taken from De Grauwe (1992).

$$\pi_A - \pi_B = \alpha(q_{TA} - q_{TB}) - \alpha(q_{NA} - q_{NB}).$$

If we assume that there is equal productivity growth in non-tradables in both countries, we obtain the following equation:

$$\pi_A - \pi_B = \alpha(q_{TA} - q_{TB})$$

which implies that if *A*'s labour productivity in tradable sector grows faster than *B*'s, *A* will experience higher inflation than will *B*. So, uneven productivity growth implies uneven inflation in a monetary union, which is unavoidable, unless the growth is stopped.

Although this model is a convenient way to start exploring the impact of uneven growth on the economy of monetary union, it does not address a number of important issues. In particular, what happens to employment and income in the member countries? How the inflation can be managed by means of monetary policy? What are the opportunities and challenges for the SGC being in a monetary union with FGC? These and some other questions we are to answer by exploring the model of H-B-S effect in detail.

Section 1

The Harrod-Balassa-Samuelson Effect and Its Implications for the Case of One Country

In this chapter, we explore the implications of the H-B-S effect for the price level, output, domestic demand and export potential in the case of one country, and also link it with the monetary policy stance so as to show its implications for the exchange rate. It will be shown that productivity growth in the tradable sector leads to an appreciation of the country's *real* exchange rate, but that monetary policy can be used to reach a trade-off between *nominal* exchange rate appreciation and inflation. Besides, in no case will a country experiencing productivity growth lose its competitive advantage in real terms. It has a wide choice of exchange rate/inflation tradeoffs which do not hurt its position on the world market.

1.1. Assumptions

Consider a country *S* with a small open economy that takes the price of imports and exports as given on the world market. There are two sectors in the economy: tradables (goods available for trade worldwide with reasonable costs of shipping and other trade barriers), and non-tradables (goods so costly to trade that they never enter the international trade). The relative unit composite price of non-tradables in terms of tradables is set equal to p_S, with an initial value of 1. There are two factors used in production: labour and capital. While *S* is able to freely import capital from abroad at a fixed interest rate *r*, the domestic supply of labour is limited and equal to $L_s = L_{TS} + L_{NS}$, where subscripts *TS* and *NS* stand for the tradable and non-tradable sectors in *S*, respectively. All factor markets in *S* are perfectly competitive, which implies that wages are equal across the whole economy. Some other assumptions also apply:

1. Output in both sectors is determined by the Cobb-Douglas production function with two factors, labour and capital, and constant returns to scale:

$$Y_{TS} = A_{TS} K_{TS}^{\alpha_{TS}} L_{TS}^{1-\alpha_{TS}}$$
$$Y_{NS} = p_S A_{NS} K_{NS}^{\alpha_{NS}} L_{NS}^{1-\alpha_{NS}} \qquad (1.1.1)$$

2. Consumption is regulated by a constant-elasticity-of-substitution (CES) utility function:

$$u_S(C) = \left[\gamma_S^{\frac{1}{\theta_S}} \cdot C_{TS}^{\frac{\theta_S - 1}{\theta_S}} + (1-\gamma_S)^{\frac{1}{\theta_S}} \cdot C_{NS}^{\frac{\theta_S - 1}{\theta_S}} \right]^{\frac{\theta_S}{\theta_S - 1}} \qquad (1.1.2)$$

subject to the budget constraint:

$$Z_s = C_{TS} + p_s C_{NS} = w_s L_s + rQ_s \qquad (1.1.3)$$

where w_s – equilibrium wage level in *S*, Q_s = domestic capital plus current account balance, C_{TS}, C_{NS} stand for consumption of tradables and non-tradables, respectively, $0<\gamma_S<1$ is the share of tradables in total consumption, $\theta_S = \frac{d \log\left(\frac{C_{TS}}{C_{NS}}\right)}{d \log p_S}$ – the elasticity of substitution between tradables and non-tradables, meaning that with a 1% increase in pS consumption of tradables grows by θS% relative to that of non-tradables.

3. The nominal exchange rate between *S*'s currency and other currencies in the world is defined by

$$\varepsilon_{S,i} = \frac{P_{Ti}}{P_{TS}} \qquad (1.1.4)$$

where $P_{TS,Ti}$ are the nominal prices of tradables in countries *S* and *i*. Note that we take into account only the prices of tradables, since for the nominal exchange rate (which is formed as a result of interaction of supply and demand for currencies required to buy goods on international markets) the prices of non-tradables should not matter.

4. The real exchange rate is, according to the theory of purchasing power parity, initially equal to one for all the countries, which implies that the same bundle of consumption goods costs the same in all countries.
5. *S* experiences productivity growth in its tradable sector, $\hat{A}_{TS}=d\log A_{TS}>0$, and no productivity growth in its non-tradable sector. Also, for simplicity, it is assumed that the outer world has zero productivity growth. The assumption of no productivity growth in *S*'s non-tradable sector is not crucial to the result, yet very helpful for deriving the algebra. Very similar calculations can be performed for the general case of non-zero productivity growth, but with considerably more technical difficulty.

1.2. The model

We approached the derivation of the H-B-S effect when modelled the impact of uneven growth on inflation differentials between two countries. The model we considered there was too simple to catch any other effect than the inflation differentials, and now we have to do some more careful modelling to show other implications of productivity growth. We start with the case of one country to show the basic intuition, and then will proceed to the case of two countries to see the "spill-over" effects of productivity growth from one country within a currency union to another. Throughout this chapter we use the modelling framework of Obstfeld and Rogoff (1996), with some extensions and minor alterations.

Define the output per employed unit of labour as *y=Y/L*. Then, given a CRS Cobb-Douglas production function (eq. (1.1.1)),

$$y_{NS,TS}=(p_S)A_{NS,TS}\cdot k_{NS,TS}^{\ \ \alpha_{NS,TS}}$$

where *k=K/L*. By assumption of perfectly competitive factor markets and constant returns to scale,

$$y_{TS}=A_{TS}\cdot k_{TS}^{\ \ \alpha_{TS}}=rk_{TS}+w_S \text{ and } y_{NS}=p_S A_{NS}\cdot k_{NS}^{\ \ \alpha_{NS}}=rk_{NS}+w_S \qquad (1.2.1)$$

Log-differentiate equations (1.2.1) to get

$$\hat{y}_{TS,NS}=\frac{rk_{TS,NS}}{rk_{TS,NS}+w_S}\hat{k}_{TS,NS}+\frac{w_S}{rk_{TS,NS}+w_S}\hat{w}_S$$

which is equivalent to

$$\hat{A}_{TS}+\alpha_{TS}\hat{k}_{TS}=\alpha_{TS}\hat{k}_{TS}+(1-\alpha_{TS})w_S \text{ and } \hat{p}_S+\hat{A}_{NS}+\alpha_{NS}\hat{k}_{NS}=\alpha_{NS}\hat{k}_{NS}+(1-\alpha_{NS})w_S$$

where we made use of the fact that the shares of capital and labour in the total output are equal to *α* and *(1-α)*, respectively. Define *1-α=μ*. Then

$$\hat{A}_{TS} = \mu_{TS}\hat{w}_S \text{ and } \hat{p}_S + \hat{A}_{NS} = \mu_{NS}\hat{w}_S$$

which gives us

$$\hat{p}_S = \frac{\mu_{NS}}{\mu_{TS}}\hat{A}_{TS} - \hat{A}_{NS} \qquad (1.2.2)$$

But remembering that we assumed no growth in *S*'s non-tradable sector, equation (1.2.2) simplifies to

$$\hat{p}_S = \frac{\mu_{NS}}{\mu_{TS}}\hat{A}_{TS}$$

This can be interpreted as follows: the elasticity of p_s with respect to A_{TS} is $\frac{\mu_{NS}}{\mu_{TS}}$. That is 1% increase in tradable sector productivity causes $\frac{\mu_{NS}}{\mu_{TS}}$ % increase in relative price of non-tradables.

By maximizing the utility function (eq. (1.1.2)), we get the following demand schedules:

$$C_{TS} = \frac{\gamma_S Z_S}{\gamma_S + (1-\gamma_S)p_S^{\,1-\theta_S}}, \qquad C_{NS} = \frac{p_S^{\,-\theta_S}(1-\gamma_S)Z_S}{\gamma_S + (1-\gamma_S)p_S^{\,1-\theta_S}} \qquad (1.2.3)$$

By substituting equations (1.2.3) back into eq. (1.1.2) and scaling it down to unity, we get the overall price level (defined as minimum expenditure such that *C*=1),

$$P_S = \left[\gamma_S + (1-\gamma_S)p_S^{\,1-\theta_S}\right]^{\frac{1}{1-\theta_S}} \qquad (1.2.4)$$

Log-differentiate eq. (1.2.4) to obtain

$$\hat{P}_S = \frac{1}{1-\theta_S}\frac{(1-\theta_S)(1-\gamma_S)\hat{p}_S}{\left[\gamma_S + (1-\gamma_S)p_S^{\,1-\theta_S}\right]} \qquad (1.2.5)$$

Remembering that we have set up p_s=1 initially, eq. (1.2.5) simplifies to

$$\hat{P}_S = (1-\gamma_S)\hat{p}_S$$

This result suggests that the real aggregate price level in *S* increases by (1-γ_s)% with each 1% increase in p_s, or, equivalently, by $\frac{\mu_{NS}}{\mu_{TS}}$ (1-γ_s)% with each 1% increase in tradable sector productivity.

So, we have derived H-B-S effect in its initial formulation: wealthier countries tend to have higher price levels. With output growing in *S* due to increased productivity, its wealth increases, but also does its price level. Now comes the implication for the real exchange rate: assuming that there is no productivity growth in the reference country *i*, *S*'s real exchange rate related to *i*'s currency appreciates, as *S* has become a more "expensive" country with an increase in productivity there.

1.3. Further implications

Following the theoretical model of the H-B-S effect, we can also derive some implications of that in *S* for its output per worker, total output, income growth, domestic demand and allocation of labour in the economy, and finally link the H-B-S effect with inflation and the exchange rate through monetary policy.

Changes in output per-worker. Recall that $y_{TS} = A_{TS} k_{TS}^{\alpha_{TS}} = r k_{TS} + w_S$ (eq. (1.2.1)). Differentiate with respect to k_{TS} to get:

$$\alpha_{TS} A_{TS} k_{TS}^{\alpha_{TS}-1} = r \qquad (1.3.1)$$

Then log-differentiate eq. (1.3.1) to get:

$$\hat{a}_{TS} + \hat{A}_{TS} + (\alpha_{TS} - 1)\hat{k}_{TS} = \hat{r}$$

Because *r* and *α* are constant, the above reduces to

$$\hat{k}_{TS} = \frac{\hat{A}_{TS}}{\mu_{TS}} \qquad (1.3.2)$$

Combining eqs. (1.2.1) and (1.3.2), we obtain:

$$\hat{y}_{TS} = \hat{k}_{TS} \qquad (1.3.3)$$

which means that with a 1% productivity growth in tradables, per-worker output in this sector grows by $\frac{1}{\mu_{TS}}$ %. If we redo these calculations for the non-tradable good, *NS*, we get:

$$\hat{y}_{NS} = \hat{k}_{NS} = \frac{\hat{p}_s + \hat{A}_{NS}}{\mu_{NS}} = \frac{\hat{p}_s}{\mu_{NS}} \qquad (1.3.4)$$

which is equal to the growth of output per worker in *TS*, if we apply equation (1.2.2). This result is paradoxical, but only at the first sight: since the wage and interest rate are the same in all sectors of the economy, labour and capital are employed up to the point where their marginal products are equal for all sectors. Actually, this is one of the implications of the H-B-S effect: the relative price of non-tradables makes up for the gap in real productivities between tradables and non-tradables.

Changes in wages and total income. Recall from previous derivations that $\hat{A}_{TS} = \mu_{TS} \cdot \hat{w}_S$, or $\hat{w}_S = \frac{\hat{A}_{TS}}{\mu_{TS}}$. So, $\hat{y}_{TS} = \hat{w}_S$! This says that the increase in wages is fully compensated by the labour productivity increase, then labour still receives its marginal product and the nominal price of tradables (if we were to introduce one at this point) stays unchanged, *ceteris paribus*. This result goes to show that any other country trading with *S* will not have inflationary pressure from importing *TS*, because its price does not change due to productivity increase.

Recall the budget constraint (eq. (1.1.3)), $Z_s = w_sL_s + rQ_s$. Clearly, with a 1% increase in w_s, Z_s grows by $\varphi = \frac{w_S L_S}{w_S L_S + rQ_S}$%. Since $\hat{w}_S = \frac{\hat{A}_{TS}}{\mu_{TS}} = \frac{\hat{p}_S}{\mu_{NS}}$, Z_s grows by $\frac{\varphi}{\mu_{TS}}$% with a 1% increase in productivity, or by $\frac{\varphi}{\mu_{NS}}$% with a 1% increase in p_s. With income increasing, demand should also increase, but its increase need not necessarily match the output increase, so that we may have a change in *S*'s export potential, which we will not be able to calculate before we explore how domestic demand reacts to the increase in productivity.

Changes in domestic demand. Log-differentiate the optimal demand schedules (1.2.3) to get

$$\hat{C}_{TS} = \hat{Z}_S - (1-\gamma_S)(1-\theta_S)\hat{p}_S \text{ and } \hat{C}_{NS} = \hat{Z}_S - \left[\theta_S + (1-\gamma_S)(1-\theta_S)\right]\hat{p}_S \qquad (1.3.5)$$

Because $\hat{Z}_S = \frac{\varphi}{\mu_{NS}}\hat{p}_S$, the net increase in domestic demand for tradables is $\frac{\varphi}{\mu_{NS}} - (1-\gamma_S)(1-\theta_S)$ % per each 1% increase in p_s, or $\left[\frac{\varphi}{\mu_{TS}} - (1-\gamma_S)(1-\theta_S)\right] \cdot \frac{\mu_{NS}}{\mu_{TS}}$ % per each 1% increase in A_{TS}. Analogously, the net increase in demand for non-tradables is $\frac{\varphi}{\mu_{NS}} - \left[\theta_S + (1-\gamma_S)(1-\theta_S)\right]$ % and $\left[\frac{\varphi}{\mu_{TS}} - \left[\theta_S + (1-\gamma_S)(1-\theta_S)\right]\right] \cdot \frac{\mu_{NS}}{\mu_{TS}}$ % per each 1% increase in p_s and A_{TS}, respectively. Note that, reasonably assuming $\theta_S > 0$, consumption of non-tradables rises more slowly than that of tradables, which implies that in growing economies the share of non-tradables in consumption should gradually fall, thus lowering the impact of H-B-S effect on the overall price level.

While overproduced tradables may be exported, non-tradables must be consumed within the country. Since per-worker productivity does not necessarily have to grow by the same amount as demand, there is a possibility of reallocation of labour between tradable and non-tradable sectors, which is discussed next.

Reallocation of labour. Recall that the physical output of non-tradables is equal to $Y_{NS} = A_{NS} \cdot k_{NS}^{\alpha_{NS}} \cdot L_{NS}$. Log-differentiate this, remembering that $\hat{A}_{NS}$=0, to get:

$$\hat{L}_{NS} = \hat{Y}_{NS} - \alpha_{NS}\hat{k}_{NS} = \hat{C}_{NS} - \alpha_{NS}\hat{k}_{NS}$$

since non-tradables do not enter international trade. We already know what $\hat{C}_{NS}$ and $\hat{k}_{NS}$ are (eqs. (1.3.4) and (1.3.5)), so just by bringing them together we get:

$$\hat{L}_{NS} = [\varphi - \mu_{NS} \cdot (\theta_S + (1-\gamma_S)(1-\theta_S)) - (1-\mu_{NS})] \cdot \frac{\hat{A}_{TS}}{\mu_{TS}}, \text{ or } \hat{L}_{NS} = [\varphi - \mu_{NS} \cdot (\theta_S + (1-\gamma_S)(1-\theta_S)) - (1-\mu_{NS})] \cdot \frac{\hat{p}_S}{\mu_{NS}}.$$

We can see from this that – unless *S* has negative financial wealth so that its share of labour in output is above 1 – the higher θ_S, the lower is the growth of employment in the non-tradable sector. Indeed, if non-tradables are well-substituted for by tradables (θ_S approaching 1 from below), then there is no need to produce more non-tradables, because the actual demand for them will not grow even though income will (if θ_S =1 and φ<1 employment in non-tradable sector should actually fall). On the other hand, if non-tradables are not easily substituted for by tradables, there will be a higher growth of employment in that sector to meet the growing demand.

Theoretically, there need not be an increase in unemployment because of labour reallocation: production of non-tradables will exactly meet the demand for them, and every extra unit of tradables produced will be sold on the world market. However, because of structural rigidities and imperfect competition on the world market, a country experiencing productivity improvement may find it difficult to sell all its extra output of tradables abroad and then unemployment may rise. Analysis of this situation is out of this topic, but one can find casual evidence of this in Gordon (1998).

Changes in total output. In this paragraph we continue to assume that labour reallocation does not cause unemployment. Before the productivity shock, the quantity of labour employed in the non-tradable sector was $\frac{\gamma_S (w_S L_S + rQ_S)\mu_{NS}}{w_S} = \Delta$, and therefore L_S-Δ units of labour were employed in tradables. If with a 1% increase in p_s there is $\hat{L}_{NS}$ % increase in the labour employed in non-tradables, then the tradable sector is going to have $L_S - \Delta \cdot \frac{100 + \hat{L}_{NS}}{100}$ units employed, thus growing by $-\frac{\Delta \cdot \hat{L}_{NS}/100}{L_S - \Delta} \cdot 100 = \nu\%$.[3] Then the tradable output grows at

$$\hat{Y}_{TS} = \hat{y}_{TS} + \hat{L}_{TS} = \frac{\hat{p}_S}{\mu_{NS}} + \nu \hat{p}_S \tag{1.3.6}$$

which is $\frac{1}{\mu_{NS}} + \nu$ % per each 1% increase in p_s. The growth of total output is a weighted average of the growth rates of tradable and non-tradable outputs.[4]

Changes in export potential. Given that consumption of tradables grows by $\frac{\varphi}{\mu_{NS}} - (1-\gamma_S)(1-\theta_S)$ %, and that tradable output grows by $\frac{1}{\mu_{NS}} + \nu$ % (eq. (1.3.6)), the net increase in *S*'s export potential is $\frac{1-\varphi}{\mu_{NS}} + (1-\gamma_S)(1-\theta_S) + \nu$ % per 1% increase in p_s,. This is very likely to be positive, suggesting that a country experiencing productivity growth tends to have its current account balance improved through exports. The extent to which it can do so depends on the economy's structural parameters and consumer preferences. A high share of labour employed in the zero-growing non-tradable sector dampens the effect of productivity growth in tradables. A high share of labour income in GDP creates higher internal demand for tradables, because it is the workers who benefit from the improvement in productivity first. Low substitutability between tradables and non-tradables reduces the effective internal demand for tradables thus increasing export potential. On the other hand, if non-tradables are easily substituted by tradables, there is little room for a substantial increase in export potential, because much of the increase in output would be "eaten up" by domestic consumers.

Changes in social welfare and consumer behaviour. Social welfare improves with the increase in consumption, provided the share of labour income in GDP is high enough, non-tradables are substitutable for tradables and there are no significant structural rigidities on the factor markets. The role of substitutability should be clear from what was written above. The impact of nominal rigidities imposed on the labour market will be discussed in Section 2. Now we want to briefly explain why it is important to have an adequately high share of labour income in GDP. Recall that

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[3] The same sort of calculation can be performed for each 1% increase in A_{TS} using eq. (2.2.2)

[4] However, the growth of total output is much less important to us than the growth of tradable output, because it is tradable output that influences the current account, which in its turn, may induce exchange rate realignment to keep the current account constant. So, the exchange rate may be influenced by productivity growth not only directly, but also indirectly, through the current account balance. Exploring this link is relevant for my topic, but is left out of the thesis for further exploration at later date.

$\frac{\hat{C}_{TS}}{\hat{p}_s} = \frac{\varphi}{\mu_{NS}} - (1-\gamma_S)(1-\theta_S)$ and $\frac{\hat{C}_{NS}}{\hat{p}_s} = \frac{\varphi}{\mu_{NS}} - [\theta_S + (1-\gamma_S)(1-\theta_S)]$. So, for a positive growth in consumption of tradables, $\varphi \geq (1-\gamma_S)(1-\theta_S)\cdot\mu_{NS}$; and for a positive growth in consumption of non-tradables, $\varphi \geq [\theta_S + (1-\gamma_S)(1-\theta_S)]\cdot\mu_{NS}$. Therefore, since utility (hence social welfare) is non-decreasing function of consumption, it improves only if the share of labour income in GDP, φ, is high enough.

Furthermore, along with the obvious result that output grows with improvements in productivity, we get a less obvious result that *S* is very likely to get richer in terms of purchasing power: while its aggregate real price level rises by (1-γ_S)% with each 1% increase in p_S, its income goes up by $\frac{\varphi}{\mu_{NS}}\%$ for the same increase in p_S, not to mention an increase in its current account surplus due to more exports. One implication of this is growing demand for imports, which is a very important insight for the next part of the discussion – the case of two countries in a monetary union.

1.4. A monetary policy link

Notice that all the derivations above do not depend on nominal prices (in other words, they are correct for any numeraire), since they were calculated for relative prices. But now we can link the H-B-S effect with monetary policy and the nominal exchange rate. Although the H-B-S effect is modelled using relative prices, we can introduce money in this model if we assume a certain monetary policy stance. Consider two possible different cases of a "neutral" monetary policy: 1) when the money stock grows proportionally to the GNP (that is when M/Y=*const*); 2) when the money stock is constant irrespective of output changes.

The case when M/Y=*const*. Recalling Friedman's celebrated formula, *MV=PY*, *M/Y=const* implies that the aggregate *nominal* price level, P_n, stays constant unless there are changes in the velocity of circulation. Since the relative price of non-tradables rises, in order to guarantee that the average price level, P_n, remains constant, its base, that is the nominal price of tradables, should fall. But in that case, because of competitive forces, the country's nominal exchange rate must appreciate, thus bringing the price of its tradables back to the international level.

Formally, the nominal price level is equal to the real price level multiplied by some numeraire η, for which it is convenient to use the price of tradables:

$$P_n = \eta \cdot P_S = \eta \cdot \left[\gamma_S + (1-\gamma_S)p_S^{\,1-\theta_S}\right]^{\frac{1}{1-\theta_S}} \tag{1.4.1}$$

Log-differentiating (1.4.1) we get:

$$\hat{P}_n = \hat{\eta} + \hat{P}_S = \hat{\eta} + (1-\gamma_S)\hat{p}_s \tag{1.4.2}$$

Then, to keep the above constant, we need $\hat{\eta} = -(1-\gamma_S)\hat{p}_s$, that is the numeraire should fall by (1-γ_s)% with each 1% increase in p_s, or, equivalently, by $\frac{\mu_{NS}}{\mu_{TS}}$ (1-γ_s)% with each 1% increase in tradable sector productivity.

Recalling the formula for the nominal exchange rate between countries S and i (eq. (1.1.4)) and log-differentiating it, we obtain:

$$\hat{\varepsilon}_{S,i} = \hat{P}_{Ti} - \hat{P}_{TS} = \hat{P}_{Ti} - \hat{\eta}$$

Since we have assumed that there is no productivity growth in the outer world, P_{Ti} should not change, and then we have the nominal exchange rate appreciating by (1-γ_s)% with each 1% increase in p_s. Perhaps it is now needless to say that *S* does not lose its competitiveness because its exchange rate appreciation is exactly matched by the fall in its domestic price of tradables.[5]

The case when M=const. Constant money supply implies a reduction in the aggregate price level, and the price of tradables falling even more than in the previous case. The exchange rate appreciation is greater, but as before, such exchange rate appreciation does not mean any loss of competitiveness, because it proceeds to the point where the domestic price of tradables equals their international price.

M=const means $\hat{P}_n + \hat{Y} = 0$, so that the nominal price level should fall by as much as the total output would grow as a result of productivity increase (or by as much as the relative price of non-tradables increases, as one means the other). The total output growth associated with a 1% increase in p_S is

$$(1-\gamma_S)\cdot\left(\frac{\varphi}{\mu_{NS}} - \left[\theta_S + (1-\gamma_S)(1-\theta_S)\right]\right) + \gamma_S\cdot\left(\frac{1}{\mu_{NS}} + \nu\right) = \psi \%$$

Then P_n should fall by ψ%, which means that the price of tradables drops by (1-γ_s+ψ)%, which is more than in the previous case. Again, the nominal exchange rate should appreciate by the same percentage.

There is also a wide range of exchange rate/inflation tradeoffs, in which the money stock grows faster than output, which leads to less exchange rate appreciation but more inflation. Suppose *M/Y* is not constant, but rather $\hat{P}_n = k > 0$. Then $\hat{\eta} = k - (1-\gamma_S)\hat{p}_s$. Since it still holds that $\hat{\varepsilon}_{S,i} = \hat{P}_{Ti} - \hat{P}_{TS} = \hat{P}_{Ti} - \hat{\eta}$ and we continue to assume that there is no price changes in country *i*, $\varepsilon_{S,i}$ appreciates by exactly $k - (1-\gamma_S)\hat{p}_s$. This implies that whatever growth money stock may have, the exchange rate is a mirror image of the movements in the numeraire, therefore, there is no loss of competitive advantage for the countries experiencing the H-B-S effect, but no gain either.

[5] In a more complex setup, though, when we have to deal with non-tradable inputs in tradable goods, there may be some loss of competitiveness, but the question then is whether such goods should be classified as fully tradable.

Thus, we have seen that productivity growth in *S* has an impact on income, production and consumption, the price level and exchange rate in *S*, and now aim to explore what “spill-over” effects these changes have on *S*’s monetary union partners.

Section 2:

Two Countries in a Monetary Union: What Influence Does the BS Effect in One Country Have on the Other?

2.1. Preliminary observations

Now that we have studied the implications of the H-B-S effect for one country, we are ready to examine its impact on the other countries tied to the FGC by a monetary union and, therefore, by a single monetary policy. All the implications for one country which were derived in real terms are still valid. However, there are some differences in the effects of monetary policy, and some feedback impact from the FGC on their slower-growing monetary union partners. In particular:

1. The fall in the numeraire required to keep the aggregate price level unchanged is smaller now, because the SGC do not experience an increase in their price levels;
2. The SGC may have its exports (and employment) increase through the increase in demand in its faster-growing partner, but taking full advantage of this requires flexible labour market, namely the ability to index the wage to the numeraire (i.e. the exchange rate) in order to stay competitive;
3. If labour markets in the SGC are rigid, not only will it be difficult for the SGC to export more, but also employment may fall – unless there will be adequate growth in labour productivity;
4. However, if there is no productivity growth in the SGC and they are unable to make their labour market flexible enough, the union’s Central Bank might consider tolerating higher inflation for the union as a whole (although this would not increase inflation in the SGC).

To illustrate this formally, consider a slower-growing country named *G* forming a monetary union with *S* where productivity grows faster than in *G*. Let *S* produce one tradable good, *AS*, which it can export worldwide and sell at the world market’s prevailing price. *G* produces two tradable goods: *AG* (identical to *AS*) and *BG*, which *S* cannot produce. Goods *AS*, *AG* and *BG* are also produced and traded worldwide. Both *G* and *S* are small countries relative to the size of the world market, so the price elasticity of demand for their exports is assumed to be infinite.

All the assumptions made earlier for *S* are valid for *G*, except that *G* does not experience productivity growth at all. Again, this is not a crucial assumption, but does greatly simplify calculations. All the conclusions are valid even if there is some productivity growth in *G* (lower than in *S*), although they become less pronounced.

In addition to the assumptions made in the previous section, we now introduce utility measures for the whole *G*+*S* union and for both tradable goods (*A* and *B)*. We continue to use CES utility functions. The beauty of the CES utility function is that it allows easy aggregation of the goods entering it, and the price index implied by it can contain aggregated prices of its components indexed in a similar way as is the final price index. Furthermore, since we calculate the effects in percentage points, we are free to choose suitable initial values of relative prices, which greatly simplifies calculations and serves for clarity of results.

Thus, introducing a CES utility function for the *G*+*S* union including aggregate goods ***S*** and ***G***,

$$u(C_{G+S}) = \left[\delta^{\frac{1}{\theta}} \cdot C_G^{\frac{\theta-1}{\theta}} + (1-\delta)^{\frac{1}{\theta}} \cdot C_S^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

(where δ=share of *G*'s economy in the union, and θ is the elasticity of substitution in consumption between goods ***S*** and ***G*** – in fact the propensity to migrate), we derive the ***G***+***S*** aggregate price index in the usual way as

$$P_{G+S} = \left[\delta + (1-\delta)\rho^{1-\theta}\right]^{\frac{1}{1-\theta}}$$

where ρ is the relative price of good ***S*** in terms of good ***G***. From here we can immediately see that, if a 1% increase in p_S causes a (1-γ_s)% increase in P_S, then it also causes a (1- δ)(1-γ_s)% increase in P_{G+S}, by analogy with eq. (1.2.5). Thus the presence of a slower-growing country in the union will attenuate the exchange rate realignment required to keep the nominal price level constant.

Another lesson is that the H-B-S effect in *S* does not have any bearing on inflation in *G*. As was shown previously, $\hat{y}_{TS} = \hat{w}_S$, so that the nominal price of tradables stays unchanged. Thus, there will be no H-B-S effect-caused price growth in *G* because of trade with *S*, no matter how much the price index in *S* appreciates due to the H-B-S effect (as long as there is no autonomous H-B-S effect in *G* itself).

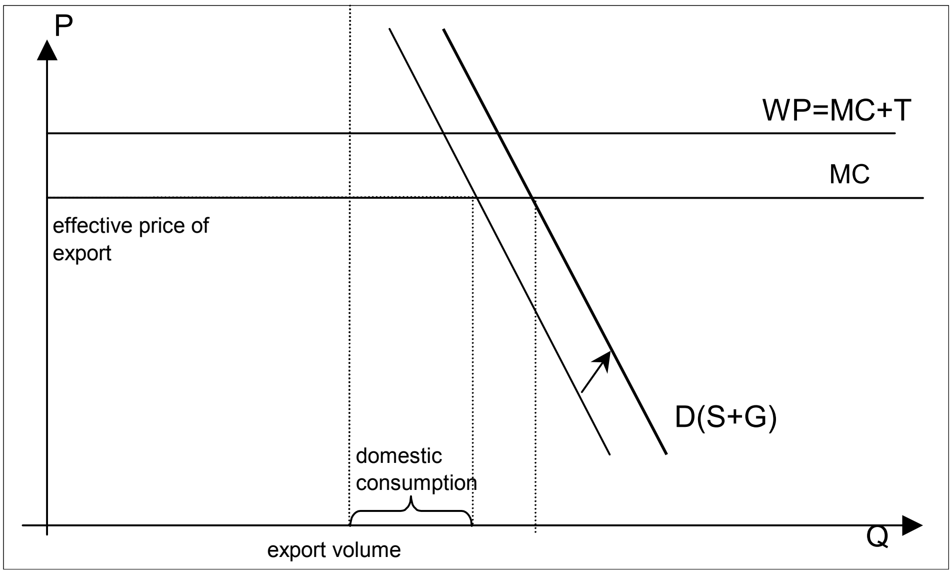
In this section, implications of growth in the FGC for the SGC will be derived only for the "M/Y=*const*" case. However, one can use previous intuition and insights from Section 1 to see that in the case of fixed money stock, the implications to be derived will be qualitatively the same, except that the magnitudes of deflation and exchange rate appreciation will be bigger.

2.2. The impact of growth in S on output and employment in *G*: the flexible labour market case

We assume that in presence of the flexible labour market the *nominal* wage can be instantaneously adjusted so as to render the *real* wage equal to marginal product of labour. However, we do not assume here that there is full employment. Even if the wage is perfectly flexible, there may be structural and frictional unemployment caused by various side factors.

Furthermore, there may be a part of population able but not willing to work whose preference towards employment may change over time. So, if there is an increase in the labour demand, it can, in principle, be met without the real wage going up.

Recall from previous derivations that a 1% increase in p_s results in a $\frac{\varphi}{\mu_{NS}}-(1-\gamma_S)(1-\theta_S)$ % increase in demand for tradables, including good *BG*. How does *G* benefit from the increase in demand for *BG* in *S*? If *G* is a net exporter of good *BG* and faces constant long-term marginal costs MC (because of CRS in the production function), transportation costs for delivery outside the *G*+*S* union, T, the world market's price level, WP, and the aggregate downward-sloping intra-union demand curve, D_{S+G}, then the picture looks as follows: see graph below.



G sells *BG* worldwide at WP (and covers transportation costs), and within the union at MC. The volume of exports to the world is unaffected by the increase in demand within the union, so the union consumes the output of *BG* that is left. Because of transportation costs, every increase in demand for *BG* in the union is met by increased production of *BG* in *G*, not in the world. Then for every 1% increase in p_s *G* gains $\frac{\varphi}{\mu_{NS}}-(1-\gamma_S)(1-\theta_S)$ % in employment[6] in the sector meeting *S*'s demand for *BG* and a corresponding increase in income.

2.3. The impact of growth in *S* on nominal price levels

As we have seen in sub-section 2.1, 1% increase in p_S causes a (1- δ)(1-γ_s)% increase in P_{G+S}. Therefore, in order to keep the overall nominal *G+S* price index constant, the numeraire in *G+S*

[6] If there is a CRS technology in place.

(i.e. the price of its tradable goods) has to go down by the same percentage, which implies a corresponding nominal exchange rate appreciation, but no loss of competitiveness for either *S* or *G*, just as in the case of one country. However, because of differences in growth rates, we now have positive dynamics in *S*'s price level and negative dynamics in *G*'s. Namely, P_S rises by $(1-\gamma_s)-(1-\delta)(1-\gamma_s)=\delta(1-\gamma_s)$% (because it is cushioned by its slower-growing neighbour), but P_G goes down by $(1-\delta)(1-\gamma_s)$%.

2.4. The impact of growth in *S* on output and employment in *G*: the rigid nominal wages case

Nominal wage rigidity can be a real threat for a slow-growing country which is in a monetary union with a faster-growing one, especially when the union's monetary authorities adopt a strong anti-inflationary stance. A rigid labour market in *G* means that while P_G goes down, the nominal wage does not, thus leading to real wage increases in *G* unmatched by productivity growth. Therefore the demand for labour will decline. Because of subsequent nominal exchange rate appreciation in the union's currency, there will also be a drop in *G*'s exports to the rest of the world (as MC in the production of *BG* in the world's currency, e.g. USD, shifts upwards) and an increase in its imports, as marginal cost in the production of *AG* increases and that in the production of *AS* remains constant.

All this will increase *G*'s unemployment and worsen its current account. True, these negative effects will be mitigated by real earnings growth, but the per-capita earnings growth for those in employment must, in its turn, be set against the drop in employment. For *G* to avoid job cuts and a decline in income from exports, the central bank of the *G*+*S* monetary union would have to consider issuing more money than would be enough to satisfy M/Y=*const*. A good choice would be to set $\hat{M}-\hat{Y}=(1-\delta)(1-\gamma_S)$ for each 1% increase in p_S, in which case the price level in *G* would stay unchanged, although of course, at the price of somewhat higher inflation in the union as a whole.

We next examine the impact of wage rigidity for employment and output in detail in both the short and long run.

Short-run impact. We use two definitions of the short run: 1) as the period in which capital-to-labour ratio is fixed at its historical level, and 2) as the period in which the stock of capital is fixed. Both definitions lead to fundamentally the same results. Namely, in the short run, without an adequate growth in labour productivity, the increase in the real wage renders *G*'s exports uncompetitive on the world market, no matter how labour intensive they may be. In this situation, *G* faces the choice of either withdrawing from the world market or subsidizing the exports of the industries that have costs higher than revenues. However, because of the transportation costs barrier, domestic production will not stop completely.

To see this, consider production of goods *AG* and *BG* for export outside the union. In the case of fixed *K/L* ratio, the CRS Cobb-Douglas production function can be transformed as follows:

$$Y = A K^{\alpha} L^{1-\alpha} = A k^{\alpha} L$$

where *k=K/L*, which is fixed. The total cost function in this case is trivial:

$$C(w, r, Y) = L(rk + w) = \frac{rk + w}{A k^{\alpha}} Y \tag{2.4.1}$$

from which we derive the marginal (and average) cost function:

$$MC = \frac{rk + w}{A k^{\alpha}} \tag{2.4.2}$$

Log-differentiate (2.4.2) to get:

$$d \log(MC) = (1 - \alpha)\hat{w} \tag{2.4.3}$$

which implies that, under given technology the only way to prevent average costs from growing (i.e. to break even with exports) is to avoid wage increases in the absence of adequate labour productivity growth. If the wage grows unmatched by productivity, exports become uncompetitive and the workers lose their jobs.

If there were some productivity growth, eq. (2.4.3) would look differently:

$$d \log(MC) = \hat{w}(1 - \alpha) - \hat{A}$$

So, it would be possible to offset the increase in costs due to real wage increases by sufficient increases in labour productivity. Notice here that for a given productivity growth in *S*'s tradable sector it takes much lower (but non-zero!) productivity growth in *G*'s tradable sector to restore *G*'s competitiveness. With a 1% increase in A_{TS}, p_S goes up by $\mu_{TS}/\mu_{NS} < 1$% (eq. (1.2.2)), then the wage in *G* increases by $\frac{\mu_{TS}}{\mu_{NS}}$ (1- δ)(1-γ_s)%, which requires $\frac{\mu_{TS}}{\mu_{NS}}$ (1- δ)(1-γ_s)(1-α)% increase in *A* in the production function, which is much less than the 1% improvement in productivity in *TS*. Therefore, *G* can cope with the impact of productivity growth in *S*, if it ensures that its workers receive exactly their marginal product.

When capital stock is fixed, we come to fundamentally the same results, with the difference that it is now possible to trim *marginal* costs down to the WP-C level by decreasing the output of *BG* and substituting labour by relatively cheaper capital. However, with the real wage increase unmatched with productivity growth, it is impossible to restore *average* costs, so that the export industry will be making negative profits.

Consider the output per unit of capital,

$$y = Y/K = A(L/K)^{1-\alpha} = Al^{1-\alpha} \tag{2.4.4}$$

where *l=L/K*.

Derive *l* from eq. (2.4.4) and substitute the result back to the total cost function per unit of capital:

$$c = C/K = wl + r = r + w(y/A)^{\frac{1}{1-\alpha}}$$

Derive the marginal cost function and log-differentiate it (holding *A* and *r* are fixed):

$$MC = \frac{1}{1-\alpha} \cdot \frac{w}{A^{\frac{1}{1-\alpha}}} y^{\frac{\alpha}{1-\alpha}}$$

$$M\hat{C} = \hat{w} + \frac{\alpha}{1-\alpha}\hat{y}$$

We see that it is now possible to manipulate output in order to keep marginal costs unchanged. To keep $M\hat{C} = 0$ in the absence of productivity growth, the following must hold:

$$\hat{w} = -\frac{\alpha}{1-\alpha}\hat{y}$$

i.e. with every 1% increase in wage, output must contract by $\frac{1-\alpha}{\alpha}$ %, which, given our production function, is equivalent to $\frac{1}{\alpha}$ % drop in employment (consider that $\hat{l} = \hat{L} - \hat{K} = \hat{L}$).

Log-differentiating the average cost function,

$$AC = \frac{r}{y} + \frac{w}{A^{\frac{1}{1-\alpha}}} y^{\frac{\alpha}{1-\alpha}},$$

we get:

$$A\hat{C} = \frac{r}{y} + \frac{w}{A^{\frac{1}{1-\alpha}}} y^{\frac{\alpha}{1-\alpha}} = (1-\alpha)\hat{w} + \hat{y} - \hat{y} = (1-\alpha)\hat{w} \tag{2.4.5}$$

So, it is not possible to adjust the average costs to their previous level, unless there is an adequate growth in labour productivity. If there is none, then the exporting industries will make losses and, if not subsidised, will have to withdraw from the market. However, if we assume that capital, once allocated to production in a particular sector cannot be reallocated to another (so that it effectively becomes a bye-gone cost), then exports of *BG* will not collapse immediately. What will collapse is returns to the owners of capital used in the production of *BG*, who will effectively suffer a capital loss. Such a situation will lead to a slow decline in *BG* production, as capital used in the sector declines through depreciation which is not replaced.

For intra-union exports of *AG* the situation is similar: since *S* is now the most efficient producer of *A*, the intra-union trade of *A* will decline, until it ultimately becomes negligible. However, with intra-union sales of *BG* the situation is different: because of the protection offered to *G*'s producers by transportation costs of *B* from the rest of the world, it is cheaper for *S* to buy *BG* than its analogue on the world market. This implies that there exists a finite price elasticity of exports on the intra-union market, -*σ*% per each 1% increase in price. Thus the producers of *BG* meeting the demand from *S* do not have to shut down or ask for subsidies. Nevertheless, they will also experience a decrease in output and employment.

With each 1% increase in p_S marginal costs of good *BG* increase by $(1-\gamma_S)(1-\delta)(1-\alpha')$ % (where *(1-ά)* = the share of labour in the production of *BG*). The increase in the price of good *BG* relative to the price of *AS* (not of *AG* because there is no point in buying *A* at a dearer price from *G* than it can be obtained domestically in *S*) is also $(1-\gamma_S)(1-\delta)(1-\alpha')$ %. Assuming a CES demand function for goods *A* and *B* in both countries, the demand for *B* from *S* falls by $[\omega+(1-\beta)(1-\omega)](1-\gamma_S)(1-\delta)(1-\alpha')\%$, where *ω* is the elasticity of substitution in consumption between *A* and *BG* and *β* is the share of *BG* in total consumption of tradables by *S*. However, with income in *S* rising, the net increase in demand for *BG* is

$$\lambda=\frac{\varphi}{\mu_{LNS}}-(1-\gamma_S)(1-\theta_S)-[\omega+(1-\beta)(1-\omega)](1-\gamma_S)(1-\delta)(1-\alpha')\%$$

per 1% increase in p_s, the sign of which is ambiguous. One insight of the expression above is that if good *BG* is capital intensive then nominal wage rigidity in *G* does not have too great an impact on demand for *BG* in *S*, but that otherwise *G* is likely to lose sales even in friendly *S*. Recalling eq. (2.4.4) for *BG*, we obtain the net increase in employment in sector *BG*, *λ/(1-ά)*%, while in sector *AG* there is clearly negative employment growth. So, the only hope for *G*'s exports to *S* to recover is for higher exports of *BG*, which is not produced in *S* and which it is cheaper for *S*'s consumers to buy from *G* than to import from the world market (up to the point at which the increase in the price of *GB* corresponds to the transportation cost of bringing *B* from the world market).

With employment and output in export sectors decreasing in *G*, the trend in domestic sales is also likely to be downward (the detailed calculations are skipped here). Increases in wage costs will lead to higher unemployment, which will further reduce consumption. True, the increase in per-capita labour income may stimulate demand and thus reduce the layoffs, but it will not completely offset the divestment of labour, because of the substitution effect between labour and capital. Therefore, although the situation with output is unclear, in the end we observe a decrease in employment in the sum of the tradable and non-tradable sectors, except as regards *BG*, where the situation with employment is uncertain.

Long-run impact. In the long run, capital use can be adjusted to its most efficient level. With wages remaining rigid, and in the absence of labour productivity growth, *G* will lose its competitiveness on the world market, because there will be no way to adjust its marginal costs back to the world market's price. Changing the technology parameter, "alpha", will not reduce costs either. Since it is hardly possible that the government will subsidise *G*'s industry in the long run, inability to adjust marginal costs down will result in withdrawal of *G*'s goods from the world market. Of course, this is in case of infinite price elasticity of exports. In another framework (e.g., Dixit and Stiglitz, 1977), where countries are assumed to have some pricing power on the world market, higher costs would mean a reduction of exports, not their complete cessation. On the intra-union market, the situation will be the same as described for the short run.

To see why marginal costs cannot be adjusted downwards with real wage increases and zero productivity growth, consider the cost minimization problem with a Cobb-Douglas production function with CRS:

$$\min wL + rK, \quad s.t. \; AK^{\alpha}L^{1-\alpha} = Y$$

After some algebraic manipulation, we obtain the demand functions for capital and labour:

$$K = \frac{Y}{A} \cdot \left[\frac{\alpha}{1-\alpha} \cdot \frac{w}{r} \right]^{1-\alpha}, \quad L = \frac{Y}{A} \left[\frac{1-\alpha}{\alpha} \cdot \frac{r}{w} \right]^{\alpha}$$

and then the total cost function:

$$C = \frac{Y}{A} \left[\frac{r}{\alpha} \right]^{\alpha} \cdot \left[\frac{w}{1-\alpha} \right]^{1-\alpha}$$

and the marginal cost function:

$$c = \frac{1}{A} \left[\frac{r}{\alpha} \right]^{\alpha} \cdot \left[\frac{w}{1-\alpha} \right]^{1-\alpha} \qquad (2.4.7)$$

Marginal costs, in this case equal to average costs, are now constant regardless of the volume of output, so that we cannot simply reduce them by reducing output. Changing the "alpha" does not solve the problem, either. To see this, log-differentiate eq. (2.4.7) holding *A* and *r* fixed to get:

$$\hat{c} = -\alpha\hat{\alpha} + (1-\alpha)\cdot\left[\hat{w} + \frac{\alpha}{1-\alpha}\hat{\alpha}\right] = (1-\alpha)\cdot\hat{w}$$

Again, as in the short-run case, if there were adequate labour productivity growth, the marginal costs would not increase, so that *G* would remain competitive in the world market. This can be seen immediately from eq. (2.4.7).

Other implications. The wage rigidity in *G* has further repercussions for its economy, especially for income and employment. Acquiring extra capital will worsen *G*'s current account. Domestic demand in *G* will be damaged by unemployment: although there will be an increase in real wages, some labour will be divested thus lowering aggregate demand. Some second-order effects (e.g., demand switching from *AG* to cheaper *AS*, labour migration from *G* to *S*, market segmentation) could also be modelled.

But it does not take an advanced modelling exercise to make the important point here: in slow-growing parts of a monetary union, wage rigidities seriously damage the economy by reducing employment and income, and depriving citizens of a great deal of the potential benefits that their faster-growing partner countries could bring. Therefore governments in SGC should not focus on trying to delay the accession of new, faster-growing members, or on hindering growth accelerating reforms in their current partners, but rather on institutional reforms to enhance the flexibility of their own markets.

An alternative solution to the dilemma of the SGC with inflexible labour markets, is for the currency union's central bank to allow slightly higher inflation in the union. However, this would not be for the sake of faster-growing *S* (it is doing fine at whatever union-wide inflation rate), but to help *G*'s workers keep their jobs, in spite of their nominal wage rigidity and the ensuing mismatch between real wages and productivity in *G*. Such an increase in the union's inflation, however, would not have to be met by increases in the interest rate, as long as price increases in non-tradables in *S* are caused by productivity (and therefore production) growth in *S*'s tradables sector.

Concluding Remarks

The results obtained above suggest the following:

1. For a monetary union, having countries that grow at a faster-than-average rate does not increase union-wide inflation, if a neutral monetary policy stance (*M/Y=const*) is adopted by the central bank. However, this comes at the expense of higher inflation in faster-growing countries and lower inflation (or even deflation) in slower-growing countries of the union.
2. Under the neutral monetary policy described above, and provided that SGCs have flexible enough labour markets (so that they can adjust their nominal wages in line with actual inflation or deflation), SGCs clearly benefit from increased demand for their exports from faster-growing countries. If, however, there are rigid labour markets in SGCs, they are likely to

suffer a fall in output and employment. Even though there will still be an increase in demand from faster-growing countries, it's effects on output and employment in SGCs may be significantly limited by increased real production costs. For the same reason SGCs, with rigid labour markets and fast growing co-members of a monetary union implementing a neutral policy stance, will find it increasingly hard to compete on the international markets with more efficient producers – unless they generate adequate productivity growth. However, the amount of productivity growth that needs to be generated for SGCs to avoid suffering as a result of fast growth among their union partners is a small fraction of the growth that the FGCs achieve.

3. Therefore, the real problem SGCs face in admitting new, faster-growing countries to a monetary union they belong to, or seeing current members growing faster, is not that this will increase union-wide inflation (let alone the SGC domestic inflation), given a neutral monetary policy, but rather that their rigid labour markets will render them less competitive both union-wide and internationally. Generally, the more labour-intensive their exports are and the more oriented they are to world trade outside the monetary union, the more will their losses in employment and output be.
4. The overall gain or loss for SGCs from the monetary union's expansion depends on many factors, such as technology parameters (labour intensity), shares of tradables and non-tradables in consumption, the share of exports going to countries within the union, nominal rigidities in labour markets, etc. However, the union's central bank may want to protect slow-growing members from losses by setting its monetary policy so that their aggregate price level is unchanged (most importantly, does not decline). In this case there will be no nominal appreciation of the union's currency, no losses due to labour market rigidities, but higher than zero union-wide inflation. However, it is important to understand that this measure is undertaken to protect slower-growing countries, while faster-growing ones would do just as well under a zero inflation target.

There are also a few policy implications following from the theoretical discussion above. First, in a monetary union in which members experience unequal productivity growth rates and have rigid labour markets, the monetary authorities are faced with three choices (and their combinations, wherever possible): 1) low or zero union-wide inflation, with output contraction and unemployment in slower-growing countries; 2) higher inflation in faster-growing countries, low or zero inflation in slower-growing countries, and moderate inflation union-wide, with no losses of income or employment in SGCs; 3) zero union-wide inflation and labour market reforms in slower-growing countries.

The final choice depends on the decision-making process and on how successfully individual countries lobby their positions with the monetary authority, which is supranational by default. Thus, the first choice seems to be the best for the union's Central Bank, as it pursues union-wide objectives, such as the aggregate inflation level. The third choice is also good for the CB, but individual countries might find it difficult to implement labour market reforms. The second choice is the best for the SGCs, which do not have to undertake any reform in this case, but the CB might well argue against it and FGCs might loose slightly from the slightly higher inflation they experience.

In the end we would like to stress that in no case should higher-than-average productivity growth be an obstacle for any country trying to join a monetary union. High growth in some union members is an economic blessing that can be shared among all the union's participants, if they are flexible enough to benefit from it, and not a curse that should be avoided. With long-established economic ties and political integration accelerating recently, fast and smooth accession of the new EU members to the EMU may become critical for the overall success of the European project.

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