1. Recent Developments in the Predictive Assessment of Dynamic Integration Effects: A Critical Appraisal

Dirk Willenbockel

1. Introduction

Predictive quantitative assessments of regional economic integration arrangements using standard partial-analytic or computable general equilibrium methods have until recently focused almost exclusively on the evaluation of static allocative effects. However, in the wake of the renewed interest of mainstream economists in the determinants of long-run growth, there has been a rising suspicion that such traditional approaches miss the point by neglecting the potential link between integration and growth performance in the medium and long run.

Over the past decade, a new wave of theoretical and empirical studies related to the growth-integration nexus has emerged, and a number of recent contributions suggest practical methods for the forward looking evaluation of dynamic integration effects. This chapter provides a critical appraisal of these contemporary applied modelling efforts and their theoretical underpinnings.

Thus I am revisiting the question: Do conventional comparative-static approaches to the predictive quantitative evaluation of economic integration programs underestimate the potential long-run benefits by ignoring induced growth processes? And if so, how can the likely magnitude of such dynamic integration effects be measured ex ante? In two related papers, published timely at the height of the debates about the economic consequences of the Single European Market and NAFTA, Richard Baldwin[1989,1992] provided refreshingly simple tentative answers to both questions. He suggested in particular that the familiar static efficiency gains from trade liberalization trigger a medium-run aggregate capital accumulation process, which "can be described in theory and measured in practice". Pointing to the first generation of endogenous growth models emerging at the time, Baldwin's 1989 paper also contained some more cautious speculations about potential shifts in long-run growth rates due to

closer European integration. I will take these contributions as point of departure for the present chapter.

To set the stage, Section 2 briefly recapitulates Baldwin's medium-run growth argument and measurement method. Section 3 discusses a number of principal objections to Baldwin's approach raised in the subsequent literature. Some recent contributions to endogenous growth theory suggest that regional integration may not only raise growth temporarily above the long-run trend but might affect long-run growth rates themselves. Section 4 surveys potential channels through which integration might affect growth permanently according to the new growth literature and comments on the measurability of such permanent effects. Section 5 casts a sceptical glance at recent developments in dynamic computable general equilibrium analysis of European integration and NAFTA, and Section 6 draws some tentative conclusions.

2. The Baldwin Multiplier Revisited

The Medium-Run Growth Effect According to Baldwin[1989]

The analytic vehicle used by Baldwin[1989] to demonstrate the presence and measurability of medium-run growth effects is a modified closed-economy Solow growth model which allows for the presence of aggregate increasing returns. This choice of setting is perhaps somewhat astonishing as one might expect that a minimum requirement for an analytic framework purporting to throw light on regional integration effects would be the explicit incorporation of such phenomena as international trade and factor movements. But let us brush aside such nitpicking for the moment and follow Baldwin in considering a simple one-sector economy comprising the whole integration area, in which aggregate output Y is produced by combining homogeneous labour L and capital K subject to a generalized Cobb-Douglas technology $Y=AK^{á+â}\ L^{1-á}$, which is homogeneous of degree 1+β. A constant fraction s of real output is saved and invested, the rate of capital depreciation is ä, and population growth as well as the rate of technological progress is zero. Thus the dynamics of capital accumulation is described by

$$(1)\quad \dot{K} = sAK^{a+b}L^{1-a} - dK, \quad L = \overline{L},\ K(0) = K_o .$$

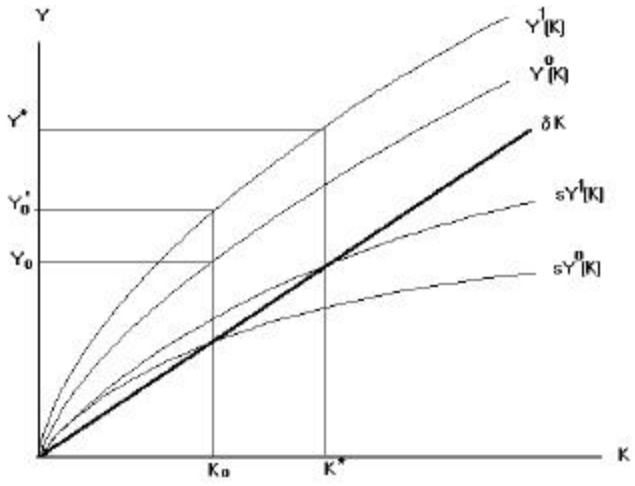
For á+â<1, the system converges to a steady state with constant capital stock and constant GDP. In the borderline case á+â=1, income and capital stock grow perpetually at constant rate

$$(2)\quad \dot{Y} / Y = \dot{K} / K = sA\bar{L}^{1-a} - d \quad (for\ a + b = 1)$$

while the case á+â >1 would imply perpetual growth at an accelerating rate and can be dismissed on empirical grounds.

Now economic integration programs like "Europe 1992", so the argument goes, raise total factor productivity due to the removal of distortionary and resource-binding barriers to trade and factor mobility. In the present model, this efficiency gain corresponds with a one-off increase in A to a new higher permanent level. At the given initial factor endowment, real income rises directly by (dA/A*100) percent. Traditional comparative-static partial and general equilibrium methods for the quantitative ex-ante evaluation of trade liberalization or integration effects[1] are restricted to an estimation of this direct effect. Yet in the Solow framework with á+â<1, the productivity change induces a transitional growth process, which is conveniently visualized in Figure 1.

Figure 1: The Medium-Run Growth Effect of a Productivity Jump in a Solow Economy



Starting from an initial steady state with capital stock K_o and real income Y_o, the integration-induced productivity jump shifts production function and saving schedule upward, and income rises immediately to Y_o'. The additional income induces additional saving and investment rises above replacement level, the capital stock starts growing and over time the economy converges to a new steady state with capital stock K^* and income Y^*.

The rise from Y_o' to Y^* is labelled "medium-term growth effect" by Baldwin[1989]. Log-differentiating (1) at steady state, we find that the proportional change of the capital stock from its pre- to its post-integration steady-state level is approximately

$$(3) \quad \hat{K}^* = \frac{1}{1-a-b}\hat{A} \ ,$$

where hat (^) notation is used to express proportional changes. Using (3) in the aggregate production function, we infer that the total - direct plus medium-run growth - effect of the productivity change on steady-state income can be measured by

$$(4) \quad \hat{Y}^* = \frac{1}{1-a-b}\hat{A} = \hat{A} + \left[\frac{1}{a+b} - 1\right]^{-1}\hat{A} \ , \ a+b<1 \ .$$

The far RHS of (4) decomposes the total effect into the static effect (corresponding to the move from Y_o to Y_o' in Fig.1) and the medium-run growth effect (corresponding to the move from Y_o' to Y^*). The bracket term in (4) is sometimes referred to as the Baldwin multiplier in the subsequent literature.

A traditional growth accounting framework based on constant returns to scale would suggest that is zero and is equal to the capital income share in GDP and thus in a neighbourhood of 0.3. Some more recent econometric studies allowing for external economies of scale suggest significantly higher values for the aggregate capital-output elasticity. Baldwin summarizes the empirical evidence for a number of EU core countries reporting estimates for á+â between 0.20 and 0.58.

Hence Baldwin concludes on basis of (4) that comparative-static estimates of the effect of integration on aggregate income like those reported in the European

Commission's Cecchini Report underestimate the medium-run effect by at least 25 percent and probably by as much as nearly 140 percent.

How long does it take for the medium-run effect to materialize, if we take this simple quantitative analysis seriously? Baldwin[1989:266] notes that "the medium run will last a long time" and more specifically that "half the adjustment would be achieved within 8-12 years". Table 1 provides a slightly more detailed picture of the adjustment dynamics. Like Baldwin, I assume a depreciation rate of 12 percent in the calculation.

The figures in Table 1 are based on the premise that the direct real income gain is realized instantaneously due to the instant jump of A. If one takes into account that the restructuring processes at intra- and inter-industry level which underlie this direct aggregate productivity effect will themselves only gradually evolve over time, the reported adjustment times have to be revised further upwards.

The whole argument concerning the medium-run growth bonus in Baldwin[1989] rests on the crucial assumption that the impact effect of an integration arrangement is readily captured by a Hicks-neutral technology jump embracing the entire integrated area. The sign and size of this aggregate productivity change itself is not endogenously determined within the model as a result of agents' responses to a specified set of integration measures, but must be drawn from some extraneous source and enters the quantitative analysis in form of an exogenous shock.

Table 1: Time of Adjustment to Productivity Shock in the Baldwin-Solow Model

	Number of years after shock	
Percent of full adjustment	á+â = 0.3	á+â = 0.6
25%	3.4	6.0
50%	8.3	14.4
75%	16.5	28.8
95%	35.7	62.4

99%	54.8	95.9

Source: Author's calculation.

This two-step ad hoc approach is not only unsatisfactory from a perspective of internal theoretical coherence and analytic rigour. Due to its aggregative nature, it is of course also not suitable to throw light on the most hotly debated practical questions arising in the context of any large-scale regional integration scheme - namely questions pertaining to the identification of likely "winners" and "losers" in terms of industries and individual countries or regions. Baldwin[1989:249] defends his approach to the measurement of dynamic integration effects by pointing out that

"(T)he results should be thought of as rough, back-of-the-envelope calculations. Samuel Johnson's quip about a dog walking on its hind legs applies to my empirical work: the interest lies not in that it is done well, but rather that it is done at all".

The Medium-Run Growth Effect According to Baldwin[1992]

Baldwin[1992] presents a more articulate analytical framework with stylized micro-foundations, in which the direct real income effect of trade liberalization between two symmetric countries is explicitly modelled.

Tastes, technologies and initial factor endowments are identical in the two countries, which are thus mirror images of each other. Intertemporal preferences of the representative consumer in each country take the iso-elastic form

$$(5)\quad U(0) = \int_0^{\infty} u(C[t])\, e^{-rt}\, dt \;,\; u(C) = \frac{s}{s-1} C^{(s-1)/s} \;,$$

where is the subjective discount rate, ó is the constant intertemporal elasticity of substitution, and C is a Cobb-Douglas consumption index defined over N domestic and N imported types of goods, in which all individual goods enter with equal weights. P denotes the true price index dual to C and p$_i$ is the domestic consumer price of variety i. The investment good is likewise a Cobb-Douglas composite over all 2N commodities.

There are N symmetric oligopolistic industries in each country corresponding to the N domestic product types. Each industry is populated by m firms which are assumed to act as static Cournot players. Each firm faces a

recurrent fixed cost: ê units of labour are required at each point in time before the first unit of output can be produced according to a Cobb-Douglas technology $y=Bk^{á}l^{1-á}$ with $B=AK^{â}$. So total factor productivity is a positive function of the aggregate capital stock K=mNk and investment is associated with a positive externality, which may be justified by the presence of learning-by doing effects with knowledge spillovers along Arrow-Sheshinski lines. Aggregation over the mN firms leads to the same aggregate production function as in the 1989 Baldwin-Solow model. The individual firm does not perceive to have an influence on the aggregate capital stock but treats B as an exogenous datum in the determination of its profit-maximizing input demands at any point in time. It is assumed that free entry keeps pure profits at zero level in all industries.

Nontariff trade barriers (NTBs) are entered in form of iceberg transportation costs to capture the direct resource-wasting character of most intra-EC trade impediments targeted by the Single Market programme. A fraction ô/(1+ô) of each output unit exported melts away during shipment and the importing country receives only 1/(1+ô) units. Thus when p* denotes the price faced by the importing country per unit *received*, the producer price per unit *exported* is p*/(1+ô).

The demand elasticity perceived by the individual Cournot oligopolist is -m in both markets and hence we have

$$(6)\quad p_i\,(1-1/m) \;=\; \frac{p_i^*}{1-t}(1-1/m) \;=\; marginal\,cost$$

Recalling that cost conditions are identical across industries and countries are symmetric, we may drop industry subscripts and the aggregate price index becomes $P=Ù^{-1}p$, $Ù=(1+ô)^{-0.5}$. Nominal GDP in each country can then be expressed as

$$(7)\quad PY \;=\; pymN \;=\; P\Omega BK^{a}L^{1-a}\;,\; L \;=\; mNl \;=\; \overline{L}-mNk\;,\; K \;=\; mNk.$$

Assuming with Baldwin that the rate of depreciation is zero and letting r denote the rental price of capital, firms hire capital up to the point where

$$(8)\quad \frac{r(t)}{p(t)} \;=\; aB\left(\frac{k(t)}{l(t)}\right)^{a-1}\left(1-\frac{1}{m}\right) \;-\; \frac{r(t)}{P(t)} \;=\; \Omega aB\left(\frac{L(t)}{K(t)}\right)^{a-1}\left(1-\frac{1}{m}\right).$$

The representative aggregate household in each country receives income from leasing capital at rental rate r and by supplying labour inelastically at wage rate w,

and chooses a consumption path which maximizes (5) subject to the dynamic budget constraint

$$(9)\quad \dot{K}(t) = \frac{r(t)}{P(t)}K(t) + \frac{w(t)}{P(t)}\bar{L} - C(t)\ ,\quad K(0) = K_o\ .$$

The first-order condition characterizing the optimal consumption-saving plan entails that $\dot{r}/P=\tilde{n}$ in the steady state. Combining this result with (8) while recalling $B=AK^{\hat{a}}$ and log-differentiating with respect to Ù (noting that the number of firms per industry remains unaffected by variations in ô), the steady-state effect of a roundabout reduction of NTBs on the capital stock and on real GDP turns out to be

$$(10)\quad \hat{K}^{*} = \frac{1}{1-a-b}\hat{\Omega}\ ,\quad \hat{Y}^{*} = \frac{1}{1-a-b}\hat{\Omega}\ ,\quad \hat{\Omega} = -\frac{1}{2}\frac{\Delta t}{1+t}\ ,$$

which closely resembles the multiplier relationships (3) and (4) between K^{*}, Y^{*} and the factor productivity parameter A in the 1989 model.

From (7) it is also obvious that the percentage change in Ù equals the immediate "static" percentage change in GDP, so that the change in long-run effect on GDP is related to the immediate effect by the same form of multiplier relationship as in (4). For Baldwin this fact provides the justification for applying the multiplier to the Cecchini Report estimates of the "static" real income gains from "Europe 1992" in the same way as in his earlier paper. This is yet again a rather heroic step, given that the Ce cchini Report estimates are largely based on a large-scale industry restructuring and firm consolidation scenario involving a move towards fewer suppliers with lower price-cost markets due to intensified competition, which is evidently distinctly at odds with the industry-level effects in Baldwin's model, in which firm numbers and price mark-ups are fixed.

Baldwin also shows that *at the margin* the growth effect generates an additional welfare gain only due to the assumed divergence between the private and social return to capital. If â=0, the growth process induced by a *small* variation in ô does not entail an additional dynamic welfare gain (on top of the gain due to the productivity jump at unchanged capital endowment). Optimizing agents are just indifferent between immediate consumption or investment of an incremental income rise and the envelope theorem applies. If â>0, however, the social marginal return to capital exceeds the perceived private return and the accumulation effect is associated with an additional welfare gain which is

proportional to the "static" welfare gain arising without the dynamic adjustment of the capital stock. Yet the size of the proportionality factor or "welfare multiplier" relating the "static" and "dynamic" welfare gain remains well below the size of the corresponding output multiplier.

How long is the medium run in this model? Willenbockel[1998] simulates the dynamic adjustment path to a trade liberalization shock implied by the Baldwin model using Baldwin's own parameter settings, which were chosen in conformity with econometric evidence, and finds that it takes about 150 years until just 50 percent of the total capital stock adjustment is completed: In Baldwin's medium run we are all dead.

Moreover, if we take Balwin's optimizing model seriously, it would actually predict a significant initial drop in investment and GDP, when we take into account that major integration programmes like Europe 1992, NAFTA, or Mercosul do not come as overnight surprises, but are announced well in advance of the actual implementation date. This negative announcement effect on growth is a straightforward implication of consumption smoothing implied by intertemporal optimizing behaviour. The announcement of future integration gains raises households' expected lifetime income profile and consumption rises immediately in anticipation of the future integration benefits. Thus, as illustrated in Willenbockel[1998], in the period between announcement and implementation of the integration arrangement, saving and investment rates actually decline in the Baldwin model.

The explicit model of Baldwin[1992] may be seen to provide a "microfoundation" for the Baldwin[1989] multiplier, if "microfoundation" is taken to mean that it is enough to write down *some* specific model with optimizing agents which generates the desired result - no matter how counterfactual the other empirical implications of this model actually are. The trouble with this kind of reasoning is, that it is likewise possible to write down "micro-founded" optimizing models with no less plausible features, in which trade liberalization raises real income but has no effect or even a negative effect on capital accumulation. In a recent comment on Baldwin's approach, Mazumdar[1996] demonstrates this point by recourse to a traditional two-sector open-economy growth model of the Oniki-Uzawa type. The following section provides a brief generalized recapitulation of Mazumdar's critique.

3. Trade and Capital Accumulation in a Two-Sector Growth Model

Formal theorizing about the nexus between trade and growth did of course by no means start with Baldwin's contributions. Within the "older" pure theory of trade, the link has been studied extensively over the 1960s and 1970s, and from Oniki/Uzawa[1965] onwards the preferred analytic workhorse has been a two-sector growth model distinguishing consumption and investment goods.[2] Mazumdar's critique of Baldwin is essentially a recap of the old insight that within this setting real income gains from free trade do not necessarily induce additional capital accumulation. Whether or not an accumulation effect occurs depends on the direction of trade.

To elucidate the point, consider an initially closed small economy with fixed labour endowment which produces a consumption good (subscript c) and an investment good (subscript k) using linear-homogeneous technologies with usual standard properties:

$$(11)\quad Q_i = L_i\, f_i(k_i)\ ,\quad i \in I = \{c,k\}\ ;$$

$$(12)\quad k_i = K_i / L_i\ ;\ \bar{L} = L_k + L_c\ ;\ K = K_k + K_c\ ;\ k = K/L\ ;$$

Q_i: Production quantity of sector i; K_i: Capital employed in sector i; L_i: Labour employed in sector i.

Both labour and capital are intersectorally mobile. We choose the consumption good as numeraire and let p, w and z:=p(r+ä) denote respectively the price of the investment good, the wage rate and the gross rental rate of capital in terms of the numeraire. Profit maximizing behaviour under perfect competition entails

$$(13)\quad z = pf_k'(k_k)\ ,\quad w = p[\ f_k(k_k) - f_k'(k_k)k_k\ ]$$

for the investment good industry and

$$(14)\quad z = f_c'(k_c)\ ,\quad w = f_c(k_c) - f_c'(k_c)k_c$$

for the consumption good industry. Thus

$$(15)\quad \frac{f_i(k_i) - f_i'(k_i)k_i}{f_i'(k_i)} = \frac{w}{z} := w\ ,$$

i.e. the optimal capital-labour ratios are positive functions of the wage-rental ratio:

$$(16)\quad k_i = g_i(w)\ ,\quad g_i'(w) > 0\ ,\quad i \in I.$$

Like Mazumdar we will focus on the Cobb-Douglas case $f_i(.) = A_i k_i^{\alpha_i}$. Then the $g(.)$ functions in (16) take the linear form $\alpha_i\omega/(1-\alpha_i)$ as depicted in the first quadrant of Figure 4, and we do not have to bother with the possibility of factor intensity reversals. In an equilibrium with incomplete specialization (13)-(16) establish a monotonous relationship between the product price ratio and the factor price ratio:

$$(17)\quad p = \frac{f_c'[g_c(w)]}{f_k'[g_k(w)]} = H w^{\alpha_c - \alpha_k}\ ,\quad H = const > 0\ .$$

If the consumption good industry is the more capital-intensive sector, p is increasing in ω as depicted in the south-east quadrant of Figure 4, while for $\alpha_c<\alpha_k$ p and ω are inversely related under non-specialization. In the borderline case of identical factor intensities ($\alpha_c=\alpha_k$) - which is the case considered by Mazumdar - $p = A_c/A_k$ in the autarky equilibrium which would correspond with a horizontal line in the p- plane.

To maintain comparability with preceding sections, the household sector is represented by L identical infinitely-lived agents with iso-elastic utility functions as in (5), who choose an optimal consumption and investment plan subject to the dynamic budget constraint

$$(18)\quad p(t)\dot{k}(t) = (z(t) - \delta)k(t) + w(t) - c(t) \Leftrightarrow \dot{k}(t) = r(t)k(t) + w(t)/p(t) - c(t)/p(t)$$

The optimal plan must satisfy

$$(19)\quad \frac{\dot{c}(t)}{c(t)} = s\left[r(t) + \frac{\dot{p}(t)}{p(t)} - \rho\right]\ .$$

Using (13) in (19), the optimal steady-state capital stock in the investment good sector is determined by

$$(20)\quad f_k'(k_k^*) = \rho + \delta\ .$$

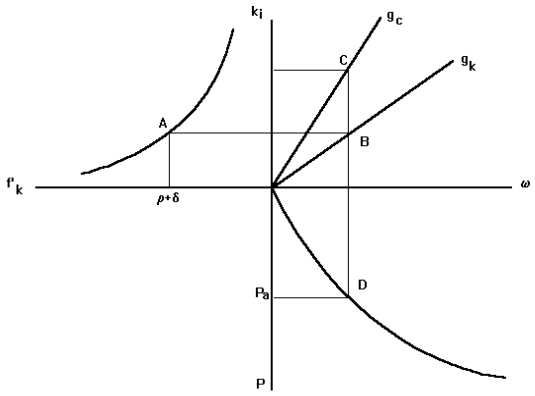
Condition (20) corresponds with point A in the second quadrant of Figure 2. Moving eastwards to point B, one finds the associated long-run equilibrium wage-rental ratio, while the steady-state levels of k_c and p are found by moving vertically to points C and D respectively.[3]

It is obvious from the graph that a move from autarky to free trade at given world market terms of trade p_w must lead to complete specialization - unless p_w is exactly equal to the autarky price relation p_a, in which case integration is a

pointless exercise to begin with. In particular, if $p_w > p_a$, the economy has a comparative advantage in the production of the investment good and the domestic consumer goods industry shuts down. The economy-wide capital-labour ratio in the new long-run equilibrium is $k^* = k_k^*$ as determined by (20) and is necessarily smaller than k in the initial autarky equilibrium, given that the investment good industry is by assumption the less capital-intensive sector. Thus in this case integration leads actually to a process of capital decumulation while the economy enjoys at the same time a rise in real income and welfare. On the other hand, if $p_w < p_a$, the economy specializes completely in the production of the consumption good and the new steady-state capital-labour ratio, which is now governed by (14), is higher than in the initial equilibrium. So in this case integration does induce a phase of positive capital accumulation.

In sum, in the two-sector optimal growth model considered here integration has a positive effect on domestic capital accumulation only if the economy specializes in the relatively capital-intensive good. The setting considered by Mazumdar[1996], which assumes identical capital intensities in both sectors ($á_c = á_k$), is an interesting special case of the more general model considered above. It is straightforward to sees that even in this case a capital stock growth effect occurs only if the economy under consideration has a comparative advantage in the consumer good industry.

Figure 2: Long-Run Autarky Equilibrium in a Two-Sector Optimal Growth Model



The general message from the two-sector analysis is that the presence of static income gains from trade is not sufficient for the generation of a medium-run growth effect. Since the effect of integration on investment activity depends on the direction of the induced trade effects, the aggregative short-cut approach of Baldwin[1989], which sidesteps the analysis of trade effects, is potentially misleading. As Mazumdar puts it, Baldwin "makes the crucial assumption that a single-good economy is a reasonable approximation for a multi-good one and that this assumption does not make any difference to his basic result that trade leads to growth as long as trade increases real income. This assumption is incorrect and leads to his misleading conclusion".

This criticism may not seem to apply to the explicit model of Baldwin[1992] outlined above, which has an explicit trade story to tell. However, given the strong and counterfactual symmetry assumptions which are necessary (as they serve to rule out any intersectoral reallocation effects) to derive the neat multiplier formula from this model, it certainly requires a major act of faith to be persuaded by Baldwin's suggestion, that the aggregate dynamic effects can be measured in practice in a meaningful sense by application of this formula.[4]

Surely, the neoclassical two-sector growth model with its extreme and likewise counterfactual specialization assumptions and its blatant inability to account for the basic stylized facts about observable trade patterns provides also no suitable basis for a predictive quantitative evaluation of dynamic integration effects. Bluntly speaking, in a world where intra-industry trade in all manufacturing categories is prevalent among industrialized countries, propositions like "one need not take into account dynamic effects if trade liberalization does not lead to imports of capital goods" (Mazumdar[1996:1337]) are evidently not tremendously helpful, as far as the practical measurement problem is concerned.

Nevertheless, the preceding analysis indicates that in cases where the integration program under consideration is likely to alter sectoral production patterns, the Baldwin multiplier does not constitute a satisfactory substitute for a sectorally and geographically disaggregated computable dynamic general equilibrium analysis on basis of a model with sufficient structure to capture the most decisive stylized facts about production and trade patterns in the status

quo ante - which is of course easier said than done. Section 5 casts a brief glance at promising recent developments in this direction.

4. Endogenous Growth Effects of Economic Integration

So far our discussion has neglected the possibility that integration may not merely affect growth in the medium run, but may change the steady-state growth rate - though the convergence speed analysis for the medium-run growth model in section 2 suggests that empirically it may be difficult to distinguish between medium- and long-run growth effects, as the medium-run effect itself raises observable growth rates above the long-run trend growth rate for several decades. In Baldwin's 1989 model, the integration-induced productivity effect would raise the long-run growth rate if á+â is exactly unity (see (2)). In this case the model takes in effect the form of the AK model of endogenous growth. Since it requires more than the usual suspension of disbelief - to borrow a phrase used by Baldwin himself in this context - to attach any credence to predictions which are not robust to infinitesimal variations in parameter values [5], we do not comment further on Baldwin[1989:267-8]'s computations for this case.

The current generation of endogenous growth models, in which R&D activity is the prime driving force for long-run growth, identifies basically four mechanisms through which economic integration may affect long-run growth rates: 1) knowledge diffusion effects, 2) R&D redundancy effects, 3) market scale effects, and 4) re-allocation effects.[6]

1. Close economic relations among countries foster the international transmission of knowledge about product and process innovations. In some theoretical formulations, international knowledge diffusion occurs automatically at a given exogenous rate (e.g. Currie et al.[1996]). In other models, knowledge spillovers are linked to cumulated trade volumes as in Grossman/Helpman[1991:165-70], to patent licensing as in Rivera-Batiz/Xie[1992], or to foreign direct investment as in Walz[1997b]. In either case, integration broadens a country's knowledge base and raises the productivity of its R&D sector.

2. Integration discourages the duplication of R&D efforts. When "wheels" can be readily imported from abroad, it becomes unprofitable for firms to reinvent the wheel rather than developing a new product which gives the innovator at least a temporary monopoly position.

3. Market enlargement effects due to integration have two opposing implications for the profitability of innovation activity: On the one hand, from the perspective of an individual innovator a larger prospective sales volume in an integrated market entails higher profits for a given market share. On the other hand, the presence of a larger number of rival firms producing similar varieties in the integrated area tends to reduce the market share per firm.

4. Trade liberalization induces resource shifts between R&D activity and other productive activities, in particular when trade barriers fall among countries with significant differences in factor endowments and R&D efficiency. Consider e.g. a two-country setting with a human-capital-intensive tradable good, a labour-intensive tradable good, and a human-capital using R&D sector generating productivity-raising innovations a la Grossman/ Helpman [1991: Ch.6 and 9]. From the perspective of a country with a comparative advantage in skill-intensive goods, a move from autarky to free trade raises the relative price of human capital due to the Stolper-Samuelson effect, R&D activity becomes less profitable due to the cost increase and human capital is pulled from R&D to the exports-manufacturing sector. Thus this resource re-allocation effect per se would reduce the rate of innovation and output growth in the human-capital-rich country, while speeding up growth in the labour-rich country.

The overall effect of an integration scheme on the steady-state growth rate of a country depends on the interplay of these various mechanisms. While the general presumption is that endogenous growth theorizing reinforces standard economic arguments in favour of openness, various contributions to the theoretical literature have considered cases in which integration in fact reduces a country's long-run output growth rate vis-a-vis the pre-integration situation.[7]

Numerous empirical cross-country studies seem to find a clear positive relationship between openness of trade policy and growth performance, though as Edwards[1998] notes, some sceptics remain unconvinced in view of the serious measurement, endogeneity, and multicollinearity problems inherent in much of this work. Taking up some of these criticisms, Edwards presents new evidence on the relation between total factor productivity growth and openness for a cross-section of 93 countries using nine different indicators for the stance of trade policy. He finds that the data suggest "with tremendous consistency that

there is a significantly positive relationship between openness and productivity growth".

Henrekson et al.[1997] investigate the growth effects of European integration through inclusion of an EC-EFTA dummy variable in a cross-country regression study including a relatively careful sensitivity analysis and find a fairly robust association between EC or EFTA membership and average growth performance over the period 1976-85. The estimated growth effect is on the order of 0.6 to 0.8 percentage points per annum.

Like other economists, Edwards as well as Henrekson et al.[1997] suggest that the endogenous growth approach provides the long-missing rigorous theoretical explanation for such observable regularities between openness and growth. However, a closer look at the empirical evidence raises doubts about the ability of current-generation new growth models to account for observable facts regarding growth - and hence doubts about their suitability as an analytic framework for the predictive quantitative assessment of integration effects.

In a rather revealing analysis of the fragility of results from previous cross-country growth regressions on the basis of a 119-country sample, Levine/Renelt[1992] find a robust link between investment rates and GDP growth and between openness and investment rates, but no independent relationship between openness indicators and growth when investment shares are controlled for. That is, openness seems to promote growth only by promoting physical capital investment - and not via R&D-related factor productivity improvements as suggested by the new growth theories summarized above. As Baldwin/Seghezza[1996] comment on the same finding, "[i]t seems ... that trade-induced productivity-led growth is not empirically important, or at least not important enough to show up in cross-country data. This rejects the main prediction of the new-trade-new-growth literature, namely that trade affects GDP growth by influencing productivity growth."

Yet this interpretation of the data is in turn not consistent with the mentioned results of the Edwards[1998] study, in which openness is directly related to productivity growth so that differences in investment rates are accounted for via the preceding estimation of total factor productivity by country. It is also not consistent with the reported results of Henrekson et al.[1997], who find a significant link between growth and European integration but no significant influence of EC-EFTA membership on investment rates.

In short, then, the cross-country evidence on the presence of productivity-led (as opposed to investment led) growth effects of global or regional integration suggested by new growth theory remains inconclusive at present. It is likely to remain inconclusive in the future, given the principal unsuitability of cross-section studies to address questions about chains of causation and given the inherent data limitations.[8]

A severe blow to the empirical relevance of endogenous growth theory comes from time series evidence. Jones[1995] points out that neither the US GDP growth rate over the past century nor post-world-war-II growth rates for other advanced OECD countries exhibit large persistent changes. At the same time, variables that are predicted to have permanent growth rate effects according to new growth theory - such as the level of resources devoted to R&D or openness to international trade - do show permanent shifts in the supposedly growth-enhancing direction over the same period. According to Jones, these basic time series facts provide compelling evidence against the current generation of R&D-based endogenous growth models: "... either by some astonishing coincidence all of the movements in variables that can have permanent effects on growth rates have been offsetting, or the hallmark of the endogenous growth models, that permanent changes in policy variables have permanent effects on growth rates is misleading."

Thus, current state-of-the-arts endogenous growth models do not appear to provide a suitable framework for the predictive evaluation of integration effects, given that their key predictions are rejected by the time series evidence. Anyway, in fact the highly stylized nature of existing models has so far not invited serious efforts at calibration to concrete data sets in order to assess the likely magnitude of long-run growth effects of particular integration programmes.[9]

5. A Note on Recent Developments in Dynamic Computable General Equilibrium Analysis

The basic message from of section 3 was, that in situations where an integration arrangement is likely to affect the sectoral and geographic production structure in the integrating area, a multisectoral modelling approach is required to assess potential growth effects.

In the area of tax policy analysis, dynamic applied general equilibrium models with internally consistent microfoundations have been in use for quite some time, yet in the area of trade policy and economic integration analysis, multisectoral comparative-static CGE modelling remained until recently the prevailing mode of analysis, despite various attempts to introduce some mechanical pseudo-dynamics into such models here and there.[10] A pioneering effort to analyze dynamic trade liberalization effects along with sectoral restructuring effects simultaneously within a disaggregated applied general equilibrium model with explicit intertemporal microfoundations is the study of Boulder/Eichengreen[1992] for the US economy. With a view to our discussion of the Baldwin multiplier in sections 2 and 3, it is noteworthy to point out, that the authors' simulation of a unilateral elimination of US import tariffs and quota restrictions predicts positive efficiency effects for the US economy, but no investment-led medium growth effect whatsoever. In fact the analysis suggests that rates of investment and the aggregate US capital stock would slightly fall.

In a series of multi-country dynamic general equilibrium computations, McKibbin[1994] and Manchester/McKibbin[1995] take inspiration from Baldwin and use the MSG-2 world model of McKibbin/Sachs[1990], which features no sectoral industry disaggregation, to simulate the dynamic effects of NAFTA and "Europe 1992" plainly as a response to an exogenous increase in total factor productivity growth for a number of years. In my view, these exercises are not particularly illuminating, as they essentially assume the answer to the starting question.

An interesting and potentially fruitful recent development is Keuschnigg/Kohler[1996]'s dynamic extension of CGE trade policy analysis under imperfect competition in the tradition of Harris[1984]. Given the widespread use of comparative-static Harris-type models in the context of European integration, NAFTA, Mercosul and other proposed regional integration schemes over the past few years, Keuschnigg/Kohler's pioneering study is likely to constitute the starting point for a new generation of models, which may potentially help to throw further light on the questions posed at the outset of this essay.

6. Concluding Remarks

Some general conclusion about the state of the art in the predictive measurement of dynamic integration effects emerge from the preceding discussion. To begin

with, Baldwin's bold suggestion that the aggregate transitory growth effects of efficiency-raising trade liberalization or integration schemes can be roughly quantified by application of a simple multiplier formula to an estimate of 'static' allocative gains, does not hold up under closer scrutiny. In principle, the multiplier approach might even mispredict the sign of induced accumulation effects. Even in situations where this theoretical possibility can safely be ruled out, Baldwin's own analytic framework taken at face value predicts that the investment-led medium-run growth effect would evolve only very gradually over the decades - in Baldwin's medium run we are all dead.

Recent contributions to endogenous growth theory suggest that closer economic integration might shift a country's growth rate permanently, yet the empirical evidence on such long-run growth effects is not clear-cut at present. Many cross-country studies appear to find a significant positive link between openness and growth performance, but there is contradictory evidence with regard to the source of this link. Some studies seem to support the view emphasised in new growth theory that the link is indeed due to R&D-related long-run effects on factor productivity growth, while other studies find that the link is purely due to induced physical capital accumulation effects, which would contradict the main prediction of current open-economy endogenous growth models. Moreover, it is not quite sure whether such cross-country regressions really capture long-run growth effects or merely transitory effects with low convergence speeds.

A closer look at the time series evidence is more conclusive: The basic proposition of contemporary endogenous growth models about the relation between the *level* of resources devoted to R&D and long-run growth is compellingly rejected by the data for advanced OECD countries. Hence the current generation of endogenous growth models does not appear to provide a suitable framework for the predictive quantitative evaluation of growth effects from integration.

Some interesting and potentially fruitful efforts to dynamize traditional multisectoral CGE models for trade policy and integration analysis are currently undertaken. Yet of course the quality of the output from counterfactual CGE simulations will always critically depend on the quality of the positive empirical

knowledge from secondary sources, which is used during the model design and numerical calibration stages.

Perhaps not too surprisingly, at present a solid empirically corroborated theoretical basis for a forward-looking evaluation of the medium- or long-run growth consequences of concrete integration arrangement does not exist - and sceptics may doubt that it ever will. Hence any existing ex-ante estimates of such growth effects that can be found in the literature should reasonably be taken with a large grain of salt.

Notes

1 See Willenbockel[1994:9-83] for a survey.

2 See e.g. Findlay[1984:206-11] and Smith[1984:298-307] for brief selective surveys of this literature.

3 See Srinivasan/Bhagwati[1980:349] for a similar graphical representation.

4 Baldwin[1992:163] himself notes the possibility of a negative effect of trade liberalization on the return to capital and on the long-run capital stock at the outset, but then ignores this possibility without further discussion in the remainder of the paper. Baldwin/Venables[1995:1615] acknowledge "that the output multiplier need not exceed unity or even be positive. If ... [the] main impact is on labour-intensive sectors then the policy change could lower the rate of return on capital, changing the sign of effects", but argue that "empirical evaluations ... suggest that this has not been the case for NAFTA and EC92". However, the empirical evaluations referred to are in fact ex-ante computable general equilibrium studies.

5 Recall that the system (1) has a bifurcation at $\alpha+\beta=1$, i.e. any arbitrarily deviation of the capital-output elasticity from unity entails that the long-run growth rate is either zero or infinite.

6 This taxonomy is loosely based on Walz[1997a], Grossman/Helpman [1991:237-57], and Rivera-Batiz/Romer[1991]. Compare also Taylor[1994].

7 See Grossman/Helpman [1991:152-4,246-56], Rivera-Batiz/Xie [1993], Feenstra [1996]. Note however, that most of these cases presume the absence of international knowledge spillovers. Note further that a drop in a country's post-integration long-run growth rate does not necessarily entail that integration makes the country worse off, since positive consumption *level* effects may well overcompensate the adverse *growth* effect - see in particular Grossman/Helpman[1991:161, 249-56] and Li[1996].

8 See Mankiw[1995:301-8] for a lucid non-technical discussion of the econometric problems and inherent limitations of cross-country growth regressions. Compare also Baldwin/Venables[1995:1628].

9 See Dinopoulos/Syropoulos[1996] for some rudimentary hypothetical back-of-the-envelope calculations. Funke/Strulik[1996] use a numerically specified

endogenous growth model to simulate some aspects of the integration process between East and West Germany.

10 See Willenbockel[1994] for further reference.

References

Baldwin, Richard [1989]: The Growth Effects of 1992. *Economic Policy* 9, 247-81.

Baldwin, Richard E. [1992]: Measurable Dynamic Gains from Trade. *Journal of Political Economy* 100, 162-74.

Baldwin, Richard E./ Venables, Anthony J.[1995]: Regional Economic Integration. In: Gene M. Grossman/ Kenneth Rogoff (eds): *Handbook of International Economics Vol.III*. Amsterdam: Elsevier, 1597-644.

Baldwin, Richard E./ Seghezza, Elena [1996]: Trade-Induced Investment-Led Growth. *CEPR Discussion Paper* No.1420. London: Centre for Economic Policy Research.

Boulder, Laurence H./ Eichengreen, Barry [1992]: Trade Liberalization in General Equilibrium: Intertemporal and Interindustry Effects. *Canadian Journal of Economics* 25, 253-80.

Currie, David / Levine, Paul / Pearlman, Joseph / Chui, Michael [1996]: Phases of Imitation and Innovation in a North-South Endogenous Growth Model (mimeo).

Dinopoulos, Elias / Syropoulos, Constantinos [1996]: Growth-Creating Trading Blocs. *Canadian Journal of Economics* Vol.29 (Special Issue), S371-5.

Edwards, Sebastian [1998]: Openness, Productivity and Growth: What Do We Really Know? *Economic Journal* 108, 383-98.

Feenstra, Robert [1996]: Trade and Uneven Growth. *Journal of Development Economics* 49, 229-56.

Findlay, Ronald [1984]: Growth and Development in Trade Models. In: Ronald W. Jones/Peter B. Kenen (eds.): *Handbook of International Economics* Vol.I. Amsterdam: Elsevier, 185-236.

Funke, Michael / Strulik, Holger [1996]: Eastern Germany: Halfway in from the Cold or a New Northern Mezzogiorno? University of Hamburg (Mimeo - forthcoming in *European Economic Review*).

Grossman, Gene M. / Helpman, Elhanan [1991]: *Innovation and Growth in the Global Economy*. Cambridge MA: MIT Press.

Harris, Richard [1984]: Applied General Equilibrium Analysis of Small Open Economies with Scale Economies and Imperfect Competition. *American Economic Review* 74, 1016-32.

Henrekson, Magnus / Torstensson, Johan / Torstensson, Rasha [1997]: Growth Effects of European Integration. *European Economic Review* 41, 1537-57.

Jones, Charles I. [1995]: Time Series Tests of Endogenous Growth Theories. *Quarterly Journal of Economics* 110, 495-525.

Keuschnigg, Christian / Kohler, Wilhelm [1996]: Commercial Policy and Dynamic Adjustment Under Monopolistic Competition. In: *Journal of International Economics* 40, 373-409.

Levine, Ross / Renelt, David [1992]: A Sensitivity Analysis of Cross-Country Growth Regressions. *American Economic Review* 82, 942-63.

Li, Dajin [1996]: The Welfare Effect of Trade in the Endogenous Growth Model. *Canadian Journal of Economics* 29 (Special Issue), S384-8.

Manchester J / McKibbin, Warwick J.[1995]: The Global Macroeconomics of NAFTA. *Open Economies Review* 6, 203-23.

Mankiw, N. Gregory [1995]: The Growth of Nations. *Brookings Papers on Economic Activity* No.1, 275-326.

Mazumdar, Joy [1996]: Do Static Ga ins from Trade Lead to Medium-Run Growth? *Journal of Political Economy* 104, 1328-37.

McKibbin, Warwick J.[1994]: Dynamic Adjustment to Regional Integration: Europe 1992 and NAFTA. *Journal of the Japanese and International Economics* 8, 422-53.

McKibbin, Warwick J./ Sachs, Jeffrey D.[1991]: *Global Linkages: Macroeconomic Interdependence and Cooperation in the World Economy*. Washington D.C.: Brookings Institution.

Oniki, Haijme / Uzawa, Hirofumi [1965]: Patterns of Trade and Investment in a Dynamic Model of International Trade. *Review of Economic Studies* 32, 15-38.

Rivera-Batiz, Luis. A./ Romer, Paul M.[1991]: Economic Integration and Endogenous Growth. *Quarterly Journal of Economics* 106, 531-55.

Rivera-Batiz, Luis A./ Xie, Danyang [1992]: GATT, Trade, and Growth. *American Economic Review - Papers & Proceedings* 82, 422-27.

Rivera-Batiz, Luis A./ Xie, Danyang [1993]: Integration among Unequals. *Regional Science and Urban Economics* 23, 337-54.

Smith, Alasdair [1984]: Capital Theory and Trade Theory. In: Ronald W. Jones/Peter B. Kenen (eds.): *Handbook of International Economics* Vol.I. Amsterdam: Elsevier, 289-324.

Srinivasan, T N./ Bhagwati, Jagdish N. [1980]: Trade and Welfare in a Steady State. In: John S. Chipman / Charles P. Kindleberger (eds.): *Flexible Exchange Rates and the Balance of Payments: Essays in Memory of Egon Sohmen*. Amsterdam: North-Holland, 341-53.

Taylor, M. Scott [1994]: "Once-off" and Continuing Gains from Trade. *Review of Economic Studies* 61, 589-601.

Walz, Uwe [1997a]: Dynamic Effects of Economic Integration: A Survey. *Open Economies Review* 8, 309-26.

Walz, Uwe [1997b]: Innovation, Foreign Direct Investment and Growth. *Economica* 64, 63-79.

Willenbockel, Dirk [1994]: *Applied General Equilibrium Modelling: Imperfect Competition and European Integration*. Chichester / New York: John Wiley.

Willenbockel, Dirk [1998]: Growth Effects of Anticipated Trade Liberalization and the Baldwin Multiplier. *Economics Letters* 59, 231-5.