Analytical notes on the Balassa-Samuelson effect [*]

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1. The Balassa-Samuelson effect: intuition and standard formalisation

The intuition underlying the Balassa-Samuelson effect (BSE) is as follows: consider a country producing two goods: tradables and non-tradables. Suppose the wage rate in either sector equals the marginal labour product. Assume that labour is mobile and homogenous; also assume that both sectors pay the same wage rate. Now imagine an increase in the (physical) labour productivity in the tradable sector – for instance, on account of technological change. Then there is a rise in the wage rate in the sector. Due to the 'law of one wage' that is assumed, the wage rate in the non-tradable sector rises as well. This raises costs and hence prices in the latter sector. In effect, a rise in the relative (non-tradable/tradable) price ratio follows.

The BSE can be formalised in many ways. Most of the recent papers referring to the BSE[1] follow, directly of indirectly, the formali-

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[1] The literature on the BSE is vast. The EconLit bibliographical data bank identifies 49 items (as at the end of April 2002) that mention the Balassa-Samuelson effect in their titles or abstracts. The AltaVista internet search machine lists 244 entries. This is only a fraction of output available from various research institutions, national banks and international organisations featuring the BSE quite prominently. Very recent examples of unlisted texts include a chapter in the 2001 UN *Economic Survey of Europe*. Explicit references to the BSE also appear very frequently in papers and memoranda etc. published in the languages spoken in the countries of Central and Eastern Europe. Of course, many papers rely essentially on the BSE without men-

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sation presented in De Gregorio, Giovannini and Wolf (1994) and Froot and Rogoff (1995). That formalisation explicitly makes the following assumptions: *i*) the country in question is small and open to trade and capital flows; *ii*) its internal price for a tradable good is given (the law of one price for the tradable good prevails internationally); *iii*) perfect competition obtains in both sectors; *iv*) both sectors pay the same wage rate; *v*) marginal products of labour equal the wage rate; *vi*) production in either sector is a constant returns-to-scale Cobb-Douglas function of labour and capital; *vii*) the rate of return on capital ('the world interest rate') is the same in both sectors (and equal to its respective marginal productivity) and fixed (i.e. determined by global market conditions). Expressed in symbols, the physical levels of production of tradable and non-tradable goods, Y_t and Y_n, are functions of the 'physical' quantities of labour and capital employed. They are given by

$$Y_t = A\, L_t^{\alpha} K_t^{(1-\alpha)} \quad \text{and} \quad Y_n = B\, L_n^{\beta} K_n^{(1-\beta)} \tag{1}$$

where L_t, L_n, K_t and K_n are sectoral levels of labour and capital employment, and A, α, B, β the respective fixed technology parameters.

From the profit maximisation assumption one derives equations linking the money-termed items: wage and capital-rental rates, w and r, with prices p_t and p_n:

$$p_t\, A\, \alpha\, L_t^{(\alpha-1)} K_t^{(1-\alpha)} = w \qquad p_n\, B\, \beta\, L_n^{(\beta-1)} K_n^{(1-\beta)} = w \tag{2}$$

$$p_t\, A\, (1-\alpha)\, L_t^{\alpha} K_t^{-\alpha} = r \qquad p_n\, B\, (1-\beta)\, L_n^{\beta} K_n^{-\beta} = r \tag{3}$$

There is an equivalent (and more convenient[2]) way of representing the links, inherent in equations 2 and 3, between (the logarithms of) w, r, p_t and p_n:

$$\log(p_t) = -\log(A) + \alpha\log(w) + (1-\alpha)\log(r) - \alpha\log(\alpha) + - (1-\alpha)\log(1-\alpha) \tag{4}$$

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tioning it in their abstracts or key words (see, for example, Richards and Tersman 1996).

[2] Equations 4 and 5 are the so-called unit cost-functions corresponding to the Cobb-Douglas production functions.

$$\log(p_n) = -\log(B) + \beta\log(w) + (1-\beta)\log(r) - \beta\log(\beta) + \\ -(1-\beta)\log(1-\beta) \quad (5)$$

Setting $p_t = 1$, $p_n = p$, and differentiating equations 4 and 5 with respect to time (τ), one obtains

$$0 = -(dA(\tau)/d\tau)/A(\tau) + \alpha\,(dw(\tau)/d\tau)/w(\tau) \qquad \text{and} \qquad (6)$$

$$(dp(\tau)/d\tau)/p(\tau)) = -(dB(\tau)/d\tau)/B(\tau) + \beta\,(dw(\tau)/d\tau)/w(\tau)) \qquad (7)$$

Replacing equation 7 in equation 8 and suppressing τ and $d\tau$ one gets

$$dp/p = (\beta/\alpha)(dA/A)-(dB/B) \qquad (8)$$

Equation 8 is interpreted as *the* BSE:[3] *dA/A* is identified with the rate of growth of productivity in the tradable sector; *dB/B* with the rate of growth of productivity in the non-tradable sector. The relative price of the non-tradable good increases with rising *dA/A* (and decreases with rising *dB/B*). If the sectors' labour elasticities are the same ($\alpha = \beta$), the relative price of the non-tradable good rises when $dA/A > dB/B$ (and in particular when $dA/A > 0$ and $dB/B = 0$). If $\alpha < \beta$ (the tradable sector is more capital-intensive), the relative price of the non-tradable good will rise – even at the same rates of productivity growth ($dA/A = dB/B$).

A minor problem arises with equation 8. Arithmetically, equation 8 is approximately correct only for very small increments in *A*, B. The exact equivalent of equation 8 for any finite increments ΔA and ΔB (with $\Delta A = A(\tau) - A(\tau-1)$ and $\Delta B = B(\tau) - B(\tau-1)$) properly derived from equations 4-5, is

$$\Delta p/p = [(1+\Delta A/A)^{(\beta/\alpha)}/(1+\Delta B/B)] - 1 \qquad (9)$$

Of course, equation 9 preserves the gist of the BSE argument: the relative price of the non-tradable good remains a rising function of rising productivity in the tradable sector and a diminishing function of rising productivity in the non-tradable sector. *A fortiori*, the relative price of a non-tradable good is a rising function of the differential between labour productivity growth rates (tradable vs. non-tradable

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[3] See De Gregorio, Giovannini and Wolf (1994, p. 1228); Froot and Rogoff (1995, p. 1675).

goods). More specifically, $\Delta p/p$ given by 9 equals the growth rate of the relative *average*[4] physical labour productivities:

$$\Delta(v_t/v_n)/(v_t/v_n) = [(1 + \Delta A/A)^{(\beta/\alpha)}/(1 + \Delta B/B)] - 1 \qquad (10)$$

where

$$v_t = A\,[(1 - \alpha)A]^{(1-\alpha)/\alpha} \quad \text{and}$$
$$v_n = B\,A^{(1-\beta)/\alpha}\,((1-\beta)\alpha/\beta)^{(1-\beta)}(1-\alpha)^{(1-\alpha)(1-\beta)/\alpha} \qquad (11)$$

The second, and more consequential, problem pertinent to interpreting equation 8 – as well as equation 9 – arises with respect to the treatment of the production-elasticity parameters α and β. Hitherto, these have been assumed to be constant over time. Thus, equations 8 and 9 apply only when technical progress is neutral. When technical progress is non-neutral, α and β will vary over time, possibly together with A and B. In this case neither equation 8 nor equation 9 can capture the associated change in the relative price of the non-tradable good.

The proper analytical formula for determining $\Delta p/p$ as a function of all varying parameters, which can be derived from equation 6, appears rather difficult to handle in analytical terms; however, some properties of $\Delta p/p$ as a function of all parameters can be established numerically. It is of particular interest to see whether a positive association is to be observed between the (properly) calculated $\Delta p/p$ and the growth rate of the relative (tradable vs. non-tradable) *average* labour productivity. It can be shown that no such positive association generally holds. Let us start with specific initial values for the parameters: $A = 1.8$; $B = 2$; $\alpha = 0.3$; $\beta = 0.5$, and the corresponding values for the wage rate and the relative price of non-tradable goods. (The latter two items are determined from equations 4 and 5, with $r = p_t = 1$.) Next, allow some variations in the initial values and (properly) calculate, correspondingly, the new wage rate and the new relative price of the non-tradable goods. Finally, compare the resulting relative price and relative average labour productivity with the initial values.

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[4] Although predicated on the marginal products of labour, the BSE ultimately hinges on the link between *average* physical labour productivities and prices. The relative marginal productivity is not allowed to change in the BSE model because by assumption it always equals 1, irrespective of what happens to the technology parameters (see equation 2)

Table 1 summarises these comparisons for five sets of varied parameters.

TABLE 1

RESPONSES TO CHANGES IN THE TECHNOLOGY PARAMETERS

	$A+\Delta A$	$B+\Delta B$	$\alpha+\Delta\alpha$	$\beta+\Delta\beta$	$\Delta p/p$	$\Delta(v_t/v_n)/(v_t/v_n)$	$\Delta MPL/MPL$
1	1.98	2	0.3	0.5	0.172	0.172	0.1
2	1.98	2	0.36	0.5	0.083	–0.098	0.054
3	1.7	2	0.2	0.5	–0.025	0.17	–0.009
4	1.8	2.2	0.25	0.7	–0.066	0.57	0.05
5	1.98	2.5	0.35	0.7	–0.178	–0.013	0.06

As can be seen, in scenario 1 $\Delta p/p = \Delta(v_t/v_n)/(v_t/v_n)$. However, here the production elasticities α and β are kept at their initial levels.[5] In the remaining scenarios $\Delta p/p$ does not equal $\Delta(v_t/v_n)/(v_t/v_n)$. Moreover, in scenarios 2-4 $\Delta p/p$ and $\Delta(v_t/v_n)/(v_t/v_n)$ have *different* signs: here the rise (fall) in the relative price of the non-tradable goods is associated with falling (rising) relative average labour productivity. This is counter to the BSE. Finally, it is worth noting that similarly there is no firm regularity linking the associated growth rate of marginal labour productivity (or the wage rate) to either $\Delta p/p$ or $\Delta(v_t/v_n)/(v_t/v_n)$. A rise in the marginal productivity of labour can be associated with: either a rise in both relative prices and relative average productivity (scenario 1); or a drop in relative average labour productivity and a rise in relative prices (scenario 2); or a rise in relative average labour productivity and a drop in relative prices (scenario 4); or a drop in both relative average labour productivity and relative prices (scenario 5).

Lessons can be drawn from the exercise just performed. In essence, the BSE, as generally understood, need not obtain even in an 'ideal' world. In that world the relative prices of non-tradable goods can change in a way inconsistent with the BSE. Non-neutral technical progress in one (or the other) sector can generate relative price movements that run counter to conventional intuition.

[5] Application of the simplified formula 8, which is legitimate in this scenario (because the elasticities remain unchanged in this instance), yields $\Delta p/p = 0.167$.

2. The consequences of non-constant returns to scale

It is rather doubtful whether under other production functions the original BSE would hold generally. It can be shown that it does not generally hold under CES, translog and other commonly considered functions with constant returns to scale. It does not hold when the production function of one sector differs in type from that of the other sector. Basically, as long as there are more than two independently changing technology parameters, it is always possible to have relative rise (or fall) in prices irrespective of the direction in which the relative average labour productivity changes.

For the Cobb-Douglas (and other commonly considered) production functions with non-constant returns to scale, the BSE cannot be derived at all – even if the technology changes are restricted to the efficiency parameters (A and B). Basically, in the absence of constant returns to scale, the marginal rules for determining input prices (and demand for those inputs) are incompatible with the elementary national-account identity that requires equality of *a*) total costs or factor rewards ($wL_i + rK_i$); and *b*) the value of the total product (p_iY_i). Here the ratio $(w^*L_i^* + r^*K_i^*)/p_i^*Y_i^*$ always differs from the unity for the variables/parameters w^*, L_i^*, r^* K_i^*, p_i^*, Y_i^* that satisfy the usual first-order profit maximisation conditions. Moreover, that ratio depends entirely on production elasticities; it is invariant to changes in either the level of the wage rate w or the efficiency parameters A and B.

The existence of a 'surplus' (or 'deficit') of total output over total factor incomes is a logical impossibility – unless one introduces, *ad hoc*, 'the government' or 'the rest of the world'. Alternatively, one may feel obliged to assume that either the marginal rules do not apply or quantity constraints (rationing) impact on the levels of output and/or inputs employed.

The alternative approaches are bound to create problems of their own. This can be illustrated in the following model. Let us assume that firms fail completely to take the rental-rate r into account. Then, their decision making would boil down to the determination of the employment level at which a firm's residual surplus (pY – wL) attains its maximum. (In this case, total output always equals the sum of factor incomes.) More specifically, assume that initial production functions are as follows:

$$Y_t = A^0 L_t^{\alpha} \quad \text{and} \quad Y_n = B^0 L_n^{\beta}$$

Assume that the initial wage rate and prices p_t and p_n are fixed. Profit maximisation implies equalisation of the wage rate and marginal labour products:[6]

$$p_t A^0 a L_t^{(\alpha-1)} = w \qquad p_n B^0 \beta L_n^{(\beta-1)} = w$$

The profit-maximising employment levels are

$$L_t = (w/(p_t A^0 \alpha))^{1/(\alpha-1)} \qquad L_n = (w/(p_n B^0 \beta))^{1/(\beta-1)}$$

Suppose one knows that there has been an increment in the efficiency parameter A^0, with the remaining parameters unchanged. What are the consequences for the wage rate (i.e. for the marginal productivity of labour in the tradable sector)? This question cannot be answered, even if one assumes that the price of tradables p_t remains unchanged. There are an infinite number of wage rates satisfying the equation

$$p_t (A^0 + \Delta A^0) \alpha L_t^{(\alpha-1)} = w$$

Each of them corresponds to a different level of employment. Unless one makes additional assumptions (e.g. as to the level of production and hence employment or as to the specific mechanism of wage responses to changes in the *technology parameters*), one cannot say anything about the new wage rate.

To demonstrate the indeterminate character of the model, let us assume there has been no change in any of the technology parameters or in the wage rate levels. With $p_t = 1$ this implies an unchanged level of employment in the tradable sector. Does this imply the constancy of the price of non-tradables p_n? The answer is no. With higher employment in the latter sector (and output), p_n will be higher, with lower employment (and output) it will be lower.[7] Formally, p_n/p_t =

[6] On the assumption that α and $\beta < 1$.

[7] This observation suggests that changes in demand patterns, and not the alleged productivity trends, may explain the well-documented tendency of relative price of services (non-tradables) to rise with income level. Since the income elasticity of demand for non-tradables tends to increase with real income levels (and the income elasticity of demand for tradables tends to decline), non-tradables tend to become relatively more expensive as growth continues, more or less irrespective of what happens to the sectoral productivity differentials (see Podkaminer 1999).

$(A^0/B^0)(L_n^{\alpha-1}/L_t^{\beta-1})$; this indicates that in this instance the relative price is a function of the employment structure.

Observe that formally the ratio of physical labour productivities is given here by the following expression:

$$v_t / v_n = (\beta/\alpha)\ (p_n/p_t)$$

so that arithmetically

$$\Delta(p_n/p_t)/(p_n/p_t) = \Delta\ (v_t / v_n)/(v_t / v_n)$$

However, it would be erroneous to interpret this as reflecting the BSE. The causation runs here from a change in relative prices to a change in relative productivities, not vice versa.[8]

BSE may hold in a specific model that assumes a linear production function with one production factor (labour) in each sector. Of course, in such a model the wage rates cannot equal marginal productivity. Assume that initially the wage rates are set at levels w_t and w_n. Assume that mark-ups on labour costs in each sector m_t and m_n are such that

$$p_t = a\ w_t\ (1+ m_t) \quad \text{and} \quad p_n = b\ w_n\ (1+ m_n) \tag{12}$$

where *a* and *b* are unit labour requirements. (Average physical labour productivities equal 1/a and 1/b respectively.)

Assuming that the wage rate ratio (w_t/w_n) and the mark-up ratio $(1+m_t)/(1+m_n)$ do not change as the technology parameters *a* and *b* evolve, one arrives at the following form of BSE:

$$\Delta p/p = [(1 + \Delta b/b)/(1 + \Delta a/a)] - 1 \tag{13}$$

Approximately then, $\Delta p/p = \Delta b/b - \Delta a/a$.

Of course, equation 13 holds only because of the assumptions as to the constancy of ratios of wages and mark-ups. If these assumptions are not satisfied, equation 13 need not hold.

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8 Physical labour productivities here are given by $v_t = w/(\alpha\ p_t)$, $v_n = w/(\beta\ p_n)$.

3. BSE with intermediate consumption

In the real world, the production of tradables requires inputs of non-tradables – and vice versa.[9] Generally, each sector's production function should therefore be defined on three arguments: labour, capital and intermediate inputs from the other sector. If once again production in either sector is a Cobb-Douglas constant returns-to-scale function, six independent parameters determine $\Delta p/p$ and $\Delta(v_t/v_n)/(v_t/v_n)$. As long as only the constants *A* and *B* vary, equations 9 and 10 always hold – and the BSE obtains. The BSE breaks down, however, if one (or more) of the four independent elasticities is allowed to change.

In the fixed-proportions model with intermediate consumption of the other sector's output, four independent technology parameters apply. The price equations here are:

$$p_t = (a\, w_t + c\, p_n)\,(1+ m_t) \quad \text{and} \quad p_n = (b\, w_n + d\, p_t)\,(1+ m_n) \qquad (14)$$

where *c* and *d* are unit requirements for the other sector's intermediate inputs.

An explicit solution to 14 exists (provided $(c\, d)(1+ m_t)(1+ m_n) < 1$) and implies the following formula for the relative price:

$$p_n / p_t = [(1+ m_n)/(1+ m_t)]\,(w_n/w_t)\,[b + a\, d\,(1+ m_t)\,(w_t/w_n)]/ [a + b\, c\,(1+ m_n)\,(w_n/w_t)] \qquad (15)$$

The assumption that changes in the technology parameters leave the ratio of mark-ups unchanged is no longer sufficient to derive any conclusions relating to p_n/p_t. (The right-hand side of equation 15 contains separate $(1 + m_t)$ and $(1 + m_n)$ terms which cannot be expressed as the ratio $(1 + m_t)/(1 + m_n)$.) One can only proceed further when one assumes that mark-ups do not respond to changes in the technology parameters (and that only wage rates possibly do). However, this does not help much. Depending on the initial values of the technol-

[9] In particular, tradables require heavy doses of inputs from non-tradable sectors, such as retailing, storage and transportation. Conversely, many non-tradables cannot be produced without large inputs of tradables. Medical care, for that matter, is becoming ever more costly not because of exorbitant rises in nurses' wages or a slow rise in surgeons' productivity, but on account of the major inputs of tradable drugs and medical equipment, the prices of which are rising very swiftly.

ogy parameters, equation 15 is complex enough to be capable of producing the $\Delta p/p$ of any sign – even if only *one* of those parameters changes.

4. Growth rates of relative real value-added per worker given intermediate inputs

When conducting empirical research into the link between relative productivities and relative prices, the former have to be defined. Two definitions may be considered: physical (gross) output per employee or real value-added per employee. When there are no intermediate inputs, the growth rates of labour productivity, defined either way, are the same. When there are intermediate inputs, however, this need not be the case. Growth rates of physical labour productivity have the advantage of not requiring the introduction of properly defined price deflators. Nonetheless, one usually opts for the growth rates of value-added per worker, deflated by the corresponding GVA deflators. In this context, the question may well arise whether the heretical conclusions of the preceding paragraph (in which physical labour productivities were considered) may perhaps be more determinate when the analysis is conducted in terms of value-added per worker. A specific example presented below indicates that generally there is no gain in the degree of determination.

Assume the Cobb-Douglas production functions:

$$Y_t = A\, L_t^{\alpha} K_t^{\alpha'} y_n^{(1-\alpha-\alpha')} \quad \text{and} \quad Y_n = B\, L_n^{\beta} K_n^{\beta'} y_t^{(1-\beta-\beta')} \qquad (16)$$

where y_n and y_t are quantities of intermediate inputs (from the other sector) used in the production of tradables and non-tradables respectively.

The price equations corresponding to equation 16 are as follows:

$$\log(p_t) = -\log(A) + \alpha\log(w) + \alpha'\log(r) + (1-\alpha-\alpha')\log(p_n) + \\ -\alpha\log(\alpha) - \alpha'\log(\alpha') - (1-\alpha-\alpha')\log(1-\alpha-\alpha')$$

$$\log(p_n) = -\log(B) + \beta\log(w) + \beta'\log(r) + (1-\beta-\beta')\log(p_t) + \\ -\beta\log(\beta) - \beta'\log(\beta') - (1-\beta-\beta')\log(1-\beta-\beta')$$

With $p_t = r = 1$, one arrives at the (rather long, but otherwise uncomplicated) logarithms for the wage rate and p_n. On that basis equations can be formulated for $\Delta p/p$ and the growth rate of the ratio of physical labour productivities $\Delta(v_t/v_n)/(v_t/v_n)$, with v_t and v_n given by

$$\log(v_t) = \log A - (1 - \alpha)\log(\alpha /(\alpha' w)) + (1 - \alpha - \alpha')\log((1 - \alpha - \alpha')/\alpha')$$

$$\log(v_n) = \log B - (1 - \beta)\log(\beta /(\beta' w)) + (1 - \beta - \beta')\log((1 - \beta - \beta')/ \beta')$$

Nominal gross value-added for tradables is defined as $VAM_t = (p_t Y_t - p_n y_n)$ and for non-tradables as $VAM_n = (p_n Y_n - p_t y_t)$. After some protracted manipulations one arrives at the logarithms for nominal GVA per employee:

$$\log(VAM/L)_t = \log(1 - \alpha - \alpha') + \log(v_t)$$

$$\log(VAM/L)_n = \log(1 - \beta - \beta') + \log(v_n) + \log(p_n)$$

Eventually, one can produce a (somewhat complex) expression for the growth rate of the relative nominal GVA labour productivity, i.e.

$$\Delta[(VAM/L)_t /(VAM/L)_n] / [(VAM/L)_t /(VAM/L)_n] = F(\Delta A, \Delta B, \Delta\alpha, \Delta\alpha', \Delta\beta, \Delta\beta')$$

The next step entails determining the GVA deflators. The Laspeyres deflators are given by the following formulae:

$$P_{Lasp,t} = [1 - (1 - \alpha - \alpha')(p + \Delta p)/p]/ (\alpha + \alpha') \quad \text{and}$$
$$P_{Lasp,n} = [(p + \Delta p)p - (1 - \beta - \beta')]/(\beta + \beta')$$

and the Paasche deflators by

$$P_{Paa,t} = (\alpha + \Delta\alpha + \alpha' + \Delta\alpha')/[1 - (p/(p + \Delta p) (1 - \alpha - \Delta\alpha + - \alpha' - \Delta\alpha')], \text{ and}$$
$$P_{Paa,n} = (\beta + \Delta\beta + \beta' + \Delta\beta')/[(p/(p + \Delta p) - (1 - \beta - \Delta\beta - \beta' - \Delta\beta')]$$

Thus equipped with all the necessary formulae, one can now easily demonstrate that no determinate links are to be found between changes in relative price $\Delta p/p$, relative physical labour productivities $\Delta(v_t/v_n)/(v_t/v_n)$ and growth rates of relative real value-added per worker.

Let us assume the following initial values for the parameters: A= 1.8; B = 2, α = 0.3; α' = 0.25; β = 0.3; β' = 0.3. We consider three sets of altered parameters (see Table 2). Two parameters (A, α') are kept the same in all scenarios.

TABLE 2

RESPONSES TO TECHNOLOGY CHANGES IN THE MODEL WITH INTERMEDIATE INPUTS

	ΔB	Δβ	Δβ'	Δα	Δp/p	Δv/v	ΔGVA/ GVA – Lasp.	ΔGVA/ GVA – Paa.	Δw/w
1	0.2	0.03	−0.1	0	−0.046	0.048	0.107	0.095	0.027
2	0	0	0	−0.03	−0.02	0.088	−0.003	−0.005	−0.068
3	0	0.03	0.11	0	0.043	0.148	−0.009	−0.023	0.332

Δv/v is the growth rate of the ratio of physical labour productivities (tradables over non-tradables; ΔGVA/GVA – Lasp. is the growth rate of the ratio of real gross value-added per worker (adjusted using the Laspeyres GVA-deflators); ΔGVA/GVA – Paa. is the growth rate of the ratio of real value-added per worker (adjusted using the Paasche GVA-deflators), Δw/w is the growth rate of wage rate (= growth rate of marginal labour productivity).

As can be seen, Δp/p can move in the same direction as the ratio of real ΔGVA/GVA, no matter which deflator is applied.[10] This occurs in scenario 2. In the two remaining scenarios, the opposite outcome obtains. It is worth noting that the three scenarios differ in that each of them has one of the three items of interest (Δp/p, Δv/v, ΔGVA/GVA) moving in the opposite direction to the other two.

5. Additional qualifications and concluding remarks

On closer examination, it transpires that the intuition underlying the BSE is wrong: even in idealised models with highly restrictive features, the BSE need not obtain at all. A proper analysis of conventional models customarily believed to yield the BSE rigorously, in the form of an equation, indicates that changes in the relative prices of non-tradable goods may be totally unrelated to changes in relative productivity levels. Of course, in more realistic models (i.e. those that

[10] Remember that any standard price index can take on values that fall into the ranges given by the values of the Paasche and Laspeyres indices (see e.g. Diewert 1991, pp. 771-73).

do not postulate constant returns to scale or allow for intermediate inputs) there is even less room for determinate results supporting the BSE.

This paper has not entered into many other questionable, though common and tacitly accepted features of the basic model. We have even left aside the fundamental question of the legitimacy of working with the 'surrogate' aggregate production functions based on homogenous 'capital' as their arguments – as if Pasinetti, Joan Robinson *et al*. had never put them to rest. Serious problems arise even if one overlooks this. Perhaps one does not have to waste much space to discussing the empirical (or theoretical) relevance of assumptions on perfect mobility of labour (domestically) and perfect mobility of capital (both domestically and internationally) or those on the 'law of one domestic wage' and the 'law of one capital-rental rate' (obtaining both domestically and internationally). Equally irrelevant and misleading is the concept of one international price for 'tradables'. In actual fact, there is no such thing – if only because every country (with the exception perhaps of some oil-exporting countries) produces different baskets of inordinately heterogeneous commodities that can in principle be exported. Moreover, as documented in numerous statistical studies on so-called 'unit values' (or price indices in exports and imports), even at a very low level of aggregation commodities traded by individual countries tend to have vastly different prices.

Perhaps the most striking feature of the BSE-type models (and of the related econometric studies) is their almost total neglect of foreign trade. These models do not address the issue of trade: this is the consequence of their assuming the homogeneity of tradables. Indeed, if both the home and foreign country produce the same tradable good, what then is the purpose of engaging in exchange? Of course, if there is only one tradable good, then each participant in the 'exchange' would enjoy balanced 'trade'. (In order to have a trade imbalance, one would have to introduce a second tradable item after all: viz. some internationally accepted fiat money, something that has yet to be attempted.) Moreover, if there is no foreign trade, how did the internationally prevailing, single price for 'tradables' ever come into being?

It ought to be noted that the standard BSE model implicitly presumes fixed exchange rates that, of course, do not change in relation to events in the home country. Only on this assumption can one proceed with models in which the internationally prevailing price of tradables and the capital-rental rate are exogenous parameters to which everything else adapts. This has not deterred people in various follow-up research activities from speculating how, after all, the BSE might relate to exchange rate movements. Much of that research postulates a link between exchange rates and purchasing power parities. Insofar as the gaps between the purchasing power parities and exchange rates are explained by the differences in relative prices of non-tradables, it is useful to study the developments in relative prices. However, the specific convention usually adopted assumes that: *i*) prices of tradables observe the law of one price; *ii*) changes in the prices of tradables in terms of non-tradables are identified with changes in *real* exchange rates. Both assumptions are debatable, if not wrong. Furthermore, of course, the basic maintained hypothesis on the link between productivity and price developments is – as argued above – generally untrue. This, incidentally, has been confirmed by a number of studies which failed to find any statistically robust evidence in favour of the BSE-based hypotheses. However, some studies claim to have found evidence to that effect. In any case, given that the core BSE is itself flawed, the need to put it to the empirical test appears a problematic issue.

In summary, the theory underlying the purported regularity linking trends in relative prices to trends in relative productivities is quite weak. It is all the more deplorable that vast amounts of effort have gone into econometric studies on the estimation of the responses of relative prices to relative productivities. Worse still, serious economic policy debate often refers to the estimates derived from those studies that border on the spurious. For example, the BSE plays a prominent role in considerations of the exchange rate and anti-inflation policies pursued by the countries of Central and Eastern Europe aspiring to EU membership (and in debates on the timing of the switch to euro).[11] In these considerations, the BSE serves several purposes. First, by drawing on the BSE, the much higher inflation rate in the applicant countries compared to the EU can be portrayed as an 'equilibrium adjustment' to relative productivity (tradables over non-tradables) which has risen more rapidly than in the EU. Secondly, the BSE is invoked to rationalise the trend towards real appreciation being sustained over quite long time-periods in most countries in Central and Eastern Europe. However, there is no rigorous argu-

[11] See e.g. Buiter and Grafe (2002).

ment linking higher inflation or the trend towards real appreciation to the core BSE theory – be its assumptions satisfied in practice or not. In the ultimate analysis, the BSE is all about the dynamics of *relative* prices – and not about the evolution of price *levels.* Similarly, as already mentioned, there is no rigorous way of tying the evolution of real exchange rates to that of domestic relative prices. First and foremost, the study of inflation and the trend towards real appreciation requires a better understanding of both the monetary policies pursued in the transition countries and the impact of the freer movements of capital.

This preoccupation with possible Balassa-Samuelson effects obscures the real issues that the transition countries face, such as the propensity to run unsustainable trade deficits. Ironically, this propensity – which does not seem to have much to do with the shifts in *internal* relative prices – suggests that despite high growth rates in labour productivity in the tradable sectors, the transition countries are not improving their competitive position *vis-à-vis* the EU.

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