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Joan Robinson: early endogenous growth theorist

Christine Oughton and Damian Tobin*

We start from Robinson's article on Harrod's Dynamic Economics and her criticism that technological change was exogenous: 'in Mr. Harrod's world, technical progress falls like the gentle dew from heaven and is not susceptible to any economic influence'. Throughout her work she highlighted the endogenous sources of technological progress and growth and pre-empted both the National Systems of Innovation (NSI) literature and New Growth Theory (NGT), where the latter (NGT) appears to be neither new, nor able to explain innovation, growth and convergence trajectories. We also show that the productivity slowdown in advanced economies is explained by a fall in the wage share, a drop in the rate of accumulation of capital and prioritisation of incentives for R&D over policy instruments to diffuse innovation. While for developing economies, the failure of neoclassical economics to resolve the paradox of promoting market incentives for diffusion, while protecting intellectual property rights, implies an inevitable slowing of convergence.

Key words: Joan Robinson, Technical progress, Innovation, Growth, Convergence, Development
JEL classifications: B0, D33, O1

1. Introduction

In 1949 Joan Robinson published an article on *Mr Harrod's Dynamics* criticising it for assuming that technological change was exogenous. Robinson argued that 'in Mr. Harrod's world, technical progress falls like the gentle dew from heaven and is not susceptible to any economic influence' (Robinson, 1949, p. 84). Over time, Robinson's 'gentle dew from heaven' became 'manna from heaven' losing the irony of her original depiction of technical change as a gentle process. Nevertheless, to this day, her critique continues to focus attention on the need for an endogenous theory of technical progress better able to predict and explain the salient features of economic development across nations.

Robinson was acutely aware that technical progress was neither gentle nor exogenous. She understood that technical progress is created endogenously within the economic

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system and typically entails disruptive transformation and change.[1] Her own analysis and critique of the 'the anarchy of unplanned growth' was summarised in a lecture at Barnard College in 1976 that draws together many of her ideas,[2] while the idea of endogenous technological change forms a central theme that runs through her research.

Revisiting her work, it is evident that Joan Robinson was an early endogenous growth theorist utilising both an analytical core (including her concept of a *golden age*) and a wider systems approach to understand technological change and accumulation as processes that take place in historical time. While much has been written on the Cambridge Capital Controversies and her critique of the Solow model, far less attention has been paid to her own contribution to the endogenous determinants of technological change, distribution, and growth. The focus on her critique of neoclassical growth theory has tended to obscure her alternative analysis of growth as an endogenous process occurring in a systems context over time. Her advocacy of a systems approach to understanding the sources of technological change and accumulation can be viewed as a precursor to the National Systems of Innovation (NSI) approach of Freeman (1987, 1995), Dosi *et al.* (1988), Nelson (1993), Freeman and Soete (1997), Lundvall (2010) and the NSI school. We find striking similarities in method, scope and analysis which suggest that Robinson was ahead of her time in terms of her analysis of technical change in both her theoretical and empirical work. We also argue that her work in this area provides a critique of NGT (Aghion *et al.*, 2021) that is just as compelling as her critique of Solow's model in relation to determining growth and income distribution. Finally, we show how Robinson's analysis can be used to shed light on key contemporary problems such as the failure to achieve convergence in per capita incomes across countries, the slowdown in productivity in the USA and inequality.

The remainder of this paper is organised as follows. In the following section we provide a reappraisal of the analytical core of Robinson's work, which combines equilibrium and historical analysis centred around her concept of a *golden age*, and show that it influenced the development of both neoclassical and non-neoclassical endogenous growth theory. We further show that she used a broad systems approach to analyse technical progress and growth in historical time and draw out similarities with the NSI approach and Freeman's (2019) 'reasoned history' method. In section 3 we use Robinson's insights to critically appraise neoclassical endogenous growth theory and the related NGT of Philippon (2019), Bloom *et al.* (2020) and Aghion *et al.* (2021), while section 4 focuses on the application of different types of endogenous growth theory to the question of convergence in per capita incomes over time. The final section considers the implications of our analysis for economic policy and future research.

2. Accumulation and growth, endogenous technical progress, systems and dynamics

In this section we set out the analytical core that runs through Robinson's work from her 1937–38 paper on the classification of inventions, to the *Accumulation of Capital*

[1] In 1943, Robinson had reviewed Schumpeter's *Capitalism, Socialism and Democracy* for the *Economic Journal*. Her review of Schumpeter (1942) and her 1949 *Economic Journal* article on Harrod's Dynamics appear back to back in Volume II of her *Collected Economic Papers* (Robinson, 1980C).

[2] p. 127 Volume V of *Collected Economic Papers* (Robinson, 1980D) and p. 8 Challenge, May June 1976. Barnard College, New York, was established in 1889 for women as they were excluded from Columbia University. It retains its identity and purpose and now has a formal partnership with Columbia University.

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(*AoC*, 1956) and subsequent work on economic systems and history versus equilibrium. We show that her work on accumulation and growth led to the development of three important strands of literature: neoclassical endogenous growth theory, non-neoclassical endogenous growth theory and the analysis of national economic systems in historical time within a systems context.

2.1 Robinson's early work on inventions and labour productivity

Robinson's (1937 and 1937–38) work on technical change was inspired by a desire to extend Keynes's *General Theory* into the long run. In her *Essays in the Theory of Employment* (1937) and her 1938–39 article she looked at the effect of inventions on long-run equilibrium growth using the concept of Hicks and Harrod neutrality. She showed that a Harrod neutral invention that leaves the capital-output ratio unchanged at a constant rate of interest, raises the efficiency of labour, but leaves the distribution of income between wages and profits unchanged (Robinson, 1937–38).[3] In *AoC*, Robinson (1956) continued her quest to extend Keynes' analysis into the long run. Influenced by Sraffa's introduction to Ricardo's *Principles*, she recognised in her 1956 *Preface* that consideration of economic growth and the long-run development of the economy, together with related questions of distribution and technological change represented a revival of classical theory and a move away from a static theory of relative prices and value. At the same time, she introduced the concept of a (mythical) *golden age*, which bears similarities with Harrod's concept of steady state growth characterised by full employment of capital and labour. She utilised Harrod's concept of neutral technical progress, to define a *golden age* (an equilibrium growth path) which also served as a launch pad for her own dynamic analysis introducing and interweaving several strands of her work on endogenous growth theory. Harrod (1939 and 1948) set out two rates of growth in addition to the actual rate of growth, g, namely, the warranted rate of growth, g_w which ensures full employment of capital ($g_w = s/v$ where s is the savings ratio and v is the capital-output ratio), and the natural rate of growth, g_n ($g_n = n + t$ where n = the rate of growth of the labour force and t represents technical progress) which ensures full employment of labour. He noted that there is no inherent tendency for these two rates to coincide or to equal the actual rate of growth of the economy, indeed he saw steady state growth as a knife edge from which it was easy to tip into unemployment or inflation.

In Robinson's *golden age*, with Harrod neutral technical progress, free competition, a growing population, and $g_w = g_n$, the rate of profit is constant and wages rise in line with productivity. In her (1949, p. 169) review of Harrod's *Economic Dynamics*, Robinson considers the case where the natural rate of growth exceeds the warranted rate *and* technical progress is reducing the need for labour, giving rise to unemployment, which she termed Marxian unemployment to distinguish it from the Keynesian variety arising from deficient effective demand. Robinson was clearly influenced both by Keynes' analysis of unemployment, and by Marx's analysis of the role of the reserve army of labour in restraining wages (Alves, 2022, p. 259). When applied to technological change, she argued that the failure of wages to rise in line with productivity growth acts as a drag on effective demand and lowers growth and the rate of investment in new technology.

[3] This analysis was later used by Uzawa (1961) in his paper on labour augmenting technical change and his (1965) paper on endogenous growth.

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Her work differs from Harrod's in important respects, not least in the fact that she analysed out of steady state behaviour. In addition, while Harrod's main objective was to provide a toolkit for dynamic analysis, Robinson's aim was to use her concept of a mythical *golden age* as a reference point from which to consider what might happen to growth and development when the warranted rate and the natural rate are not equal and technical progress is endogenous. The clearest statement of this is found in Book II of the *AoC*, which King (2016) regards as its analytical core, where Robinson argues that technical progress should be treated as an endogenous variable capable of being influenced by the wage rate (income distribution) and labour supply:

> But at the same time technical progress is being speeded up to keep step with accumulation. The rate of progress is not a natural phenomenon that falls like the gentle rain from heaven. When there is an economic motive for raising output per man the entrepreneurs seek out inventions and improvements. Even more important than speeding up discoveries is the speeding up of the rate at which innovations are diffused. When entrepreneurs find themselves in a situation where potential markets are expanding but labour hard to find, they have every motive to increase productivity; and the experience of wage rates rising with output overcomes the reluctance of the workers to assist them to do so. In short, the capitalist rules of the game produce the most flourishing results when the available supply of labour is tending to shrink (population is increasing little, if at all, and hours of work are falling) and the available supply of capital tending to grow, so that a rise in real wages (due to scarcity of labour) is constantly threatening a fall in the rate of profit, which technical progress is constantly fending off. In these conditions the economy is most highly productive (though not necessarily most agreeable in other ways). (Robinson, 1956, pp. 96–97)

She relates her concept of a *golden age* where technical progress and the rate of growth of labour supply are given exogenously by nature to Harrod's $g = g_w = g_n$ equilibrium path,[4]

> If we conceive the rate of technical progress and the rate of growth of population as given by nature then we may say that the golden age appropriate to the given conditions represents a state of economic bliss, since consumption is then increasing at the maximum technically feasible rate which is compatible with maintaining that rate of increase.[1]" [And in footnote 1 she adds] "In the language of Mr Harrod's Towards a Dynamic Economy the natural, the warranted and the actual rate of growth are all equal." (Robinson, 1956, pp. 99–100).

But she quickly goes on to consider what happens when the stringent conditions necessary for a *golden age* are not met and growth is determined endogenously by technical progress and diffusion associated with accumulation spurred on by competition and higher wage rates:

> But this [a *golden age*] is not a very enlightening way of looking at the matter, for technical progress is not a natural phenomenon, and there is no limit to human ingenuity. Whatever rate of progress is being maintained, in a golden age, it would always be possible to progress faster. If the rate of accumulation were speeded up (or the rate of growth of population were to decline, or the available supply of labour to be reduced by shortening hours, while accumulation went on as fast) the pressure of scarcity of labour, driving up wage rates, would induce more inventions to be made and hasten the diffusion of improvements already known, so that the level of real wages would rise all the faster. The limit to the rate of growth of wealth, over the long run, is set

[4] Pasinetti (1962 and 1981) assimilated and formalised features of Keynesian and classical growth in a multi-sectoral framework to consider the dynamics of uneven development associated with different rates of labour productivity growth across sectors, though he assumed the rate of change of labour coefficients was given exogenously. Pasinetti identified a dynamic natural equilibrium (akin to a *golden age* with productivity growing at a uniform rate across sectors) but the clear implication of his analysis is that the system is prone to economic crises which will arise unless adjustments to new production and demand conditions take place smoothly and continuously.

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not by technical boundaries but by the lethargy which develops when the goad of competition and rising wage rates is blunted. Robinson (1956 pp. 99–100).

For Robinson, the mythical concept of a *golden age* was a platform from which to consider out of equilibrium dynamics and endogenous behaviour that may affect the actual rate of growth: history vs. equilibrium.

She elaborated further on these ideas in her 1963 *Essays in the Theory of Economic Growth (ETEG)* and her 1974 *History vs. Equilibrium* paper. She paid particular attention to the influence of the wage rate as a determinant of technical change having rejected the marginal productivity theory of distribution as a tautology based on circular reasoning. An argument that was reinforced later by Sraffa (1960) when he showed that the wage rate and distribution of income were determined outside of the technical conditions of production. This marks a major distinction between neoclassical and non-neoclassical endogenous growth theory (see, e.g. Bhaduri, 2006).

2.2 The development of neoclassical and non-neoclassical endogenous growth theory

While Robinson's 'manna from heaven' critique of exogenous growth models is widely cited, the significant body of her work dealing with endogenous growth has received less attention. Yet, the concluding paragraphs of her 1949 article set out three determinants of the rate of technological progress: (i) the wage rate or distribution of income; (ii) the diffusion of new techniques from leading to lagging firms; and (iii) the rate of scientific discovery. Moreover, she makes plain that both the rate of scientific discovery (invention) and the rate of diffusion are susceptible to being 'directed and speeded up' by appropriate policies (Robinson, 1949, p. 85).

These ideas were revisited and further developed in *AoC* where she describes the resources and endowments of a nation state as follows:

> Its labour power consists in the brain, muscle and diligence of its citizens; its capital in natural resources, training and education, and physical goods; its organisation is partly directed consciously by accepted authorities and partly emerges from the operation of the rules of the game. Robinson (1956, pp. 33–34).

For Robinson, a nation's endowments of capital and labour (human capital) are not given exogenously but created by the economic system, or rather the system of political economy combining economics, politics, and institutions. Education and training enhance the capabilities of the labour force and are under the control of government and industry, 'The educational system in a modern economy (even in the USSR) is devoted to providing the required numbers both of experts for the technostructure and of operatives who are taught to think of themselves as too stupid to master technology, though they are allowed the necessary training required for productive work' (Robinson, 1974, p. 40).

Despite Robinson's (1949) critique of technological change falling like 'manna from heaven', exogenous technical change remained a mainstay of neoclassical growth theory until Uzawa's (1961 and 1965) papers led to the formalisation of an endogenous growth model[5] using Robinson's analysis of Harrod neutral technical change and her result that at a constant rate of interest a Harrod neutral invention raises the efficiency of labour but leaves the capital-output ratio, the rate of profit and factor shares unchanged. Uzawa (1961) used Robinson's theorem and assumed the efficiency of labour would grow at

[5] We are grateful to an anonymous referee for this point.

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an exogenous rate $A(t)L(t)$, where A is the efficiency of labour, t is time and L is labour supply. He subsequently (Uzawa, 1965) extended this to a two-sector endogenous growth model where, 'various activities in the form of education, health, construction, and maintenance of public goods, etc., which result in an improvement in labour efficiency, $A(t)$, are put together as one sector, to be referred to as the education sector' (p. 18/19) which generates improvements in labour productivity in the whole economy. This is often referred to as the Uzawa-Lucas model (see Barnett and Ghosh, 2014), but it has its roots in Robinson's analysis. A similar approach was taken by Lucas (1988) where the education sector gives rise to positive externalities associated with human capital accumulation and growth. Romer (1986) set out a similar neoclassical endogenous growth model where growth springs from investment in knowledge. New knowledge creation is subject to diminishing returns but positive externalities arise from knowledge spillovers that lead to increasing returns and endogenous growth. However, these models generally stick with the neoclassical assumptions of competitive markets and the marginal productivity theory of distribution (Romer, 1994) so the wage is tied (an approach rejected by Robinson). They also assume that 'patent escape' is *fixed* at some positive rate in contrast to Robinson's treatment of patents as part of the capitalist rules of the game. Hence the models overlook a central tenet of Robinson's argument, that the rate of technical change could be directed and speeded up, with appropriate policies and changes in patent law, employment laws, education and training.

Robinson's (1956) *paradox of patents* embodies the idea that patents act as a spur to invention and a brake on diffusion with their combined impact on technical progress dependent on the specificities of the invention and its subsequent diffusion,

> The justification of the patent system is that by slowing down the diffusion of technical progress it ensures that there will be more progress to diffuse. … Since it is rooted in a contradiction, there can be no such thing as an ideally beneficial patent system, and it is bound to produce negative results in particular instances, impeding progress unnecessarily, even if its general effect is favourable on balance. Robinson (1956, p. 85).

Finally, it's important to note that while Robinson identified the conditions necessary to achieve a *golden age* in *AoC* and *ETEG* her interest in out of equilibrium (out of *golden age*) behaviour led her to introduce history into the picture—a theme that runs through her work and is articulated most clearly in her *History vs. Equilibrium* paper (1974)—along with political economy, or what she termed the capitalist rules of the game. For example, her discussion of patents and diffusion in *AoC* shows deep understanding of how laws and institutions affect accumulation and growth. In addition to the distribution of income and endogenous technical change, Robinson was open to considering political influences on economic growth, as well as the role of uncertainty and Keynesian animal spirits, recognising that neither could be easily integrated into a formal dynamic model.

2.3 Non-neoclassical endogenous growth theory

Bhaduri (2006) developed a new approach to endogenous growth à la Robinson where labour productivity growth is determined endogenously via conflict over the distribution of income between wages and profits, so that the wage rate becomes an endogenous determinant of the rate of growth, alongside effective demand. In this approach the 'adoption and diffusion of the rate of technical progress becomes an outcome of a complex race between the growth rates in the real wage and, in labour productivity' (Bhaduri, 2006, p. 81). This illustrates why labour productivity must rise in order for

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the share of wages to remain constant over time and in policy terms illuminates the misguided nature of flexible labour markets as a means of keeping the wage level low (Bhaduri, 2006). A higher wage makes a more rather than less mechanised technique preferable for the entrepreneur (Robinson, 1956, p. 130). That does not rule out the possibility of higher wages without higher productivity, conditional on a low rate of accumulation, but under competitive conditions, or moderately competitive conditions, higher productivity would not be possible without higher wages (Bhaduri, 2006).

In the following section we show how NGT continues to miss this relationship, by not fully appreciating that patents cut both ways (Robinson's patents paradox) and by ignoring the relationship between diffusion and real wages. NGT also misses what Bhaduri and Marglin (1990) describe as the two-sided role of wages in industrial capitalism where higher wages increase manufacturing costs but also stimulate demand via workers' increased purchasing power. In section 4 we point to evidence from the patent system to show that it has been used by rich countries to prevent diffusion via intellectual monopoly capitalism (Pagano, 2014). This suggests that the problem is not necessarily one of a drying up of ideas, but rather a deliberate slowdown in the rate of diffusion.

It is evident that throughout her work, Robinson consistently treated technical progress as an endogenous variable influenced *inter alia* by: human capital (1956); education and training (1956, 1976); the rate of scientific discovery (1949, 1956); the diffusion of new techniques from leading to lagging firms (1949, 1956); finance (1974/1980A, p. 41); policies designed to speed up scientific discovery and diffusion (1949, 1956); the wage rate or distribution of income (1949, p. 85 and 1980B, p. xi); the degree of competition (1956, p. 100); policies on patents and IPR (1956, pp. 85–86), institutions or the rules of the game (1956, pp. 85–86); industrial policy and planning (1949, p. 85). Her work led to the development of neoclassical endogenous growth theory [Uzawa (1965) building on his 1961 article, which in turn influenced Lucas (1988) and Romer (1986)], and to non-neoclassical growth theory, for example, Bhaduri (2006). In addition, her analysis of accumulation outside of a *golden age*, occurring in a system comprising firms, education and government, where investment and diffusion of technology take place in historical rather than logical time, shares key elements of the systems of innovation approach which we discuss below.

2.4 Evolution of technology in historical time, 'reasoned history' and systems analysis

Robinson's criticism of neoclassical economics' failure to treat time and dynamics in a meaningful way will no doubt be remembered by those who attended her lectures where she described time as an axis going back through the blackboard, 'On a two-dimensional diagram, time lies at right angles to the plane on which the diagram is drawn …. To find a new equilibrium (if there is one) we have to fill in the whole story about the behaviour of the economy when it is out of equilibrium', Robinson (1974/1980B, p. 52). Her combination of logical and historical analysis chimes with Freeman's (2019) idea of 'reasoned history' that has three key properties: (i) the ability to explain the main features of long-run growth for countries or regions that are catching up, falling behind or forging ahead; (ii) the ability to identify patterns and generalisations; and (iii) provision of a framework for analysis and testing of generalisations against empirical data and new historical evidence. Freeman's last point is not unlike Robinson's view that, history while important, 'can never give a final knockdown answer to any question', (1974/1980B, p. 118). The process of testing

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generalisations against historical data and stylised facts is a continuous one that differs across time and space.

It is possible to identify three interrelated strands of Robinson's analysis. First, in her discussion of economic dynamics, accumulation and technological change she identifies a distinct set of variables that influence the rate of technological progress: technical progress is clearly endogenous. Second, much of her methodological approach to studying endogenous technological progress is grounded in dynamic analysis set in *historical* time. This is expressed most clearly in her 1974 paper on *History vs. Equilibrium* but its roots can be traced to *AoC*. In her 1974 paper she argues that if economics is to provide meaningful analysis of contemporary economic problems, then its methodological approach must allow analysis of the evolution of the institutional 'rules of the game'. Third, in a number of her papers she argues that economics should be studied within a systems framework with politics/policy actors and instruments included as part of the system,

> I believe that the proper subject matter of economics is an examination of the manner of operation of various economic systems, particularly our own, and as long as our economy system continues to survive, a clear-sighted examination of it is more likely to favour radical views than to support the defenders of the status quo. Robinson (1974/1980A, pp. 118–119).

In this context, it is evident that she believed the economic system encompassed economics and politics and that it is impossible to isolate one from the other. The clearest statement of this is found in Robinson (1949) in her discussion of the use of policies to speed up the rate of scientific discovery,

> All of this goes very much against Mr. Harrod's grain, because to discuss either the distribution of income or measures to increase useful investment brings politics into the economic argument. But his is no way to keep politics out. His resolution to avoid these questions is itself a political decision. (Robinson, 1949, p. 85)

Her view that economic questions were best studied using a broad systems approach encompassing economics and politics may have stemmed from her reading of List, (1841) whose book,[6] *The National System of Political Economy* clearly influenced her own work on the role of trade, protectionism and industrial policy in economic development (Robinson, 1962, 1974)—arguments that were taken up by Freeman (1987) and Chang (2002) which still have resonance today. Freeman (1995) cited List's systems analysis of 'mental capital', science and education as a major influence on his own work on developing the National Systems of Innovation (NSI) approach, naming List as the first NSI theorist who considered that invention, technical progress and development were determined by the interaction of socio-economic processes and government policies.

We argue that Robinson's work can also be viewed in this vein, indeed her work bears many of the hallmarks and elements of NSI. As discussed above, in terms of the influences on invention and diffusion of innovations, Robinson considered many of the component elements of the NSI approach as central to technical progress and growth. Her research was also influenced by Veblen's evolutionary approach (see Robinson, 1974) and there are many passages in her work that fit almost exactly with the NSI approach being developed by Freeman, Lundvall and Nelson towards the end of her life. In what was probably her last journal article, she wrote, 'the evolution of technology is

[6] Robinson approvingly cited Marshall's characterisation of List as a 'briliant genius' (Robinson, 1962. p. 60).

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the most important of all aspects of capitalist development' (Bhaduri and Robinson, 1980 p. 111).

In summary, we argue that Robinson can be viewed as an early endogenous growth and systems theorist. Her analysis of technical progress and economic growth arising as outcomes of an endogenous process within an evolving political-economic system was, in many ways, ahead of its time. The fact that many of her ideas have taken form and structure within the NSI approach shows the relevance of Robinson's work today. In the following section we consider how Robinson's contribution and that of the NSI continues to provide a telling critical appraisal of neoclassical endogenous growth theory and NGT.

3. Robinson, endogenous growth theory and new growth theory

While Robinson's critique of Solow and Samuelson's neoclassical growth theory did not signal the end of the aggregate production function or the marginal productivity theory of distribution, Robinson's 'manna from heaven' critique did lead to a search for endogenous sources of growth within both neoclassical theory and alternative approaches. As discussed above, there are strong similarities between Robinson's endogenous approach to understanding technical progress as an historical process taking place in a systems context, and the NSI school. Neoclassical endogenous growth theory followed a different path seeking to incorporate endogenous determinants of technical progress while preserving their underlying assumptions of profit maximising firms, operating in ahistorical time, largely divorced from the wider system of political economy in which they operate. Usawa (1965) and Lucas (1988), as well as Arrow (1962) and Romer's (1986) analysis of external increasing returns, provide notable contributions to neoclassical endogenous growth theory. They preserve the idea of equilibrium (or saddle path) stable growth and assume that human capital is created by the education sector or that knowledge is created within firms (or by lone inventors) with positive externalities, but the idea of pro-active co-creation of knowledge between the education sector, government (via investment in R&D), public research institutes, firms and employees is largely missing. This point is recognised by Romer (1994, pp. 20–21) who criticises his own early work, arguing for greater use of historical data/evidence and examination of the institutional arrangements that facilitate the production and use of knowledge in order to understand why there is not convergence across countries. However, he stops short of advocating analysis of technological change within a NSI systems perspective that breaks with the neoclassical tradition in relation to the underlying model of the firm and methodology.

Aghion *et al.* (2021) take on board Romer's (1994) suggestions and go further to present a new paradigm that views growth as a disequilibrium process characterised by 'economic upheaval' based loosely on Schumpeter's concept of creative destruction. Their aim has resonance with Robinson's (1962/1974, p. 124) point that we need to consider what purpose growth serves—the difference between planned and unplanned growth, between growth that meets the needs of society, for example, health and education, and growth that meets narrower private interests.

However, Aghion *et al.*'s (2021) analysis falls short in important respects. Firstly, it is not obvious that they have created a new paradigm. Significant work, including by Robinson, has been undertaken on the three main purposes of their book (Aghion *et al.*, 2021, p. 1) to

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(i) 'Penetrate some of the great historical enigmas associated with the process of world growth';
(ii) 'Revisit the great debates over innovation and growth in developed nations';
(iii) 'Rethink the role of state and civil society' and the joint role they play in innovation and growth.

The book does not contain a single reference to the NSI approach, which draws extensively on Schumpeter's evolutionary analysis and has been used to address the three issues posed above for over 40 years. If we focus on some of the detail under the main objects of their study, we see that it includes analysis of secular stagnation, a topic on which Robinson wrote extensively, highlighting the need to increase the wage rate in a growing economy to maintain the share of wages, at least, at a constant level, in order to provide a spur to innovation and to ensure that consumption keeps pace with growth in output. Aghion *et al.* (2021) analyse the wage share and show that it has fallen in the USA since 2000 and in the UK and France since 1980, but they do not focus on its impact on the rate of innovation and growth. In their analysis, the wage rate is determined by innovation (the technical conditions of production—something rejected by Robinson and Sraffa 60 years ago) but it is not a determinant of innovation and growth.

Secondly, at the heart of Aghion *et al.*'s analysis lies a neoclassical model of the firm responding to profit incentives, so their analysis comes down very much in favour of a strong patents regime as a driver of innovation. However, it ignores the complexities considered by Robinson's (1956) analysis of the paradox of patents: that invention is sped up by slowing down diffusion, yet most of the benefits to society come from the diffusion of innovation rather than invention. Since Robinson's time, property rights have been extended under international law with the introduction of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) in the 1990s and, as we discuss below how this is arguably an important factor inhibiting convergence between low, middle and high-income countries (see Figure 1) that is not fully considered by Aghion *et al.* (2021).

Thirdly, and related to the above point on patents and the nature of the firm, Aghion *et al.* seem to misread Schumpeter's analysis of the role of large firms in driving innovation and technical progress by internalising R&D. For Schumpeter (1942) this is one of the key factors that undermines capitalism and has been summarised by Robinson (1943) as follows:

> Above all technical development leads to the obsolescence of the entrepreneurial function. With growth of big business and of experimental science innovation itself is reduced to routine, and the entrepreneur sinks into a bureaucrat. Robinson (1943, pp. 382–383).

Aghion *et al.*'s focus on patents also ignores important historical evidence on the other side of the scale. For example, The Netherlands and Switzerland industrialised rapidly between 1869–1912 and 1850–1907 respectively, having abolished their national patents policies (see Schiff, 1971).

In summary, NGT is not that new in that it covers many of the points analysed by Robinson and the NSI school since 1949. It is good that they have taken many of her points on board, but weaknesses remain in their interpretation of Schumpeter and more fundamentally in their model of the firm and patents.

A second strand of the new growth literature has attributed the slowdown in productivity growth in the USA and other major economies since the 1970s (Gordon,

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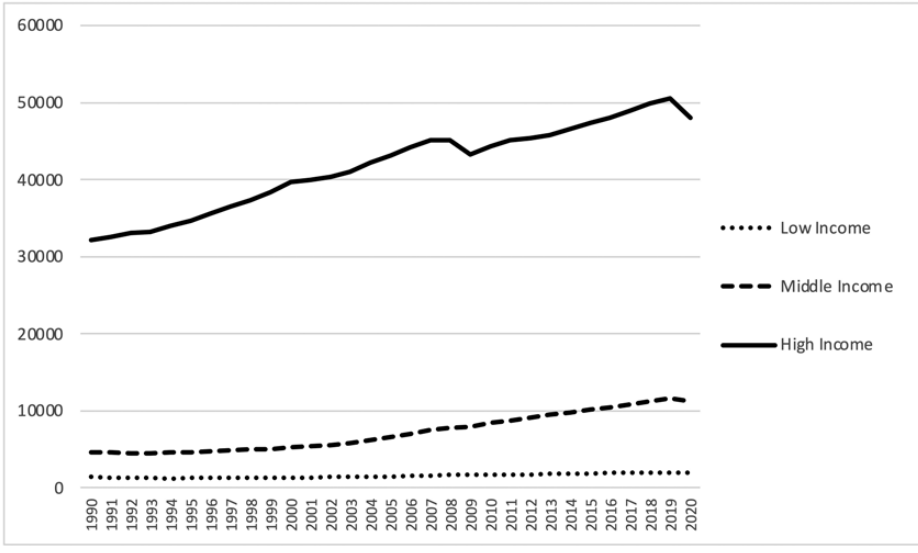


Fig. 1. *GDP per capita (measured in constant 2017 International $ at PPP).*

Source: Data on GDP per capita are from the World Bank Database.

2016) to the drying up of innovation and ideas and a decline in business dynamism (Philippon, 2019; Bloom *et al.*, 2020). In linking research productivity slowdown to ideas generation, Bloom *et al.* (2020) build on Solow's (1957) attempt to measure the contribution of technical change to growth. Their conclusions indicate that future avenues of research might find it fruitful to look at semi-endogenous growth models in explaining declining productivity. The implications of semi-endogenous growth are that research effort must run twice as fast to stand still, otherwise growth would slow because of declining marginal productivity based on the intuition that follow-on R&D delivers fewer innovations. Using this type of model Akcigit and Kerr (2018) introduce heterogeneity into the innovation process to distinguish between internal and external innovations where new entrants do not have existing innovations to build on whereas incumbents build on existing innovations. Like Bloom *et al.* (2020) this points to a decline in innovations as firms increase in size. Whether such heterogeneity can be so neatly divided given the overlapping of layers of technological systems that characterise modern economies where innovation is becoming more articulated and complex is doubtful (Dosi and Nuvolari, 2020).

Philippon (2019) argues for the virtues of market competition, also a Robinsonian spur to technical change, in resolving the productivity problem, but acknowledges that the problem of monopoly and the impact of lobbyists on business dynamism is especially serious in the USA. Declining competition and rising entry barriers have allowed incumbents to rest on their laurels in large banking, health care and technology companies. Like Aghion *et al.* (2021) the solution is more competition or creative destruction, but it remains unclear what the optimal tools for achieving this are? Philipon (2019) suggests that we need to ask Big Tech to do more, but his policy conclusions are at odds with the findings of Bloom *et al.* (2020), who argue that research productivity is declining in sectors such as semiconductor production precisely because of

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increased research effort (i.e. more researchers producing less output). The difficulty with these arguments from a Robinsonian perspective is that almost all the blame is being attributed to slow technical progress with little attention to insufficient investment and the training of workers, which would spur a rise in the ratio of investment to consumption with faster technical progress leading to faster accumulation (Robinson, 1963).

Equally problematic is the tendency on the empirical side of the NGT to rest on the connections between patent citations and firm level innovations, without ever asking whether the patent system is being deliberately used to stall diffusion, or whether the patent system is accurately capturing the rate of innovation. Robinson (1956, p. 85) pointed out that 'the speed at which new innovations are diffused depends very much on the physical life of capital goods'. This creates a type of leapfrog game 'where the economic life of plant is shorter than its potential physical life' (Robinson, 1956 p. 86). In this sense innovations that save working capital by speeding the production process are likely to be rapidly diffused, unless their diffusion in blocked by patents. The effect of patents is to slow down the rate of technical progress on the assumption that there will be more progress to diffuse later (Robinson, 1956). In section 4 we point to evidence from the patent system that it has been used by rich countries to prevent diffusion via intellectual monopoly capitalism (Pagano, 2014) and that international patents granted suggest that middle and upper middle-income countries may be innovating at a faster rate than captured in conventional measures. This suggests that the problem is not necessarily one of a drying up of ideas, but rather a deliberate slowdown in the rate of diffusion.

Interestingly, in other research on the rise of super firms and the decline of the wage share, Autor *et al.* (2020) link the rise in market concentration to the decline in wage share. The changes are related to changing boundaries of the firm such as outsourcing, a feature which they suggest might exclude a large section of the outsourced workforce from the pay premia paid to rank and file workers at high wage employers. Here again, there seems to have been a lost opportunity to draw on Robinson's (1962) formalisation of the relationship between profits and accumulation, a feature that has become central to understanding differences between wage-led and profit led growth (Orhangazi, 2019). Specifically, they appear to miss what Bhaduri and Marglin (1990) describe as the two-sided role of wages in industrial capitalism where higher wages increase manufacturing costs but also stimulate demand via workers' increased purchasing power.

4. Implications for developing economies and policy

The assumptions of partial excludability, property rights protection and competitive markets as set out in Romer (1990) and the failure of NGT to resolve the tension between the need to simultaneously codify and diffuse knowledge, implies a slower rate of convergence in living standards between rich and poor countries. Despite the promise of future convergence, neoclassical models advocating greater intellectual property protection indicate few long-term benefits for developing economies (Helpman, 1993). Furthermore, there is little evidence of long-term convergence in income levels across countries. Of the 101 middle-income countries in 1960, only 13 had reached high-income status by 2008 (World Bank and P.R.C. Development Research Center of the State Council, 2012). A recent study by Cherif and Hasanov (2019, p. 12) noted

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that 'in the past one-half of a century (1960–2014), only a handful of economies, 16 out of 182 economies in the sample in 2014…have crossed the threshold of 50% of the U.S. GDP per capita'. While neoclassical models broadly agree that differences in per capita incomes can be explained by differences in technological knowledge (Romer, 1990), this section argues that much like NGT, they lack a coherent explanation of why, if ideas and technology can flow freely across borders, there has not been a convergence in per capita incomes.

Robinson's (1974, 1979) approach to economic development was rooted in the historical method and analysis of the complexity of the rules of the game in different systems contexts. Part of this had its origins in her interest in China and motivated her to consider what types of land reform would best serve an increase in productivity (Harcourt, 1998). It also reflected a broader emphasis on the importance for developing economies of the choice of technique used in the allocation of investible resources (Robinson, 1974). This choice was endogenously determined. At the centre of her critique of approaches to economic development was the neo-liberal fallacy of treating capital as a factor of production that can costlessly absorb technical progress without loss of physical characteristics (Robinson, 1970). Applied to the problem of economic development, this led to one of the greatest obfuscations of orthodox theory, namely that when a foreign investment is made, a transfer of real resources has occurred (Robinson, 1973). At the extreme it was possible that an increase in portfolio investment could lead to the transfer of little or no productive goods.

By expressly stating that not all capital investments and loans to developing economies involve the transfer of real resources, the following argues that Robinson's work provides a basis for a more nuanced understanding of why foreign direct investment (FDI) and technology transfer have not led to faster convergence. These features have been overlooked under the neoclassical approach which tends to focus on a lack of savings and failures to meet institutional thresholds for financial globalisation, skills mismatches and barriers to the transfer and application of frontier technologies (Parente and Prescott, 1994; Basu and Weil, 1998; Acemoglu and Zilibotti, 2001; Kose *et al.*, 2006). Although Robinson's views on development can be critiqued for overstating the case for and understating the case against protectionism (Penrose, 1980), this section argues that her insights on the rules of the game shaping the challenges facing developing economies accessing and diffusing advanced technology are highly prescient. They are consistent with arguments made on the potential for endogenous technical change based on the accumulation of capabilities and industrial policy as sources of catch-up over the established industrial powers (Freeman, 1989, 1998; Wade, 1990, 2004; Amsden, 2001). Her approach to development offers an insight into the impacts of the patent system on the spur to innovation and the role of global value chains (GVC) and the multinational sector in suppressing the wage share.

4.1 Development and the value of the historical method

A consistent theme of Robinson's (1956, 1974) work was how neo-liberal economics essentially emptied history out of Marshall and replaced it with equilibrium. For Robinson this removed the costs and risks that kept managerial capitalism within its bounds, making it impossible to address how various historical, political, and psychological characteristics or even animal spirits influenced the propensity to accumulate. Dropping equilibrium and allowing for uncertainty of expectations, meant equilibrium

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was replaced by history (Robinson, 1974, p. 1). This allowed the question of where technological change came from: James Meade's steel leets (Robinson, 1978, p. 106) had to be invented somehow.

Robinson's views on the value of the historical method in understanding the problems facing developing economies, especially her views on international trade theory and the role of protectionism as a spur for technical change were clearly inspired by her readings of Frederick List. List argued that the experiences of the North American free states and Germany illustrated the point that:

> a highly advanced state of civilisation, with or without free institutions, unless supported by a suitable system of commercial policy, will prove but a poor guarantee for a nation's economic progress (List, 1841, pp. 365–366).

In making the case for a reconsideration of the theory of international trade, Robinson (1973, p. 11) illustrates the influence of List on her thinking:

> the doctrine of the advantages of free trade favoured the country which was first in the field with manufacturing industry; the doctrine of the advantage of free capital movements favours the country whose firms command the greatest fund of finance (Robinson, 1973 p. 11).

Much like her critique of the *golden age*, Robinson recognised that economic history in no way implied that countries would automatically converge towards a steady state equilibrium. Instead, endogenising technical change required industrial polices and the protection of industries that did not necessarily favour the country that was first in the field. As argued by Chang (2002) virtually all developed countries used interventionalist policies in industry, trade and the protection of technology to protect infant industries in their rapid growth phases.

While the Schumpeterian endogenous innovation models favoured by new growth theorists, which allow for technological innovation by oligopolistic producers, held out the prospect of faster convergence compared to their predecessors, they still depend on technological transfer and diffusion (Martin and Sunley, 1998). Fundamentally, they leave unanswered the question of how catch-up economies should endogenise technical change? Recent contributions to NGT have highlighted competition as being the spur for South Korea's market reforms after the Asian Financial Crisis and a catalyst for Deng Xiaoping's reforms in China in the late 1970s (Aghion *et al.*, 2021, p. 148, p. 277). As both Robinson (1973) and Freeman (1998) argued, none of this was inevitable and the simple exposure to international trade and technology transfer ignored the real-world complexities associated with the patient accumulation of capabilities. Robinson's views on economic development drew attention to the endogenous factors that have historically generated productivity growth, such as industrial policy, investment, and the rules of the game.

4.2 Convergence and the paradox of patents

The failure to find evidence of convergence has led to a recent resurgence of interest in the historical method and industrial policy. A World Bank working paper by Cherif and Hasanov (2019) drawing on the growth of the Asian miracle economies argues that the failure of total factor productivity (TFP)-based measures to adequately capture technical change indicates that 'something else other than perspiration must have happened in these countries that led them to high and sustained growth' (Cherif and Hasanov, 2019 p. 14). They note that Asian miracle economies were already applying for patents in the USA and engaging in high levels of investment even though this was not showing

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up in TFP measures. They use this to make the case for revisiting industrial policy citing the historical value of state intervention and protectionism as a spur to spending on research and development. It also highlights the need for a broader understating of what drives technical progress and growth. Using similar data on the growth of the granting on Chinese patents in the USA, the Federal Reserve Bank of St Louis posed the question as to whether China represents the next big innovation powerhouse, and noted that:

> In 2001, the U.S. granted 11,894 patents to German inventors, while granting only 266 to Chinese inventors. Over the next 19 years, as of 2020, U.S. patents granted to Germans increased 38% to just over 19,000 and U.S. patents granted to Chinese inventors increased nearly 10,000% to nearly 27,000.[7]

This is illustrated in Figure 2 which shows the dramatic growth in Chinese patents registered in the USA since the mid-1990s. Although China has developed its own system of patents, and its own competitive advantages in areas such as electric vehicles (Yuan and Li, 2021), it has also actively levered on the US patent system to enforce its intellectual property rights on a global scale. This appears to mimic a historical pattern first demonstrated by the Asian miracle economies (Cherif and Hasanov, 2019).

This reflects two salient features of international patent data that relate to the first Robinsonian spur to innovation, that is the role of competitive forces. There has been an increasing growth in the use of patents since the mid-1990s. This trend coincides with what Pagano (2014) terms intellectual monopoly capitalism where legal protection has

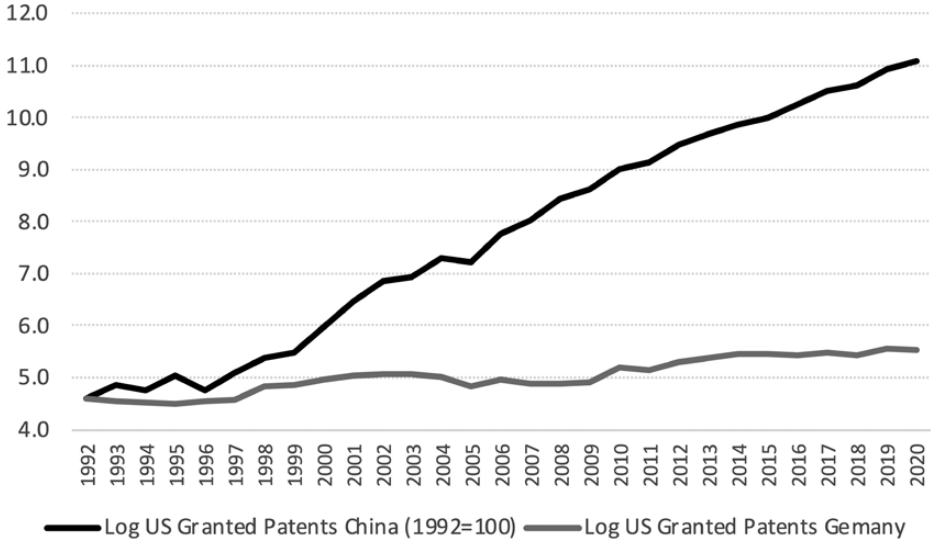


Fig. 2. *Log of US granted patents for German and Chinese applicants (1992 = 100).*
Notes: Data is based on patents granted in the USA to German and Chinese inventors. Data rebased to 1992 = 100 and transformed to its natural logarithm.
Source: U.S. Patent and Trademark Office, U.S. Granted Patents: Total Patents Originating in China and Germany using data retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/PATENT4NCNTOTAL
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[7] https://fredblog.stlouisfed.org/2021/08/is-china-becoming-a-new-innovation-powerhouse/.

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become central to the commodification of intellectual property. Legal protection reduces competition and the competitive spur to invest in key sectors, such as healthcare and high technology (Orhangazi, 2019). This alters the rules of the game and reduces the spur to accumulation that Robinson saw as essential to technical change.

A second feature of the patent data is their uneven geographical distribution. As Figure 3 shows, the main drivers of the growth of patent applications have been upper- and middle-income countries. Lower income countries tend not to register many patent applications. While this does not tell us very much about the rate of diffusion *per se*, it could reflect the fact that many lower income economies do not benefit from patenting systems that are TRIPS compliant (Love, 2001). This restricts diffusion by making it more costly for developing economies to licence patented technology. The economic costs associated with the restrictions on diffusion that this implies have become more severe as patenting became more globalised and complex, extending intellectual property rights to a variety of products from agricultural products to advanced technologies (Campi and Nuvolari, 2015). Other low-income countries have joined TRIPs but are unable to afford licencing costs. High-income countries have used the patent system to block diffusion of frontier proprietary technologies. This stalls both the catch-up and frontier innovation that NGT views as central to achieving convergence (Aghion *et al.*, 2021, p. 16) and confirms that it is not so much a drying up of ideas as argued by Bloom *et al.* (2020), but differences in the spur to innovation across different countries. These features form the essence of Robinson's (1956) paradox of patents, and her caution regarding the great complexities introduced by the patent system.

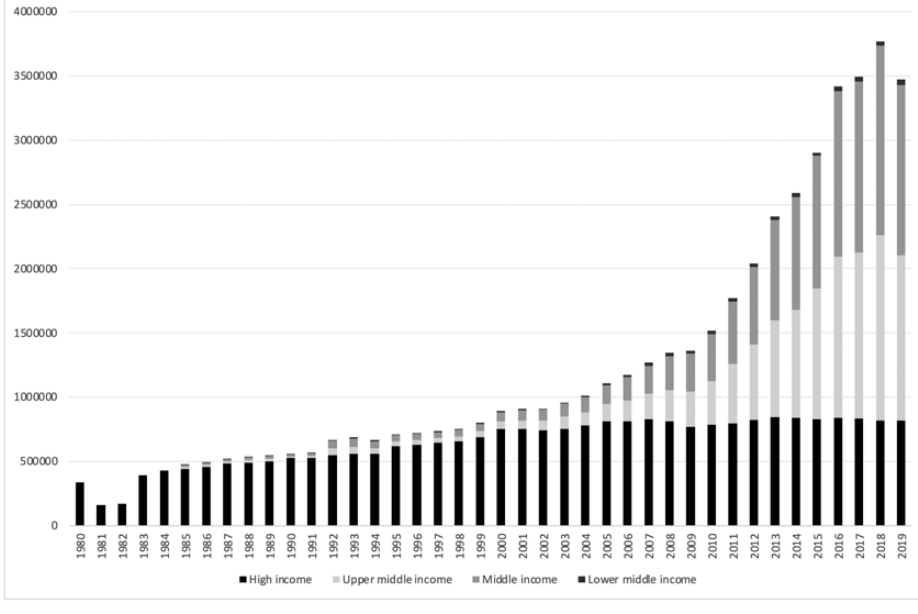


Fig. 3. *International patent applications.*
Notes: Patent applications are worldwide patent applications filed through the Patent Cooperation Treaty procedure or with a national patent office.
Source: World Development Indicators.

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4.3 The rules of the game and the wage share

Given the progress achieved by middle-income economies, it is reasonable to ask why convergence has not been faster and what Robinson can contribute to the debate? In one sense the policy toolbox for addressing convergence is still limited by its focus on market incentives for competition with less emphasis on the factors supressing the wage share. This is illustrated in the China 2030 Report (World Bank and P.R.C. Development Research Center of the State Council, 2012), which argued that the country was in danger of not making the jump from middle to higher income if it did not intensify market reforms, lower entry barriers and begin the break-up of monopolies in strategic sectors. It also recommended the establishment of a patent system like that of the USA and EU and a way of fostering the development of innovative capabilities. But the emphasis on developing a patent system and intensifying market forces overlooks what Robinson saw as the broader rules of the game shaping innovation.

This primarily relates to the second Robinsonian spur for innovation, the wage share. Increasing specialisation associated with the growth of global value chains, intellectual monopoly and global competition all reduce the cost of a stage on the value chain (Durand and Milberg, 2020). This results in the share in value added falling, with the main impact on the wage share in developing economies. These pressures are amplified by the relative market power of oligopolistic lead firms that have come to dominate the domestic markets of economies like China (Nolan, 2014), while passing cost pressures to lower tier domestic firms. Comparative advantages in low-cost labour push countries from the Global South to low-tech, labour-intensive production, reducing the demand for innovation and skills (Dünhaupt and Herr, 2021). Reversing this is key to promoting innovation. The data in Figure 4 show that China, which was one of the largest beneficiaries from the specialisation associated with GVCs, initially struggled to raise the wage share compared to other East Asian economies and emerging economies such as Brazil and Argentina. The data indicate that China's industrial policy, particularly its emphasis on increasing wages albeit from a low level through a system

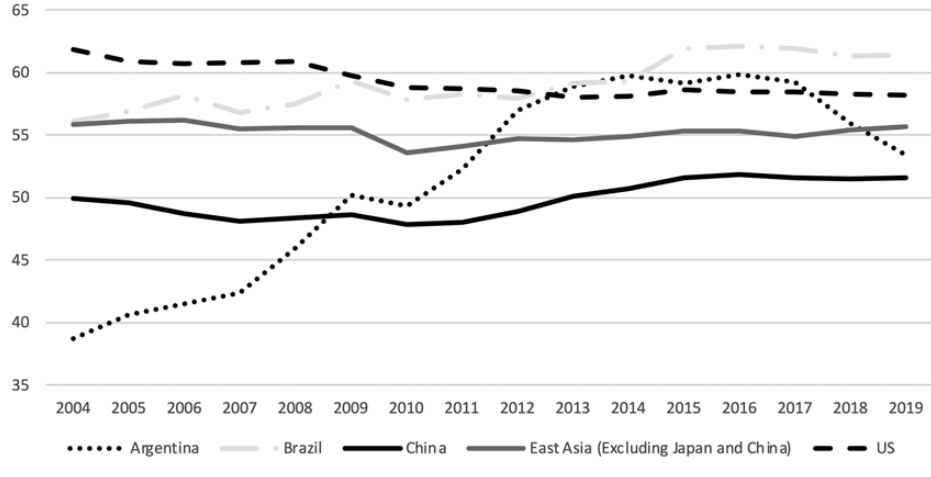


Fig. 4. *Wage share in GDP in various developed and developing economies.*
Source: United Nations Global SDG Database.

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of five-year plans favoured by Robinson, is having an effect and the wage share appears to be slowly moving upwards.

While Robinson could not have foreseen the level of specialisation in GVCs, her criticism of the fact that the amounts invested in research and development is typically lower in the overseas branches of multinational corporations (MNCs), while their tendency to focus on luxury import substitutes at the higher end of the market diverts scarce resources from the wage good sector, resonates with the wage pressures associated with GVCs (Robinson, 1973). Later studies of industrial catch-up vindicated this point. In her study of industrial upgrading, Amsden (2001) argued that MNCs via FDI do not invest in local research and development capabilities unless forced to do so.

Low investment in local research capabilities was used as a means of protecting their technological advantages. The view that the power of MNCs in developing economies was such that only state regulation could ensure their activities were conducted in a way that was beneficial for the local economy was something that both Edith Penrose and Joan Robinson could find agreement on (Penrose, 1980).

While for Penrose (1968), the need for regulating the MNC sector stemmed from their unfair pricing strategies and technological advantages, Robinson's critique was rooted in what she viewed as the hollow assumption of balanced trade that underpinned trade theory from Ricardo to Samuelson's version of the Hecksher-Ohlin theory. For Robinson, there was no mechanism to make trade balance at a country level. This relates to her scepticism on the rules of the game. Robinson's (1973) views on the British economy going through agonies to get rid of an unwanted deficit and the inflationary fears of German authorities, might as well have been written about today's monetary system and the tensions between the USA and China. Like Keynes (1941) who also recognised that it is impossible to separate trade issues from those related to the international financial system, Robinson (1973) also maintained that the new rules of the game, which she saw as based around exchange rates, were slow, clumsy and uncertain. Ultimately, they were trying to deal with a set of problems that were too difficult for it to solve.

Yet it is also interesting how nation states have responded within the rules of the game. Robinson (1973) noted the French complaints about US corporations taking over French companies and setting up local subsidiaries to compete in the local market, with the only benefit for the French economy being an increase in US dollar balances. Her suggestion that the proper response of the French, within the rules of the game, would be to buy up US industry in return, which she viewed them as incapable of doing, looks increasingly prescient. According to UNCTAD (2022) the stock of French outward investment increased at a year-on-year average rate of 13.3% for the years 1980–2019. China too has sought to combat the dominance of its domestic markets by large foreign oligopolies, by developing an internationally competitive group of state enterprises drawing heavily on the principles of industrial policy (Nolan, 2014).

5. Conclusion

There is no question that Joan Robinson was a pioneer in economics who has made a lasting contribution in a number of areas, including accumulation, growth and distribution. Her work has shone much needed light on the limitations of growth theory,

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particularly in relation to the assumption that technical progress is an exogenous variable, that 'falls like the gentle dew from heaven' (Robinson 1949, p. 84). While Robinson's (1949) 'manna from heaven' critique has received widespread recognition, less attention has been paid to the determinants of technical progress she identified in her 1949 article (the distribution of income and policies to speed up scientific discovery, innovation and diffusion) and to her later work on technical change. Throughout her academic career she continued to work on these themes and consistently treated technical change as endogenous. From a methodological perspective, she advocated a systems approach, where the system encompasses the economy and politics/policy, using a combination of logical reasoning and historical time analysis. In this, her approach was similar to that adopted later by Freeman (1987) and the NSI school. The range of variables influencing technical progress and innovation was also similar. These similarities are probably rooted in Robinson's and Freeman's understanding of, and admiration, for List's (1841) work on *The National System of Political Economy.* Robinson's work on technological change, growth and the distribution of income has resonance today for theoretical and empirical research on growth, convergence, technological progress and sustainable development, as well as for economic policy.

Robinson's (1963) model of accumulation offers policy makers a way of thinking about the interactions and cross connections between independent firm- and aggregate-level elements of the economy and how they interact with each other and with the physical, technical conditions in which they operate. These include the technical conditions that influence growth including the cross connections (Robinson, 1963, p. 36) between investment in capital, investment in education, training and human capital, and investment in research and their combined effects on the growth of technical knowledge, as well as investment policies that energise animal spirits and a competitive urge to invest and grow (Robinson, 1963 p. 38); the thriftiness conditions where savings and investment must be equal in the truistic sense but at no point need they be equal in the equilibrium sense; the role of competitive conditions, where cautious levels of investment and a lack of business dynamism reflects a low state of animal spirits; the wage bargaining environment; financial conditions; and the initial stock of capital goods and the state of expectations formed by past experience.

A reappraisal of Robinson's work, alongside consideration of more recent contributions from the NSI literature, shows that NGT is not that new and that its emphasis on private property rights and patents as key determinants of innovation and growth make it ill equipped to solve current problems of slow growth, inequality and lack of convergence.

Building on the work of List, Robinson, Freeman, Lundvall, and Chang, there is evidence that development economics is increasingly paying attention to the role of industrial policy, but it is still grappling with the nature of the rules of the game. Addressing this aspect of Robinson's contribution requires an answer to the question 'what are the rules of the game?' (Robinson, 1962, p. 136). It is notable in this regard that Robinson's (1973) observations on the challenges raised by industrialisation via import substitution led her to argue that what a developing economy really needs is a planned set of investible projects funded by the developing economy on its own terms. Robinson acknowledges that such an approach would ultimately not be that attractive to Western finance. China's use of such an approach has increased its technical capabilities and brought it closer to convergence (Figures 2 and 3), but just like the East Asian growth economies before China's rise, it has attracted calls for deeper

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market liberalisation. As Harcourt and Kerr (2009, p. 161) note, the deliberateness of Robinson's views on development are often incorrectly interpreted as superficial, when in fact, what she demonstrates is 'an awareness of a whole set of complex relationships which are responsible for maintaining the third world after 30 years of aid'.

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