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Edited by
Ben Fine (SOAS, University of London)
Dimitris Milonakis (University of Crete)

Political economy and the theory of economic and social development have long been fellow travellers, sharing an interdisciplinary and multidimensional character. Over the last 50 years, mainstream economics has become totally formalistic, attaching itself to increasingly narrow methods and techniques at the expense of other approaches. Despite this narrowness, neoclassical economics has expanded its domain of application to other social sciences, but has shown itself incapable of addressing social phenomena and coming to terms with current developments in the world economy.

With world financial crises no longer a distant memory, and neoliberal scholarship and postmodernism in retreat, prospects for political economy have strengthened. It allows constructive liaison between the dismal and other social sciences and rich potential in charting and explaining combined and uneven development.

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4.1 Overview

Growth theory fits uncomfortably around macroeconomics. On the one hand, no one can deny that it has to do with the workings of the economy as a whole. On the other hand, it is primarily concerned with the long run as opposed to the short run that preoccupies the bulk of macroeconomics, with the long run and growth taken as given for the purposes of investigating deviations around them. Symbolically, many macroeconomic textbooks have excluded growth theory altogether, or otherwise treat it as an item separate from the rest of the content. This has begun to change, with the increasing reduction of macroeconomics to microeconomics, not least through RBC theory (see Chapter 9).

This more recent fuller integration of growth theory with contemporary macroeconomics is not accidental in origins or content. Modern growth theory originates with the Harrod–Domar model, covered in Chapter 2, with its pre-occupation with the existence of steady-state balanced growth (or growing equilibrium over time) and the stability of such an equilibrium should it exist (Harrod's knife-edge problem). The neoclassical one-sector, or Solow–Swan, model of growth that emerged in the 1950s, now known as old or exogenous growth theory, is covered in Section 4.2. Without necessarily intending to do so, it laid much of the foundation of what was to follow in terms of new or endogenous growth theory, covered in Section 4.3, as well as the previously observed disjuncture with macroeconomics. In its technical content, and by unwitting implication in its conceptual content, it was deeply embedded within microeconomics as opposed to macroeconomics. In this respect, the central role played for the old growth theory (OGT) by the one-sector production function is salient, as it is a core component of the technical apparatus underpinning microeconomics (alongside the utility function, and the technical architecture of optimisation, equilibrium and efficiency, see the counterpart *Microeconomics* volume). Significantly, OGT, although almost contemporaneous with Patinkin's treatment of the classical dichotomies, finesses money and the short run by setting them aside and focusing exclusively and simply on the long-run real economy (although there is the potential for some attention to the short run in

equally simplistic terms, which leave aside both money and unemployment). In this respect, growth theory in the 1950s can be regarded as an early and unobserved example of what has been termed economics imperialism, in which rich treatments of a topic (growth and development) is colonised by economics on the basis of the narrowest of principles and considerations – bearing in mind how, Harrod–Domar apart, growth had previously been the subject of economic historians concerned with the rise of capitalism and its continuing performance.

To be fair, the OGT also had much reduced ambitions, seeking merely to measure the sources of growth and not to explain them, as covered in Section 4.2. Even in this, it was beset by major flaws in seeking to reduce growth performance to a one-sector model, as indicated here but also covered in more detail in the counterpart *Microeconomics* volume. After all, the method of measuring technical change as a source of growth is not confined to the macroeconomy and can apply at any level of economic activity, from the individual firm upward, indicative once more of the simultaneous micro/macro nature of growth theory.

No such lack of ambition, nor departure from microeconomic foundations, is evident in the new or endogenous growth theory that emerged in the 1980s, see Section 4.3. On the basis of microeconomic principles, especially those concerning market imperfections leading to increasing returns to scale, it seeks to explain and not simply to measure the contribution of productivity increase to growth. This also gave rise to concerted efforts to estimate the sources of productivity increase through growth econometrics (see Section 4.4). This is generally recognised to have failed, with the empirical results tending to invalidate the assumptions of the theory rather than providing estimates for it. In this light, Section 4.5 revisits the relationship between the old and new growth theories and the broader relationship between growth theory and macroeconomics.

4.2 Old Growth Theory

It is understandable to take OGT as the point of departure when addressing new growth theory (NGT). In turn, OGT itself originates out of the neoclassical response to the problem of existence of steady-state balanced growth (SSBG) in the Harrod–Domar model (Chapter 2). Recall that SSBG requires that the warranted (capital stock) and 'natural' (labour force) rates of growth be equal, or $s/v = n$, where s is the savings ratio, v the capital–output (K/Y) ratio and n the rate of growth of labour. When the equilibrium condition is satisfied the economy is growing along this path, charting a trajectory in which all proportions between variables remain the same even though they expand in absolute terms. However, if the warranted rate of growth is higher than that of the labour force, there will be a growing shortage of labour, and vice versa for when $s/v < n$.

The Solow–Swan one-sector growth model deals with the existence problem by endogenising just one of the three independent forces that are brought together to form the SSBG equilibrium condition, namely the capital–output ratio. This is achieved by bringing into play the neoclassical aggregate production function (thus, allowing for substitutability between capital and labour, K and L). With s and n still taken as given, v is allowed to vary to allow $s/v = n$.

The aggregate production function, $Y = F(K, L)$, can be expressed in per capita terms given the assumption of constant returns to scale. For, if so, we can divide both sides of the production function by $1/L$, $Y/L = (1/L)F(K, L) = F(K/L, 1)$, with the second variable constant and equal to 1. In other words, output per capita, $Y/L = y$, can be produced by capital per worker, $K/L = k$, and we can collapse $y = Y/L = F(K/L, 1) = F(k, 1)$ into the representation, $y = f(k)$. With the constant savings ratio, s, and total saving translating automatically and fully into investment, then per capita saving/investment is $sy = sf(k)$. As the Harrod–Domar condition requires $s/v = n$, it follows that $sf(k) = nk$ as a condition on k for SSBG. This is simply saying that the amount of saving/investment per worker should equal the amount of new investment needed to equip each new member of labour force with the same capital (when the labour force grows at rate n, the new number of workers per year is n and they need investment per worker of nk to be provided by saving sf(k)). As Diagram 4.1 shows, the SSBG is achieved at $sf(k^*) = nk^*$. At this point, the growth rates of output, the capital stock and labour are equal to one another, which also implies that the ratios (Y/L, K/L, Y/K, etc.) remain constant. In other words, the growth rate of output per worker and capital per worker are zero (since both numerators and denominators grow at the same rate). Substitutability across capital and labour (from the production function) also ensures the stability of the long-run growth path. Suppose, for example, the economy is to the left of k^*, at $k < k^*$. Then, because of the shape of the per capita production function, f, reflecting the assumption of diminishing returns to capital (and labour), $sf(k) > nk$, as also follows from the diagram (as $f(k) > (n/s)k$ to the left of k^*). This automatically leads to an increase in k until it reaches k^*. Similarly for the mirror-image case where the economy stands to the right of k^*. With labour fully employed, the extra capital per worker is insufficient to produce the extra output and saving to sustain itself, so k falls until it reaches k^*.

The workings of the adjustment mechanism are the same in cases of changes in exogenous factors, such as, say, an increase in the propensity to save, s. In Diagram 4.2, the equilibrium moves from A to B, and from lower k^* to higher k^{**}. With higher savings and thus investment, there is more capital per worker available. However, whilst at the new equilibrium the capital–labour ratio (k) and output per worker (y) have increased, the steady-state growth rate remains unchanged at n. In other words, increases in savings (and, by definition, investment) have a level effect on per capita output, but no permanent effect

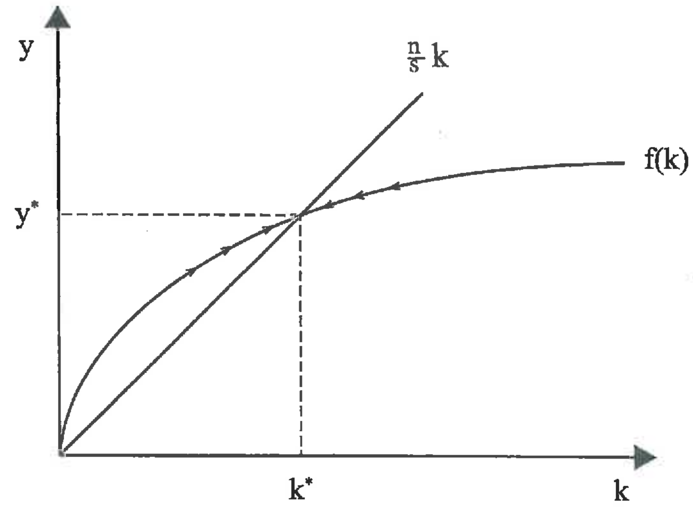

Diagram 4.1 Steady-state balanced growth for the Solow–Swan model

on the long-run growth *rate* of the economy. The same result applies to the case where population growth decreases, since again more capital per worker is available. The important point is that the SSBG rate is exogenously determined by the rate of growth of the labour force, n. At most, increasing saving, for example, boosts growth temporarily and raises per capita income but it cannot change the rate of growth itself. By the same token, per capita output remains constant along the SSBG path, and hence the growth rate of output per worker remains zero.

As is apparent, the neoclassical one-sector production function allows Harrod's existence problem for SSBG to be solved by varying v in the formula $s/v = n$. In principle, either s or n could have been allowed to vary (and there are models of this sort, with s varying with distribution between profits and wages, see Chapter 6, or n also varying with distribution in a Malthusian fashion if wages rise above subsistence). This is not our concern here. Rather, with the existence problem solved, we can now turn to Harrod's second problem of stability, or the knife-edge. This too has been surreptitiously resolved or, more exactly, set aside. As established in the stability analysis above, the diminishing returns production function and the fixed parameters of s and n suffice to ensure stability of the SSBG in the long run. Short-run deviations around this derive purely from having the wrong capital–labour ratio temporarily. But, as in the long run, the presumption in the short run is that all resources are fully employed, and that saving both drives the level of investment and is fully converted into investment. In short, the neoclassical growth model is purely a supply-side model that tracks the stability of the full employment path. In

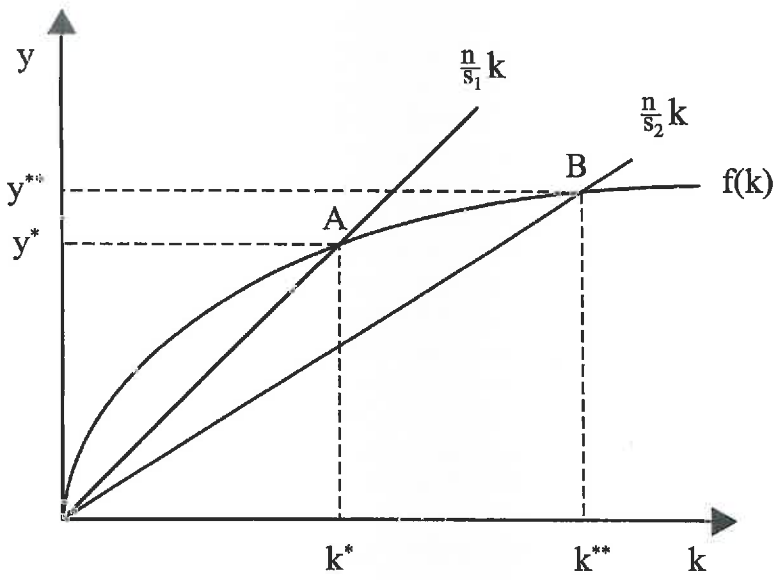

Diagram 4.2 Changes in the steady-state balanced growth path from saving ratio increases

other words, it does not allow for deviations from the long-run trend due to demand-side considerations.

By contrast, Harrod identified the knife-edge problem by considering the demand side of investment decisions (the accelerator), particularly in the context of entrepreneurs' future expectations of output demand to be met, an issue that is totally absent from the OGT. This raises the question whether growth (let alone development) can be appropriately studied from within the organising concepts of a SSBG path and a supply-side equilibrium. Growth, in practice, is neither steady (constant and smooth over time) nor balanced (with the same composition of output). And full employment at all times along, or even alongside, the path is unreasonably presumed through the mixing and matching of all capital and labour in any necessary proportion via the neoclassical production function. To be fair, the explicit rationale of OGT was to specify the long run, especially to measure the relative contributions (of factor inputs and productivity) to growth. But it can only do so by detaching the long from the short run and, as has been seen in the stability analysis above, extrapolating the long-run to short-run analysis, thereby setting aside (Keynesian) considerations of effective demand for the short run. At this stage of analysis, and at the time, this might have seemed innocent given the goal of measuring long-run contributions to growth as opposed to short-run sources of instability. But, as will be seen, it offered the first wedge in the door of collapsing the short and long runs

into one another from an analytical point of view, opening the way to presuming that effective demand could be put aside for both short- and long-run analyses, as with RBC theory (see Sections 4.5 and 9.4).

As already mentioned, technological progress was taken up in neoclassical growth theory but, as we now address, only in terms of its *exogenous* role in the SSBG path and in the measurement of its contribution to increases in output. For the first of these, technological progress, or productivity change other than from changes in k, can be added to the Solow–Swan model in the form of what is termed (exogenously imposed) labour-augmenting technical advances. The production function can be modified such that $Y = F(K, AL)$, where A is labour-augmenting technology and AL corresponds to 'effective labour'. Essentially, it is simply presumed that each unit of labour becomes more effective by the factor A. The analysis and results remain much the same as before, as can be seen by converting the system in 'per effective labour unit' terms (whenever L was present before it is now replaced by AL). The new input, effective labour (AL), has two independent and exogenous components of variation: the growth rate of the labour force (n as before) and the growth rate of its effectiveness or of A (denoted by m). Hence, with this type of technical progress, the SSBG equilibrium is given by $sf(\tilde{k}) = (n + m)\tilde{k}$, where $\tilde{k}$ is the capital per effective labour ratio, $\tilde{k} = K/AL$. The determination of the SSBG equilibrium, and the adjustment mechanism towards it, remain unchanged. But with SSBG in $\tilde{k}$, output per worker with the labour-augmenting technical progress now takes place at a constant exogenous rate, m. It is as if each worker becomes equivalent to more workers at the rate of growth m, with output per real worker correspondingly increasing. Thus, in per capita terms, the economy is growing along the SSBG path. Exogenous technological progress (of a very specific, labour-augmenting form) has an impact on the per capita growth rate (output is growing faster than labour due to increases in the latter's effectiveness).

Second, and on this basis, the neoclassical growth model has been used to measure the impact of exogenous productivity increases on increases in output. In a more general form, technological progress takes the form of exogenous changes (shifts) in the production function per se. For, the aggregate production function can be represented as $Y = F(K, L; A) = AF(K, L)$ where Y, K and L are aggregate output, capital and labour, and A, in multiplicative form, represents technological change, responsible for changes in the F function over time.

This can be shown to lead to the decomposition of output growth into three factors: growth in capital, growth in labour and what is termed total factor productivity (TFP). Taking differentials for $Y=AF(K, L)$:

$$dY = AF_K dK + AF_L dL + FdA$$

where AF_K and AF_L are the marginal products of capital and labour, respectively, and $dY/dA = F$ shows the impact that technology changes have on the production function. Diving through by $Y = AF(K, L)$ and rearranging gives:

$$(dY/Y) = (KAF_K/Y)dK/K + (LAF_L/Y)dL/L + dA/A.$$

Denoting the growth rate of variable x by $g\langle x\rangle$:

$$g\langle Y\rangle = AF_K(K/Y)g\langle K\rangle + AF_L(L/Y)g\langle L\rangle + g\langle A\rangle$$
$$g\langle Y\rangle = ag\langle K\rangle + (1 - a)g\langle L\rangle + g\langle A\rangle$$

where $a = AF_K(K/Y)$ is capital's share in output and $(1 - a) = AF_L(L/Y)$ is labour's share, under the assumptions of full employment and perfect competition. This is because, for capital say, AF_K is the marginal product of capital and so equals the profit rate (price of capital), so $AF_K(K)$ equals total profit and $AF_K(K/Y)$ equals profit share. The same applies to labour's share. In other words, the so-called growth accounting equation decomposes the growth rate of output into the contributions stemming from increases in capital (weighted by its share in output), increases in labour (weighted by its share in output) and the unobserved speculated impact of technological progress. The final term can be seen to be just:

$$g\langle A\rangle = g\langle Y\rangle - ag\langle K\rangle - (1 - a)g\langle L\rangle.$$

The term $g\langle A\rangle$ gives the output increase that is not explained by increases in inputs and so is designated as due to technological progress and, as mentioned, dubbed total factor productivity (TFP). TFP is recognised to be a *residual* after the contribution of increases in inputs have been netted out from increases in output. It is explicitly acknowledged to be unexplained, or untheorised, and only measured. This procedure is supposedly distinguishing between movements along and shifts of the production function. In other words, it attempts to decompose changes in output growth due to adjustment to the SSBG path and changes in the SSBG path per se.

However, this interpretation is not valid except under very special circumstances. And the major blow of defining and measuring TFP in this way comes from the Cambridge Critique (see chapter 5 in the counterpart *Microeconomics* volume for a detailed analysis). Suffice to say that TFP measures not only shifts in the production function, but all deviations from the assumptions upon which TFP is constructed: notably perfection competition (and hence marginal product pricing), full employment (supply-side equilibrium) and the one-sector model economy (one homogeneous capital/consumption good).

The latter problem entails deeper debates in value theory but, simply put, with more than one good and with K entering the production function as an index as if a physical quantity of capital, it would be impossible to decompose changes in the quantity of capital goods, K, and changes in the relative prices of capital and other goods. Precisely because there is only one sector in the model, any change in the relative price of capital will have to be measured as a change in its quantity. Nothing might change except the price of capital, but this would be measured as technical progress if the price of capital went down (since it would appear as if there were less capital being used) and technical decay if the price of capital goes up (appears as if more capital is being used to produce the same output).

Despite all of the above, TFP has been extensively used in analysing economic performance, with Solow providing the first such study for the US economy for the first 50 years of the 1900s, and showing that about 7/8 of the output growth could be attributed to TFP changes, with only the remaining 1/8 to capital (per worker) accumulation. Empirically, the magnitude of TFP can be cut back, through refinements in measuring the principal inputs (capital and labour), and inclusion of others (e.g. skills, natural resources, etc.). Perversely though, the empirically derived patterns for TFP tend then to be explained by causal factors that violate the assumptions under which the patterns have been derived. For example, TFP is deemed to have been poor because of a recession, or because of the increasing power of trade unions. These violate the assumptions of full employment and perfect competition, respectively, which are essential for measuring TFP in the first place, indicating that as a measure it incorporates, within its residual, all of the changes that are due to the deviations from the assumptions that it necessarily makes to construct the measure (including that there is only one good or, equivalently, no relative price changes, especially for capital and labour).

Leaving aside all these problems, one of the presumed predictions of the OGT (from the perspective of the NGT) that has played a pivotal role in future developments is the so-called convergence hypothesis. If technology is freely available to all – everyone has the same production function F – it would be expected that per capita output would converge over time across countries, especially with free capital mobility. In particular, and due to diminishing marginal returns to capital, poor countries (with a low K/L ratio) would exhibit high productivity of capital and hence grow faster than rich countries (with a high K/L ratio). This opened the field for an outpouring of empirical works, attempting to measure differences, and convergence or not, in per capita output growth across the world, and eventually to new growth theories that allow for both endogenous and unequal growth across countries.

4.3 New Growth Theory for Old?

NGT originates from the contributions of Paul Romer and Robert Lucas from the mid-1980s, and within a decade it gained considerable momentum and prominence. In understanding its contribution it is appropriate to take OGT as a point of comparison, as well as developments within the discipline of economics more generally.

Despite a proliferation of diverse NGT models, they all share a set of common theoretical tenets. First, and contrary to OGT, NGT identifies and endogenises the sources of productivity increases, and in a variety of ways. Besides externalities from learning-by-doing (and by extension by adopting, adapting, watching, exporting, etc.), which are presumed to be by-products of accumulation per se, productivity increase has been modelled by focusing on the generation, use and diffusion of new knowledge. A separate R&D or 'ideas production' sector can be set up, and productivity increase to the economy as a whole can accrue through increases in quality and variety of intermediate inputs being invented, for example. The same methodology can be applied to the quality of labour, which can be enhanced through investment in the accumulation of human capital. Again, this can be modelled in various ways and with varying outcomes.

Second, and whatever the modelling device, a central tenet in NGT is its microeconomic basis, both in terms of the models being derived from optimising intertemporal decisions of representative individuals within a general equilibrium framework, and in drawing upon microeconomic theories for the analysis of economies of scale, product differentiation, human capital formation, etc. This parallels the broader developments within mainstream economic thought with the increasing prominence of microeconomics, and the convergence of macroeconomics upon it. As a result, in many respects NGT has stronger affinities to microeconomics than even to a narrowly defined macroeconomics, at least until the current macroeconomics consensus came to prevail (see Chapters 9 and 10). Convergence to microeconomics was achieved in two stages. On the one hand, if only slightly earlier, the Solow–Swan model was derived by applying principles of individual optimisation instead of assuming given parameter values. Specifically, the constant aggregate savings rate, s, is replaced with intertemporal utility maximisation, whilst leaving the rate of growth as exogenously determined by labour force growth, n. On the other hand, with much greater substantive impact, productivity increase was endogenised. As a result, what matters in the modelling of such endogenous technological advance is that all outcomes (including invention generation) derive from the purposeful optimising behaviour of individuals in pursuit of private profit, even if optimisers do not internalise the overall (generally social) benefits (or rare losses) of their decisions. An invention brings returns to all who can use it and not just its inventor, unless it is monopolised.

The third common aspect of endogenous growth models is their reliance on market imperfections, with increasing returns to scale (IRS) and externalities being foremost. Simply put, and even if constant returns to scale persist at the individual firm level, IRS are liable to emerge at the aggregate level given the knock-on effects that the innovation processes have on current and future aggregate production possibilities. Paradoxically, then, whilst externalities and implied Pareto inefficiencies were all familiar from long-established microeconomics, NGT manages to transform their, equally well known, static deadweight losses into engines of growth at the macroeconomic level.

To reiterate, and using the terminology of OGT, NGT continues to be organised around the SSBG path, $s/v = n + m$. However, now v (capital–output ratio), s (saving–investment ratio) and m (technological advances) are endogenised within a microfounded dynamic framework. The production function is organised around IRS. Behind the new assumption of IRS lie the limitations of the neoclassical constant returns to scale production function of OGT, and particularly diminishing returns to capital. The latter assumption is crucial for the two main perceived empirical and theoretical limitations of OGT that NGT was set to overcome. First is that, due to diminishing returns to capital, convergence in per capita output is predicted as poorer countries grow faster. Second, diminishing marginal product of capital leads to per capita growth stabilising at a zero rate. In other words, a higher saving–investment ratio is offset by a lower productivity of capital and ends up having only a level rather than a growth effect (higher Y/L but its growth rate settles back to zero).

But within NGT, by invoking IRS both problems can be overcome. Simply put, and despite rampant diversity in the modelling, if it is assumed that other factors of production can behave in a similar way to capital in the sense that, once used, they can be stored and accumulated through some equivalent 'investment' process that ensures sacrifice of current resources for future benefits, then it is very straightforward to generate IRS. Consider then the aggregate production function:

$$Y = F(K,L,A) = BK^a(L_YA)^{1-a}$$

where L_Y denotes the amount of labour used for the production of final output Y, and A, as before, is a labour productivity factor. If A is assumed to be fixed, it can be absorbed into the constant term, B, and constant returns to scale prevail, with:

$$Y = (BA^{1-a})K^a L_Y^{1-a}.$$

If, however, A is a factor that varies and, in particular can be 'accumulable' (like capital), then IRS in K, L and A results, rewriting:

$$Y = BK^aL_Y^{1-a}A^{1-a}.$$

This has increasing returns, 2 − a, since a < 1.

Apart from allowing for IRS, what is distinctive in its contribution to NGT is how the nature, accumulation and diffusion of this new input, A, is specified, together with corresponding market, incentive and institutional structures. These have been modelled in different ways with varying outcomes. A standard and common representation for the accumulation of A is given by:

$$\dot{A} = \delta L_A A^{\varepsilon}.$$

With $\varepsilon = 1$, this says that the change in A is given by a constant term δ and is proportional both to the volume of labour allocated to the production of A, L_A, and to the existing stock of A. For example, with A as human capital (as in the classic contribution of Lucas), this equation implies that growth of human capital is related positively to both the amount of labour, L_A (or time/effort) allocated in non-working activities (e.g. studying), and the skills level already attained, A. Similarly, as in R&D-based models (in the spirit of Romer's), A can be viewed as ideas or knowledge that generate new varieties of intermediate capital goods. Again, new varieties accrue over time, depending linearly both on the number of people working in the research sector and the extent to which past knowledge is non-rival, and hence contributes proportionally to new knowledge. There is, hence, a positive externality (external to the individual researcher/firm) in that accumulated past knowledge spills over to future research. Of course, with an endogenous process of R&D creation derived from optimising behaviour, the number of inventors (or investors in R&D) will depend on the monopoly rents (patent structure) that can be extracted from innovation, which in turn will also relate to microeconomic parameters such as those attached to preferences (discount factor and elasticity of substitution of consumption over time) and technology (labour or capital share derived from the production function). IRS and externalities can be extended in many ways, with other models incorporating the obsolescence of old intermediate goods as new inventions take place. These 'new Schumpeterian' NGT models may also generate cycles of growth and destruction, for whilst a quick spread of innovation may lead to high productivity increases, it simultaneously undermines the incentive to innovate by shrinking temporary monopoly rents.

The rich portfolio of assumptions, extensions and outcomes, with corresponding mathematical complexity, allow for a huge variety of models, the common feature of which is to deploy some market imperfection to generate increasing returns, and so to generate the growth rate endogenously according to the resources that fuel those increasing returns (although with optimising behaviour, the extent of endogeneity is limited to differences in parameter values

– save more, for example, and you get a higher growth rate, not just a higher output level from a higher capital–labour ratio for a given growth rate). Even so, such models tend to depend upon special assumptions around parameter values, as can be seen by exploring the formal properties of the previously presented NGT models.

Let us do so by putting aside any growth in labour, n = 0, for the purposes of simplicity. If $\varepsilon < 1$, then with a constant number of skills or ideas builders, L_A (necessary for SSBG), the productivity increase from skills or ideas declines to zero over time. This is because the rate of growth of labour productivity is given by:

$$\dot{A}/A = \delta L_A A^{\varepsilon-1}.$$

As a result the model converges to the OGT as the effect of A becomes proportionately negligible over time.

On the other hand, if $\varepsilon > 1$ then it can be shown that the model generates infinite levels of growth within finite time, which is surely implausible! This is because productivity keeps on enhancing the productivity creating process – a bit like a rocket that reduces mass as it burns its fuel and so keeps going faster and faster.

It follows that SSBG can only exist in the case where $\varepsilon = 1$, despite this seemingly being an arbitrary assumption. If, on the other hand, L_A (and L) is allowed to grow, the restrictions on ε have to change. For, in this case, even a value of $\varepsilon = 1$ leads to explosive paths as the natural growth of the economy fuels productivity growth through the increasing returns.

A fourth and important point to be acknowledged, then, is how NGT models rely upon potentially complex and dynamic general equilibrium frameworks. These tend to require strong assumptions and parameter restrictions, at times more arbitrary than those used to establish the existence of SSBG in the Harrod–Domar model.

Fifth, the majority of NGT models share other implications from their mutual reliance upon market imperfections, such as externalities and IRS. The endogenous sources of productivity increase, via imperfections of different sorts, serve both as engines of sustained growth and as sources of inefficiencies. On one hand, the impact of imperfections is felt on the rate of growth, rather than the level of output for a given growth rate. This is because they are deemed to have cumulative and knock-on effects over time. On the other hand, they lead to Pareto inefficiencies whereby the optimal levels of knowledge creation, human capital formation, the saving rate, etc., tend to be below the social optimum.

Other than the conversion from level to growth effects, there is not much 'new' with new endogenous growth theory, as it is simply a theory of technical change in light of the presence of market imperfections (which have long been associated with deadweight losses or gains in partial equilibrium microeconomics). It has been recognised that most of the ideas underpinning endogenous technical change are not new. Rather, they can be traced back to works by classical political economists (e.g. Smith, Ricardo and Schumpeter) and other schools of thought (such as in Kaldor), as well as other social sciences. Nonetheless, the adoption of pre-existing ideas and theories to forge a theory of endogenous growth is achieved only on a piecemeal basis and by stripping off and simplifying original concepts so that they can be accommodated in a framework of methodological individualism and mathematical formalisation. This applies, for example, to models deploying economies of scale and scope, specialisation and agglomeration, and the role of monopoly rents in generating innovation and clusters of innovation. As for market imperfections, as mentioned, these are readily recognised to be microeconomics projected on to long-run macroeconomics, whatever the form, content and motivation are given to the IRS, monopolistic competition, product differentiation, and externalities and inefficiencies that are deployed.

It is, thus, not surprising that many of the criticisms of OGT carry over. First, NGT proceeds as if the use of the one-sector production function, F, is unproblematic. This is simply not the case, as laid out in the counterpart *Microeconomics* volume, in light of what is known as the Cambridge Critique of Capital Theory. OGT was undermined by this but NGT simply overlooks the problems involved. This goes beyond reducing the economy, as if it could be represented by a single sector production function, to setting up capital-like sectors for the production of human capital and R&D, bundling up and representing technical change through the device of treating it like a new factor of production, A (understood as a stock of ideas, knowledge or techniques). This is a transparent treatment of production and productivity through the prism of the technical apparatus and architecture available, not even acknowledging that knowledge cannot be subject to quantification. How do we scale an idea and represent it by a change in A?

Second, the tendency for NGT to be organised around SSBG shares the same problems with OGT. This simply fails to recognise what we know to be the unbalanced nature of growth in practice, although some of this has been accommodated with the appearance of multiple equilibria and more complex dynamics that are possible within NGT.

Third, and related to the previous point, it is not clear what the outcomes of NGT are. Whilst it attempts to refute what it takes to be the (convergence) predictions of OGT, and thereby produces more 'realistic' models in some sense, there is a myriad of models with different assumptions, market and institutional settings, complexities and outcomes where all or nothing can be made to fit. Depending on parameter values, an economy's growth can be explosive or dissipate; government policy may or may not have lasting effects; multiple equilibria may question the uniqueness and stability of a SSBG; and mathematical intractability limits conclusions. Even the slightest generalisations or extensions suffice to allow for different – divergent but also convergent – growth rates, and hence not many testable or tested results have been drawn from NGT models. Such liberality of outcomes is not matched by the methods employed by NGT as it proceeds by narrowing its scope whilst expanding its applicability, not least through commitment to rigorous mathematical modelling of optimising representative individuals.

4.4 Growth Econometrics

Since the 'convergence debate' took off in the 1960s, a profusion of econometric works have emerged in light of NGT, driven by the increasing availability of aggregate data and computing power. This debate has also played an important role in the formation and framing of NGT, both theoretically and in terms of empirical content, not least as to whether convergence or divergence can be contested by the old/new growth theory duo.

Relatively rapidly, empirical investigation of convergence became focused on an evolving study of the evidence in the form of cross-sectional growth regressions at the country level. In what came to be known as Barro-type growth regressions, cross-country growth rates were regressed against initial (log) per capita GDP level. The simple idea was that convergence would mean that countries with a low per capita income would grow faster. As a result, a negative coefficient on regressions of growth on per capita income could be interpreted as supportive of both (absolute) convergence and exogenous growth theory:

$$g_Y = \alpha + \beta \log Y_0 \text{ with } \beta < 0.$$

Evidently such a specification does not account for other factors that affect growth and may differ across countries. Subsequently, so-called conditional convergence became the epicentre of research, with additional variables included in the right-hand side of the equation. Beyond conditional convergence, the inclusion of other variables could identify salient determinants of growth, whilst differentiating among those supported by OGT or those indicative of sources of endogenous growth (such as human capital, R&D expenditure and so on). Accordingly:

$$g_Y = \alpha + \beta \log Y_0 + \gamma X,$$

with X a vector of other exogenous variables, and γ its associated coefficients vector.

However, it is a moot point whether – even with a negative value of β – this would offer a valid test of convergence, for it is consistent with a set of different explanations, such as catching up or structural changes in developing countries. A negative β estimate could also result from solely statistical reasons, such as the phenomenon of regression to the mean. Galston's regression fallacy (which was itself the source of the name for such regression analysis more generally) refers to a situation in which, if countries' growth rates are identically and independently randomly distributed, then if one county's observation is by chance much higher (lower) than expected (than the mean) at one point in time, then it would be expected to be lower (higher) in the next instance (thus growth regressing towards the mean of the distribution). Hence, a negative β coefficient does not necessarily say much about the cross-sectional convergence across countries.

A second problem with Barro-type growth regressions is their lack of robustness and stability. Estimation results on convergence are sensitive both to sample and time frames and to the variables included in X. Add or take away some variables and the regression coefficients can change size and even sign. What is more, the statistical significance of the regressors fluctuates as others are added or omitted. Hence, inference with regard to the convergence proposition, and to the importance of other factors in explaining growth differentials, is at best inconclusive.

Third, and despite the above caveats, this did not stop the expansion of the empirical literature along similar lines, with more than a hundred variables having being tried in different combinations, ranging from education and investment to trade openness, fiscal and monetary variables, corruption and religion, and so on. But with the simple device of adding (or dropping) variables that work (or not), the connection with theory becomes less and less visible until it drops away entirely. Essentially, as previously observed, many theories of endogenous growth could be put forward, drawing upon voluminous causal empirical evidence, reduced past theories, or even invention itself in terms of how skills are derived or research and development is generated or adopted, with mathematical tractability to the fore. In the final case, it is impossible to solve the optimisation problems with more than a few considerations in place. Consequently, the X variables might at most be justified by some model in which they appear more or less individually. Ultimately, even this rationale is no longer necessary, and you simply add into the regression any variable that might be thought to affect growth.

In this way, the Barro-type regressions became theoryless, an exercise in its own right. But the motto of theoryless econometrics ('let the data speak for themselves') brings obstacles not only for its theory-testing capabilities but also because it ignores the fact that data themselves are constructed on theoretical presumptions, and that the econometric approach itself is not entirely theory free (particularly in its pursuit of universal regularities within cross-sectional

settings). At the same time, there are so many degrees of freedom in terms of variable selection (and exclusion) that it is not clear what can be inferred out of these numerous exercises.

To be more specific, first many of the independent variables are highly correlated with one another, which is, to some extent, to be expected since correlates of growth are systematically connected. High co-linearity among independent variables, however, puts strains on the accuracy of individual estimates and on pinning causal (or not) indirect effects on growth. For example, it could be that there is a strong (causal) relationship between investment and the quality of government institutions, and that investment impacts growth via a strong institutional structure. Second, and of greater importance, the core issue of causality remains open. For example, education, investment and R&D expenditure, three of the staple ingredients in the X vector, can be viewed as both sources and consequences of growth. Or more generally, there could be underlying factors (in the error term) that affect both dependent and independent variables. In other words, there is an endogeneity problem that cannot be resolved by statistical tools, and certainly not by Barro-type regressions. Lesser reliance on theoretical grounds, even with advance in econometrical techniques, makes empirical results less convincing and meaningful. There is also the problem of functional form selection, with a linear relation from X to g_Y restricting considerably the understanding of the ways by which explanatory factors affect growth.

All of the above issues have been, to some extent, taken up by more sophisticated econometric approaches, particularly in the form of panel data estimation and a concerted focus on time series analyses – bear in mind, cross-section Barro-type regressions do not distinguish between whether the data represent convergence to SSBG paths or convergence of SSBG paths to one another. This point is made clear in Diagram 4.3. We could, for example, be appearing to converge in the short run across the two countries represented, whereas the convergence is towards long-run SSBG paths for the countries that diverge from one another. The Barro-type regressions would suggest convergence even though this is wrong. At least panel analysis can use cross-country data over time to distinguish between SSBG paths and the adjustments to them, that is, between equilibria or dynamics movements (although the extent to which segmenting time into five or ten year intervals is appropriate for the study of long-run growth is debatable).

Unlike cross-sectional regressions, panel data estimation with country fixed effects can control for country-level specificities, usually identified as exogenous differences in (initial levels of) technology. This is done by allowing for different country intercepts. However, such a parameter vector is more like a black box, including all unobserved factors that are deemed to vary sluggishly over time within each country, whilst also differing between countries. These influences

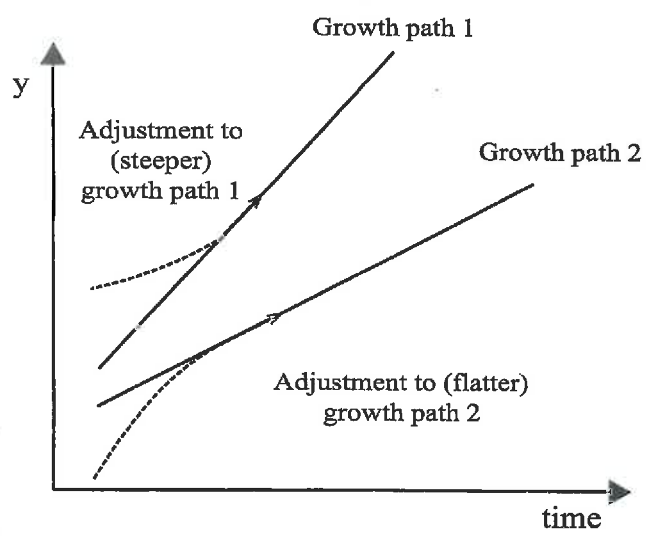

Diagram 4.3 Differences in growth paths and adjustments to growth paths

need not be just technological, but could also be institutional, political and geographical in nature. Estimates of such constant terms are, generally, found to be excessively large from one country to another – a result corroborated by new (panel or time series) TFP estimations. However, the panel estimation's main advantage is also its major drawback. Whilst accounting for unobserved country heterogeneity, it essentially gets rid of the cross-sectional variation, relying almost exclusively on within variation growth (over time within each country). And this is problematic particularly in a growth econometrics context because, first, it impedes the analysis of the effects of growth determinants (such as institutions, geography or policies) which exhibit little or no time variation. And second, unobserved country differences are treated as a nuisance – conveniently assumed rather than explicitly modelled, as in the case of cross-sectional estimations.

Either way, cross-sectional Barro-type regressions are still heavily used, not least for policy recommendation purposes. Conventionally, regressions are run log–log in the variables, and the original (prior to estimation) functional form involved is:

$$Y_t/Y_0 = aY_0^{\beta} X_1^{\gamma_1} X_2^{\gamma_2}...X_k^{\gamma_k}$$

This is a remarkable proposition, vanity even, with the growth history of the world, across all times and places, reduced to a Cobb–Douglas 'production function', incorporating any variable you consider might be relevant to growth

performance. This has had two implications. One is that the parameter estimates can be readily deemed to be appropriate for handling policy trade-offs. For, given the costs of the policy – and some might be deemed to be costless, such as trade liberalisation or lifting of foreign exchange restrictions – the estimated γs give the growth elasticities of the policy parameters. Literally, in some studies, increase the number of telephone lines per population, and growth will go up by so much.

The second implication is that growth theory, which always had its origins and deep roots within the study of developed countries and within the mainstream economics forged in that context, had become universally applicable and so considered relevant, indeed imperative, for the study of developing countries. Such ambition, however, ultimately signalled its death knell, at least in principle. Probing deeper into the results of growth econometrics, first we find that whilst most economies have grown over the past 40 years, growth rates across countries have diverged to an unprecedented extent for all but the richest countries irrespective of initial conditions (thereby casting further doubt on convergence hypotheses). Second, growth across the globe has been poorer between 1980 and 2000 than in the previous two decades and with more dispersion of growth rates (although there have been 'take-offs' for China and India, incorporating two-fifths of the world's population). Third, there have been convergence clubs of nations around growth rates, roughly coinciding with East and South East Asia, South and Central America, and sub-Saharan Africa (in order of declining performance). Fourth, identifying the causes of major take-offs and slumps in growth are of importance. Fifth, policy change and reform can be of considerable significance, as can the more or less favourable response to more general 'shocks'. Sixth, there is a need for country-specific study focusing on historical and institutional context.

Stepping back from these lessons, we can draw three further general conclusions. The first is to reinforce the conclusion that models are liable to collapse the complexity and diversity of the growth experience, partly because of the nature of the beast itself and partly because of the nature of the models, whether by virtue of necessity or by design in light of how theory and modelling have evolved in practice. Second is to observe the inconsistency between the empirical results and the theories from which they derive, ones that are almost universally based upon a dynamic organised around SSBG. Third is the almost unwitting revisiting of older traditions in economics, especially the old development economics, in the sense of seeking out empirical regularities and explanations and precedents for them, even if now on the basis of considerably larger, later and more diverse data sets and more refined statistical techniques. One has to wonder what all the maths and microfoundations provides! By the same token, where is the economic theory as such, if all and sundry are simply to be thrown into the equivalent of a single equation estimate of the world? This is truly the hitchhiker's guide to the universe of growth – literally the question asked of the computer through running millions of regressions.

4.5 Further Thoughts and Readings

It is now almost 30 years since Paul Romer drafted his classic and pioneering paper on NGT. He could not have anticipated the explosion of research that would follow, not least given the modesty of his own research methods. As he confesses in retrospect on whether he was influenced by Schumpeter's notion of creative destruction:

> No, I can honestly say that it has not. Schumpeter coined some wonderful phrases like 'creative destruction' but I did not read any of Schumpeter's work when I was creating my model. As I said, I really worked that model out from a clean sheet of paper. To be honest, the times when I have gone to try to read Schumpeter I have found it tough going. It is really hard to tell what guys like Schumpeter are talking about [*laughter*]. (Snowdon and Vane, 2005: 686)

Even if we reduce the issue of development to (endogenous) growth, contingent upon productivity increase, the resulting energy devoted to explaining it in theoretical and empirical terms has been astonishing. Hundreds of variables have been deployed and millions of regressions have been run. They offered the promise of results that could be used for economic and social engineering, not least with the idea that growth is the key to poverty reduction, a central plank of World Bank perspectives policy itself best served through neoliberal nostrums.

Such ambitions have not been realised in practice. Nonetheless, the trajectory of growth theory has been part and parcel of the evolution of macroeconomics over and above its own contribution to understanding the macroeconomy, since it helped to establish technical, conceptual and empirical methods. One, generally unobserved, characteristic of the OGT is its disregard for its empirical implications where they do not suit. For example, above the SSBG path, during a boom of higher than normal growth rates because of higher than normal capital accumulation, it is anticipated that wages would be relatively higher and profits relatively lower due to diminishing marginal products and constant returns to scale. This might be thought to be the opposite of the case, as is centring analysis on SSBG more generally. And, apart from doing macro without money and finance and legitimising the detaching of the long from the short run, as observed in Section 4.1, OGT offered the earliest, although not the fullest, reliance upon microeconomics as the foundation for macroeconomics. In doing so, it also allowed for a theory of distribution (itself fundamentally flawed in light of the capital theory critique of the one-sector production function, see the counterpart *Microeconomics* volume), in which wages as the marginal product

of labour and profit as the marginal product of capital complemented their use in measuring the contribution of the growth of factor inputs to the output (to allow for TFP to be calculated as the residual). Such starting points for determining distribution subsequently underpinned the use of intertemporal optimisation techniques for both saving and investment within growth theory itself, and ultimately RBC theory and dynamic stochastic general equilibrium (DSGE), although the OGT was more parametrically based for specifying saving functions and labour supply. Ultimately, though, as it went into decline whilst seeking pastures new, the OGT fully adopted intertemporal optimisation not least, for example, by responding to the oil crises of the 1970s, by doing so in the context of exhaustible resources.

Significantly, despite these continuities between old and new growth theory, and between each of them and macroeconomics as it was to become in terms of reduction to microeconomic principles and more or less perfectly working markets (see later Chapters 8–10), OGT was considerably more restrained in its claims. Robert Solow, for example, its leading proponent, is highly critical of NGT. In part, this is because it is misrepresented in being seen as failing to put forward a theory of technical change and in predicting convergence. On the contrary, the OGT considered that its framing was incapable of explaining technical change at the macroeconomic level precisely because of its dependence upon country-wide specific factors that could not be reduced to the economic. Further, there has been very little that is new in the NGT, with many of its ideas previously known to, and even presented by, old growth theorists. But these were primarily and appropriately seen as microeconomic and not to be extrapolated to the economy as a whole, quite apart from relying upon highly restrictive assumptions more driven by the requirements of the modelling than any rationale derived from realism.

As a result, Solow's OGT was deliberately self-contained in its purpose, leaving space for other methods and theories to address (short-run) macroeconomics and explanations for technical change. Despite providing the foundations for wider application of its microeconomic methods, as an old-fashioned Keynesian, Solow has been scathing about the consequences, describing the preoccupations of DSGE in the following terms:

> Suppose someone sits down where you are sitting right now and announces to me that he is Napoleon Bonaparte. The last thing I want to do with him is to get involved in a technical discussion on cavalry tactics at the Battle of Austerlitz. If I do that, I'm getting tacitly drawn into the game that he is Napoleon Bonaparte. (Klamer 1984: 146)

As for NGT itself, it is characterised by some peculiar anomalies not already covered. One is the total absence of price theory, even though the market sits in the background allocating resources and generating endogenous growth. Whilst the setting of prices might be deemed to be implicit as for OGT, this is problematic in the presence of IRS unless these are totally discounted from all of the optimising behaviour of individuals. This, then, raises a different problem – the presence of externalities, social IRS or whatever last indefinitely (the long run) and are never realised or addressed by optimising agents (despite being known by economists and with rational expectations already well on the horizon). Such inconveniences are not allowed to get in the way of modelling and estimation where rigour is presumed to reign supreme.

For an excellent review of NGT, from within its own perspective, see Aghion and Howitt (1998), where the models of Lucas, Romer and others, are also analysed. For critical overviews, see Fine (2000) and Kenny and Williams (2001). For OGT, see Sen (1970). Solow (2006) offers a sample of his views on the NGT. For the difficulties associated with increasing returns for the mainstream, see Arrow (2000). Reviews of growth econometrics can be found in Durlauf et al. (2005) and Islam (2003). For the reductionism of Barro-type regressions to a Cobb–Douglas function and the highly defective implications of ignoring non-linearities see Rodriguez (2006). Sala-i-Martin (1997) ran millions of such regressions. A rebirth of interest in growth, and yet another revival of old doctrines, is currently taking place in response to the global financial crisis, where vivid discussions about secular stagnation are taking place (and sometimes attached and combined with issues of growing inequality), and the first formal models are being produced. For a review on this, see Backhouse and Boianovski (2015).

5
The Keynesian Revolutions

5.1 Overview

In the immediate post-war period, Keynesianism rapidly came to the fore within economics, forging a significant relative supremacy over an increasingly standardised microeconomics, although both progressed in intellectual prominence in absolute terms. Equally, both were subject to representation in mathematical form. Initially, as covered in Section 5.2, the IS/LM interpretation of Keynesianism, or the neoclassical synthesis, rapidly achieved a near monopoly of macroeconomics. This is despite its considerable departures from the economics of Keynes.

To some degree, increasingly throughout the 1960s, these misinterpretations were in part the point of departure for a critical reinterpretation of Keynes in what was variously known as the reappraisal of Keynes, or fixed price, quantity-adjusting or rationing models. However, in many respects, as shown in Section 5.3, despite some correction of interpretation of Keynes over the neoclassical synthesis, the reappraisal had the effect of introducing even more anomalies in interpreting Keynes (and the macroeconomy) than it had corrected. Indeed, paradoxically it played some role in smoothing the transition from Keynesianism to extreme forms of monetarism and a subsequent Keynesian response that fell far short even of the erstwhile IS/LM framework with the emergence of new Keynesianism and the NCM (see Chapter 10).

5.2 IS/LM as Neoclassical Synthesis

Whilst it is more or less uncontroversial that there was a Keynesian revolution in the 1930s in response to the Great Depression, with a corresponding intellectual revolution and more in the post-war period, the exact nature and significance of that revolution is hard to pin down and controversial, possibly more so in the wake of the monetarist revolution and the rise of neoliberalism since the breakdown of the post-war boom into stagflation in the 1970s. The picture has been muddied even more both by what is termed the new Keynesian response to monetarism – the compromises around what is termed the New Consensus Macroeconomics (NCM) – and the bewildering disruption of of a much more inductive approach to the systemic properties of the particular economy under consideration. This is exactly what you will find across many analyses within political economy, whether dealing with particular economies or the global economy, with corresponding contributions both from heterodox economists and other social scientists who contribute the necessary interdisciplinarity. These contributions are as plentiful as they are fiercely contested, but they simply do not go by the name of macroeconomics.

13.2 Further Thoughts and Readings

If you have made your way to this point, you may wish to revisit Chapter 1, where its guiding threads will carry more meaning in retrospect. On the radical uncertainty attached to financialisation, see Fine (2013). For a summary of the political economy of (lack of) reregulation, see Christophers (2014).

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