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What Explains Productivity Growth?

Pre-Keynesian, Post-Keynesian, and New Keynesian Perspectives

Abstract

This paper traces how productivity and productivity growth have been understood across successive traditions of economic thought. It begins with the classical economists, examining how Smith and Ricardo linked productivity to the division of labour, technological change, distribution, and employment, before turning to Marx's analysis of labour-saving innovation and capitalist accumulation. The discussion then moves to Schumpeter's emphasis on entrepreneurship, creative destruction, and discontinuous technological change. Subsequent sections analyse how marginalist and neoclassical approaches shifted attention toward exogenous technological progress, culminating in Solow's growth accounting and the productivity residual. Then endogenous growth theory will be discussed. Keynesian and Post-Keynesian perspectives reintroduced demand, investment, distribution, expectations, and institutions as central determinants of productivity dynamics. The paper concludes with the New Keynesian framework, highlighting the transition from exogenous technology toward models incorporating innovation, R&D, human capital, and knowledge spillovers, and offers a critical assessment of the framework's ability to account for long-run productivity dynamics. It assesses the explanatory power of these approaches and their contributions to understanding long-run productivity growth.

Keywords

Productivity growth; Technological change; Classical political economy; Marx; Schumpeter; Solow; Growth accounting; Post-Keynesian theory; New Keynesian models.

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I. Introduction

Rising productivity, typically understood as output per unit of input, is a central source of long-run improvements in living standards. Yet productivity is far more than a technical measure of economic performance. Its meaning has long been contested and remains deeply embedded in broader debates about the nature of technological change, the distribution of income, and the future of economies and societies (Kurz, Strohmaier, and Knell 2025). The term itself has been used in different ways: to denote a technical ratio of inputs to outputs, as a synonym for economic or technological progress, and as a normative notion associated with social welfare (Krämer and Kurz 2021). Productivity is therefore not only a matter of measurement, but also a matter of economic theory, social interpretation, and historical context. Since the First Industrial Revolution, productivity growth has embodied a fundamental tension between the promise of greater material abundance and the prospect of social disruption through technological unemployment. It has also figured prominently in debates over alternative forms of economic and social organisation, including the long-standing conflict between capitalism and socialism.

It was not until the First Industrial Revolution that productivity growth became an object of systematic measurement and an explicit subject of economic analysis and at the same time posed intricate theoretical problems. Economists were confronted with several questions: which data needed to be collected, what caused productivity growth and explained its acceleration, could policy measures influence its pace, who benefited and who lost from it, and how did it affect the social fabric and its stability. These questions have been addressed differently across the successive traditions of economic thought, reflecting changing conceptions of the sources, determinants, and consequences of productivity growth.

This paper provides a broad survey of selected economic paradigms, situating the problem of productivity growth within wider theories of technological change and the dynamics of capitalism. At first glance, the division into pre-Keynesian, Post-Keynesian, and New Keynesian perspectives may appear to require some justification, since Keynes himself did not provide a systematic theory of productivity growth or technological progress in *The General Theory of Employment, Interest and Money* (Keynes 1936). His primary concern was with the short-run determinants of output and employment and with deviations from full-employment equilibrium. Nevertheless, Keynes was fully aware of the long-run significance of technological progress. In *Economic Possibilities for Our Grandchildren* (Keynes 1972 [1930]), he presented rising labour productivity as a foundation of long-term growth in material welfare. Although he presented the optimistic view that such a strong increase in our standard of living is possible that, in about one hundred years, the economic problem can be regarded as solved, he also emphasised the short-term risk of technological unemployment associated with mechanisation and automation. A more systematic analysis of the determinants of productivity growth emerged only later, particularly in post-Keynesian growth theory and in the work of Kaldor and other authors discussed in the following sections.

II. Pre-Keynesian Perspectives on Productivity Growth¹

In this paper, the label “pre-Keynesian perspectives” is not used in a strictly chronological sense. Rather, it refers to theoretical approaches to productivity growth that developed outside the Keynesian and subsequent Post-Keynesian traditions. The category therefore includes classical political economy, Marx, the neoclassical paradigm, endogenous growth theory, and Schumpeter’s theory of innovation, although the last three views on productivity were developed partly or entirely after Keynes. These approaches differ substantially in their analytical foundations and in their explanations of productivity growth. What they share, for the purposes of the present analysis, is that they are treated as distinct from the Post-Keynesian and, to a certain extent, from the New Keynesian approaches discussed in the subsequent sections. The relevant distinction is therefore not primarily chronological, but concerns different conceptions of the sources and determinants of productivity growth associated with the label Keynesianism.

1. Classical Political Economy

Classical British economists and especially Adam Smith and David Ricardo were amongst the first to study the problems at hand and define the confines within which much of the following discussions took place.² They elaborated an analytical framework that allows one to investigate the production, distribution and use of the social product of the economy as a whole, its trade and other relationships with other economies, and the role of the state in it. And some of them, most notably Ricardo, began to discriminate between different forms of technological progress (direct labour saving, capital or indirect labour saving, land saving and so on) and in his famous chapter 31 of the third edition of the *Principles* (1821/1951) studied the replacement of circulating capital (i.e., wages) by fixed capital (improved machines). He even contemplated the terminal point of the process of mechanisation that had just been started: a fully automated system, in which machines did all the work and human labour had become superfluous. In such a world, the concept of labour productivity had lost its traditional meaning.

The productive powers of society

John Stuart Mill and in particular Charles Babbage agreed with the classical authors that something unprecedented was occurring and elaborated on their analyses. They saw Political Economy as a science of the productive powers of society and the distribution of its fruits and placed productivity at the heart of their analyses. Most importantly, they shaped the intellectual architecture of modern economic thought concerning technological change. Their contributions went beyond descriptive accounts of innovation; they offered a systematic framework for understanding how technological progress could be quantified and integrated into broader economic analysis. Crucially, they shifted the focus from passively approaching a static technological frontier to actively redefining and investigating a frontier that was moved outwards. This reconceptualization marked a departure from earlier views of economic development, which often treated technology as an external condition, fixed by God, rather than a dynamic force

¹ This section draws on Krämer and Kurz (2026).

² Limitations of space prevent a discussion of important contributions of Italian and French economists. It must suffice to mention the Physiocrats, above all François Quesnay, whose *Tableau Économique* (1759) offered an early input–output representation of the economic system as a whole. Quesnay discussed also different forms of improvements in agriculture (e.g. the use of ox instead of horses) and their impact on the wealth and power of the French kingdom.

shaped by humans in deciphering the laws of nature and exploiting the findings in terms of larger quantities and better qualities of goods and services. Thus, technological advancement was not merely a matter of invention or mechanisation but a transformative process that augmented the productive capabilities of society. The growing social metabolism was seen as part and parcel of the natural metabolism, gradually expanding its control over the latter. Constraints imposed by nature were perceived – Ricardo spoke of the “niggardliness” of nature, and the concept of diminishing returns in agriculture and the exhaustibility of natural resources was a kind of memento mori of the finiteness of development. But the inventiveness of humans was seen as a counteracting force, and there were no signs yet that it was about to peter out.

The most salient indicator of this transformation was the rate of growth in labour productivity – a metric that captured the effectiveness with which human effort was converted into economic output. Classical economists introduced a foundational approach to quantifying technological progress – an approach that remains integral to contemporary economic analysis. They conceptualized technological advancement as measurable and proposed as a measure the growth rate of labour productivity. Define net labour productivity, denoted by y , as the ratio of the net social product Y to the total labour input L over a year:

$$y = \frac{Y}{L}$$

Accordingly, the rate of technological progress, g_{TP} , is expressed as the rate of growth of y , that is:

$$g_{TP} = \frac{dy}{dt} \left(\frac{1}{y} \right)$$

This concept of technological progress presupposes that the following two requirements are met: first, there is agreement that the magnitudes under consideration do inform about the phenomenon at hand; and, secondly, they are observable and data about them can easily be collected. The classical theorists were convinced that these requirements were met reasonably well. They thus laid the groundwork for subsequent empirical studies, relying on productivity metrics as central indicators of technological evolution. It is important to note that in their view, rising labour productivity implied rising real income per capita – Smith’s indicator of the wealth of a nation. This analytical shift had profound implications for how nations assessed their economic performance. Comparative economic success was no longer measured solely by aggregate output or trade balances but increasingly by differential rates of productivity growth. This allowed for a better understanding of development, one that could account for disparities in technological adoption, institutional capacity, and human capital.

Adam Smith

Adam Smith’s *Wealth of Nations* (1776/1976), written on the eve of the Industrial Revolution, famously used the pin factory to illustrate the division of labour within a firm. He showed that productivity was not merely a matter of individual effort but of organisation, specialization, the introduction of machinery, and thus of the accumulation of economically useful knowledge. Productivity growth, in his account, was key to national wealth and the basis of rising living standards. Smith identified the division of labour as the “greatest improvement in the productive powers of labour.” For him, productivity was not simply a matter of more output but of qualitative improvements in skills, dexterity, and innovation. He stressed the role of science and knowledge, writing that “the quantity of science in a nation” was crucial to its productive power.

This insight became later prominent again in so-called “endogenous growth theories” that linked productivity to knowledge accumulation. Yet, Smith was also aware of its limitations, given the contemporary forms of technological progress: the division of labour risked reducing workers to “as stupid and ignorant as it is possible for a human creature to become.” Productivity could deskill as well as upskill.

David Ricardo

Writing about a generation later, David Ricardo recognized more explicitly the potential for machinery to displace labour. He initially assumed machinery would benefit labour by raising output. But in the third edition of *Principles of Political Economy, and Taxation* (1821/1951), he inserted Chapter 31, “On Machinery,” conceding that mechanisation could reduce the demand for labour and lower wages. “The opinion entertained by the labouring class, that the employment of machinery is frequently detrimental to their interests, is not founded on prejudice and error, but is conformable to the correct principles of political economy” (Ricardo 1821/1951: 392). His finding that mechanisation in industries producing necessities could reduce labour demand undermined Smith’s optimism and pointed to the problem of aggregate effective demand and employment. The displacement of artisanal weavers by mechanized textile mills led to mass unemployment and social unrest. The Luddite movement, which destroyed machines, symbolized the effects of the dark side of mechanisation. The Factory Acts of the 1830s imposed limits on child labour and working hours, marking Britain’s first significant industrial labour regulation. Ricardo was not convinced that the solution of the problem was to ban the invention and use of machinery, because this would only improve the competitiveness of other countries and aggravate the employment problem at home. He rather began to discuss remedies to cope with the negative implications of technological progress, including an expanding services sector and an acceleration of capital accumulation. Ricardo clairvoyantly saw the possibility of “full automation” eventually eliminating the demand for labour altogether – a prescient anticipation of contemporary debates on AI driven automation (Korinek and Stiglitz 2021).

Ricardo refined the analysis by distinguishing between different forms of technological progress: direct labour-saving, indirect labour-saving (that is the saving of labour embodied in capital goods, i.e., capital-saving), and land-saving innovations. He argued that labour-saving innovations could reduce employment in the short run, especially when machinery replaced workers in industries producing necessities. At the same time, he saw productivity growth as ultimately expanding the national surplus, though with distributional consequences that tended to favour capitalists at the expense of workers. Ricardo’s recognition of “technological unemployment” was striking. This was a radical concession at a time when political economy was often accused of defending industrialists against workers. Ricardo’s analysis resonates today with debates about “skill-biased technological change” (Acemoglu and Autor 2011).

Charles Babbage and John Stuart Mill

Charles Babbage extended classical insights into the emerging world of mechanisation. In his *On the Economy of Machinery and Manufactures* (1835), he emphasised the substitution of machinery for human work and contemplated the possibility of machines performing mental as well as physical tasks, anticipating computers. Thus, as early as the 1830s Babbage already pointed in the direction of a Second Machine Age (Brynjolfsson and McAfee 2014), that is, machines that are capable of learning and self-optimising (Kurz 2022). He suggested profit-

sharing to ensure that workers benefitted from productivity gains. Babbage thus can be said to have started the discourse on automation and modern debates on inclusive growth. John Stuart Mill (1848) developed the classical view further. He emphasised the distinction between “laws of production,” determined by technology, and “laws of distribution,” subject to social choice. Productivity growth, in his view, was to be welcomed, but the distribution of its fruits depended on institutions. Mill also speculated about a “stationary state” in which productivity growth slowed but welfare could still improve.

Ricardo advocated the view that the exchange values of commodities and therefore relative prices were largely regulated by the amounts of labour needed directly and indirectly in their production. What became known as the labour theory of value implied a direct and inverse relationship between labour values and labour productivity: the larger the latter the smaller the former. Increases in productivity were reflected in falling quantities of labour in the production of commodities.

Outward shift of the technological frontier

A major analytical contribution of the classical economists was the discovery of the wage-profit curve, or w - r relationship, which expresses the inverse relationship between real wages, w , and the general rate of profits, r , given the system of production in use (Kurz 2010a). Technological progress shifted this frontier outwards, allowing for higher real wages and / or a higher general rate of profits. Different types of technological change involved different shifts of the frontier: labour-saving innovations raised the maximum level of the real wage rate (corresponding to a hypothetically zero rate of profits), capital-saving innovations raised the maximum level of the rate of profits (corresponding to a hypothetically zero real wage rate); labour saving-cum capital using innovations were accompanied by an increase of the maximum real wage rate and a decrease of the maximum rate of profits. This framework laid inter alia the ground for modern input-output analyses of technological change and income distribution. Empirical research using input-output tables depicting the situation in consecutive years, documented the temporal evolution of the wage-profit (w - r) relationship in a wide range of countries (Marzi and Varri 1977, and more recently Schefold 2013, Mariolis 2015, Zambelli, Fredholm and Venkatachalam 2017). These analyses have identified distinct patterns of technological change; each associated with specific developmental and growth trajectories – the subject of systematic discussion.

Measurement issues

Finally, the classicals also grappled with the measurement of productivity. They understood that productivity growth had a qualitative as well as quantitative dimension. Technological change altered not only the cost structure of existing commodities but also the composition of output, introducing new goods and rendering some old ones obsolete. This recognition of qualitative change posed deep measurement problems, which remain largely unresolved in contemporary debates about how to account for digital goods and services (Syverson, 2017). The classical authors recognized the heterogeneity of labour and rendered different kinds of labour commensurable with one another by using wage rates as weights. Ricardo warned that treating all hours of labour as equivalent was like “adding apples and pears” (Kurz and Salvadori 1995). The problem of an “invariable measure of value” haunted classical economics (Ricardo 1821/1951). A version of this problem remains relevant in contemporary debates about how to aggregate different kinds of labour in productivity statistics.

To conclude, the classical economists in their contributions to economic development and growth focused attention on productivity growth, its sources and measurement. They were keen to find out how to speed it up, because they understood that the battle of competition was first and foremost fought in terms of productivity enhancing and quality improving innovations. And they were concerned with the multivarious effects of technological change which, while benefiting some people, were detrimental to others and may even undermine social stability.³ They bequeathed to later economists a set of important questions and preliminary answers and deep insights regarding the causes, forms, and effects of technological progress.

2. Karl Marx

Karl Marx inherited the classical framework but transformed it into a radical critique of capitalism. For Marx, productivity growth was not a neutral or universal process but a historically specific feature of the capitalist mode of production. In volume I of *Capital* (1867), Marx traced the evolution of production from cooperation to manufacture, machinofacture, and the production of machines by machines (Dunford and Perrons 1983). Each stage involved a qualitative transformation in the organisation of labour and the means of production. It embodied rising productivity, but also new forms of exploitation. Machinery extended capital's command over labour, intensifying the extraction of surplus value. Productivity growth was thus inseparable from changes in the *forces of production* ("Produktivkräfte") and the corresponding *relations of production* ("Produktionsverhältnisse").

Marx argued that capitalism had an inherent bias toward labour-saving, capital-using technological change. Capitalists sought to reduce the direct labour content of commodities by increasing the indirect labour content due to the replacement of living labour by dead labour (machines etc.), which increased labour productivity. In this way they sought to extract what Marx called "relative surplus value", as opposed to absolute surplus value which resulted from a lengthening of the working day or a reduction of real wages. This increased the "organic composition of capital" (the ratio of "constant" to "variable capital", i.e., wages), which, he was convinced, would sooner or later exert a downward pressure on the rate of profit for the capitalist class as a whole. Formally, assuming that wages are paid post factum – that is, at the end of the production period – the general rate of profit is given by

$$r = \frac{P}{K} = \frac{\pi}{v}$$

where r is the profit rate, P are profits, K is the capital invested, π is the profit share, and $v = K/Y$ is the capital-output ratio. As v is assumed to rise without upper boundary, and since π cannot rise above unity, r must eventually fall. This "law of the tendency of the rate of profit to fall" was central to Marx's conviction that capitalism was not an eternal mode of production, but a transient one, like all its precursors. While productivity growth expanded material wealth, it was accompanied by a falling profitability, generating crises and paving the way towards socialism. At the same time, Marx acknowledged counter-tendencies: cheapening of capital goods, intensification of exploitation, foreign trade, and technological innovations that raised

³ For a modern reconstruction of classical value-and-distribution theory – which serves as the foundation for analysing technological change – see Sraffa (1960) and Kurz and Salvadori (1995). For an outline of how the classical economists conceived technological progress and economic dynamism, consult Kurz (2010a).

productivity without proportionally raising capital intensity.⁴ Nonetheless, he insisted that the long-term trajectory of capitalism was crisis-ridden. Empirically, the trend of profit rates is unclear. Some studies suggest a tendency for profit rates to fall (Shaikh 2016), while others see its long-term constancy (Schefold 2013).

Marx's analysis highlights the contradictory social effects of productivity growth: it reduces necessary labour time, creating the possibility of post-scarcity conditions. At the same time, it is taken to displace workers and generate a "reserve army of the unemployed." Marx's view of the systemic, conflictual, and historically contingent nature of various forms of productivity growth remains influential even nowadays. He forced economists to consider not only the technical features of innovation but also its impact on society at large, culture and the political sphere.

3. The Neoclassical Paradigm

Early representatives

The so-called marginalist revolution in the 1870s shifted the focus of economics to equilibrium allocations of scarce resources employed to serve alternative ends. Its main representatives were William Jevons (1871/1911), Carl Menger (1871/1981)⁵, and Léon Walras (1874/1954), who however put forward doctrines that were far from coherent and compatible with one another in important respects, both in terms of method and substance. The main concepts they used – marginal utility and marginal productivity – were also not original novelties but had already been elaborated by representatives of the German use-value school, especially K. H. Rau and H. H. von Thünen (Kurz 2016). While the problem of technological change was not entirely lost sight of, it was moved to the fringes of the discipline. This can be seen in the writings of all three authors. The analytically most demanding contribution was that of Walras, who, however, in his view of the long-term development of the economy replicated simply Ricardo's "natural course of events" scenario, depicting an economy subject to diminishing returns in agriculture which first stunted and then extinguished economic growth. In Ricardo, this scenario served only the purpose of a background against which the important role of technological change as a factor counteracting a tendency towards stagnation and misery, as Thomas Robert Malthus had imagined it, could be analysed. In Walras' general equilibrium, productivity growth is basically absent. Technology is largely given; natural resources are available in finite quantities – the system is under the spell of diminishing returns. As Schumpeter (1912/1934) noted, in a long-run perspective the economy is at best locked in conditions of a "circular flow" rather than innovation and development.

There were exceptions to this, but they were few and did not have much impact on the profession; see especially contributions of members of the Historical School and Marxists. Knut Wicksell (1893) deserves to be mentioned as a major representative of marginalism, who

⁴ It was Friedrich Engels who, after Karl Marx's death in 1883, edited volumes II and III of *Capital*. In doing so, he deliberately revised Marx's manuscripts somewhat (without telling the reader), in order to confirm the long-run validity of the "law" of the tendency for the rate of profit to fall. This involved downplaying Marx's own qualifying caveats and discounting passages in which Marx expressed doubts about the law's validity.

⁵ For a recent discussion of Menger's alternative to the classical theory of value and distribution, see Kurz (2023).

anticipated in terms of an Austrian time-phased model salient features of Solow's neoclassical theory of economic growth (Solow 1956, 1957).

The aggregate production function

Wicksell and Philip Wicksteed (1894) elaborated what became the workhorse of this theory: the so-called aggregate production function, which should more appropriately be called a macro production function, because it is not derived from the micro level by means of consistent aggregation. (It can be shown that consistent aggregation is only possible if extremely bold assumptions apply, which basically presuppose a one-good economy.) Long before Cobb and Douglas (1928), Wicksell and Wicksteed identified the properties such functions and forms of technological progress would have to have in order to exhibit constant income shares. With a Cobb-Douglas production function reflecting constant returns to scale, productivity growth is represented by a shift parameter, typically denoted by A , multiplying expressions of the capital (K) and labour (L) inputs:

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

Here, the exponent $a = (\partial Y / \partial K) / (Y / K)$ represents the partial elasticity of output with respect to capital. If marginal productivity theory of distribution holds, then $\partial Y / \partial K = r$, and a can be interpreted as the share of profits in national income ($1-a$ represents the wage share). Crucially, the term A reflects the level of technology or total factor productivity – it is exogenous, functioning as a “black box” shift factor, whose magnitude is not explained.

Robert Solow's Growth Accounting and After

Solow's contributions in the 1950s introduced productivity growth in a peculiar way. Using the Cobb-Douglas production function, Solow (1957) decomposed economic growth into contributions made by capital, labour, and a residual. In growth accounting, he found in U.S. data that capital and labour explained only a fraction of growth. The remainder – often more than a half – was unexplained. This became the famous “Solow residual,” interpreted as technological progress. Moses Abramovitz (1956) famously called it “a measure of our ignorance.” This finding had profound implications. It conjectured that productivity growth, not capital accumulation, was the main driver of long-run growth. Yet it also treated productivity growth as exogenous. In Solow's model, technological progress is a time trend, shifting the production function upwards and acted, as Joan Robinson used to say, like “manna from heaven.”

Growth accounting developed into a vast empirical literature, in which the presumed contributions of human capital (Denison 1962), R&D, institutions (Barro and Sala-i-Martin 2004), and other growth factors were also incorporated. Total factor productivity (TFP) became the standard measure of productivity growth. TFP is supposed to measure the productivity of all inputs, not just labour; while a somewhat flaky number, it is still widely used as an indicator. Yet as critics such as Felipe and McCombie (2013) argued, TFP conflates many effects, from mis-measurement to utilisation rates, and rests on problematic macro production functions. Diffusion studies, such as those by Dale Jorgenson (2001), revealed that new technologies typically spread in S-shaped patterns, with slow initial adoption rates, rapid diffusion, and eventual saturation. Despite its severe limitations and problematic setup, Solow's framework established productivity as the central explanandum of growth, but, strangely enough, failed to explain it.

The tools provided by marginalist authors became very prominent despite their highly dubious nature. The question of which factors (economic behaviour, socio-economic institutions

including e.g., religious beliefs, economic policies etc.) promote or impede productivity growth, was shunted aside. Critics of Solow's model have, with some justification, argued that it does not provide a theory of economic growth at all but merely postulates the long-term growth rate. Compared to the conceptual fecundity and historical richness of classical and Marxian contributions, the Solow model looks barren and sterile.

4. Endogenous Growth Theory

From the 1980s onwards, the neoclassical framework was extended through the development of what was dubbed "new growth theory". This sought to explain productivity growth with reference to the motivations and decisions of rational agents and thus tried to provide a micro foundation of technological progress. Paul Romer, Robert Lucas, Philippe Aghion, and Peter Howitt developed models in which technological progress was the result of purposeful actions, such as R&D, education, and innovation.

Romer (1986, 1990) emphasised the role of knowledge as a non-rival but temporarily excludable good. Investment in R&D produces new ideas that raise productivity, with increasing returns due to knowledge spillovers. His later model introduced product variety: new designs for intermediate goods enhance productivity in final goods production. Lucas (1988) focused on human capital accumulation, modelling it as a decision problem between working and schooling. He posited externalities in education: the productivity of each individual depended on the average level of human capital in the economy. Even with constant returns in production, these externalities generated endogenous growth. Lucas's work underscored the role of knowledge spillovers and the broader social returns to education. Aghion and Howitt (1992, 1998) developed a "Schumpeterian" model of innovation, featuring a sequence of rival innovations that temporarily grant monopoly profits before getting displaced by new inventions. This "creative destruction" mechanism creates growth through successive quality improvements. Their framework accounted for R&D decisions, firm dynamics, and policy incentives to innovate. It also highlighted the trade-off between protecting existing technologies and encouraging new entry. Acemoglu's (2009) subsequent work integrated factors such as directed technical change, political economy influences, and skill-biased technological progress. He stressed that innovation is purposive and shaped by market size, factor prices, and institutional constraints. His models demonstrate how taxation, regulation, and education policies could direct the path of technological change toward labour-saving or labour-augmenting innovations, with profound distributional consequences.

These models make productivity growth endogenous, linking it to incentives, institutions, and policies. They explain why countries with similar savings rates could experience divergent growth paths: differences in education, R&D, or "systems of innovation" matter. Yet the models also reproduced some of the limitations of earlier frameworks. As Romer himself acknowledged, unbounded growth often resulted from linear assumptions underlying their structure. Martin Weitzman (1998) further criticised these models and provided arguments why there is no continual increase in growth rates: while human inventiveness generates a vast and rapidly expanding stock of economically useful knowledge, actual savings limit the share that can be realised in new products and new methods of production, echoing a core idea of the Harrod-Domar model.

5. Joseph Schumpeter and Innovation

In the early twentieth century, Joseph Schumpeter gave a new impulse to the concern in economics with technological progress and productivity growth. Innovations, he insisted, are the “overwhelming fact in the history of capitalism”, and “entrepreneurs” are the main agents of change. While he admired Marx’s recognition of capitalism’s dynamism, he rejected the view that profits resulted from the exploitation of workers. He also questioned the view that socialism was historically inevitable, but he saw forces at work, which had nothing to do with an alleged tendency of the rate of profits to fall, that steered the system in its direction. For Schumpeter, productivity growth was the material expression of “creative destruction.” Entrepreneurs introduced new products, processes, and organisational forms that disrupted existing states of affairs. These innovations raised productivity, displaced old firms, and restructured industries. Capitalism’s essence was not static efficiency but dynamic innovation. In *The Theory of Economic Development* (1912), he identified five types of innovation: new products, new production methods, new markets, new sources of supply, and new organisational forms. Each type contributed to productivity growth by expanding the scope and efficiency of production (Kurz 2012). Unlike the neoclassical economists, who focused on equilibrium allocations, Schumpeter (1939) emphasised disequilibrium dynamics. Productivity growth was not smooth but clustered in cycles. In addition to business cycles (“Juglars”) he saw growth cycles or long waves of economic activity, named after the Russian statistician Kondratiev, which lasted some 50 to 60 years. Each wave is driven by what now is dubbed a “General-Purpose Technology”: steam in the early nineteenth century, railways in the mid-nineteenth century, electricity and chemicals around 1900, and automobiles and mass production gaining momentum in the early twentieth century.

In *Capitalism, Socialism and Democracy* (1942), Schumpeter coined the term “creative destruction”, but the concept, if not the term, can already be discerned in his earlier writings. Productivity growth was taken to be the essence of capitalism: old structures were destroyed, new ones created. This contrasted with Solow’s smooth residual. Schumpeter emphasised heterogeneity, disruption, systemic restructuring. And he insisted that a distinguishing feature of capitalism was credit creation to finance innovations and a banking system that was up to the task. Entrepreneurs typically lacked the capital to realize their innovations, requiring credit from banks. A well-functioning banking system was thus essential to enable economic dynamism. This emphasis on finance anticipated modern discussions of venture capital and innovation systems (Mazzucato 2013). In contrast to Marx and the classical authors, Schumpeter saw profits essentially as the reward for successful innovations, which led him to deny that in a circular flow or stationary economy there could be profits or interest. Productivity growth, in his view, ultimately raised living standards and real wages, even if it caused short-term disruption. Capitalism was uniquely suited to generate and absorb innovation, though he worried that bureaucratization and social resistance might eventually stifle entrepreneurship.

Schumpeter’s influence endures in the contemporary emphasis on innovation, entrepreneurship, and “disruptive technologies.” His metaphor of creative destruction captures the dual nature of productivity growth, which Solow’s treatment of technological progress as exogenous does not. It highlights the heterogeneity of innovations, the cyclical nature of technological change, and the systemic restructuring it entails. Neo-Schumpeterian contributions (Nelson and Winter 1982, Metcalfe 1998, Aghion and Howitt 1998) stress innovation, creative destruction, and cycles. Contemporary debates on digital platforms and artificial intelligence echo Schumpeterian themes (Aghion, Antonin, and Bunel 2021).

III. Post-Keynesian School Perspectives on Productivity Growth

The treatment of productivity growth within Keynesian, Kaleckian and Post-Keynesian traditions reflects both a theoretical reorientation and a historical evolution of economic thought. While neoclassical theories tended to regard productivity increases as the outcome of exogenous technological progress, Keynes and his successors (implicitly siding at least partly with the classical authors) stressed the endogeneity of productivity growth, rooted in demand, distribution, and institutional dynamics. Over time, this perspective developed into a rich theoretical body that links macroeconomic performance with long-run productivity trajectories.

John Maynard Keynes did not formulate a theory of productivity growth, but his *General Theory of Employment, Interest and Money* (Keynes 1936) contained foundational elements on which later scholars elaborated. In Keynes's framework (as in Schumpeter's), investment is not the passive result of savings but rather the driving force of growth, determined by the "marginal efficiency of capital", which is shaped by expectations under fundamental uncertainty. Because investment decisions embody technological innovations, productivity growth is linked to the psychology of investors and the dynamics of effective demand (Keynes 1936, Minsky 1975). Keynes's notion of "animal spirits" implied that uncertainty and confidence affect not only output and employment in the short run but also the pace at which new, productivity-enhancing technologies are adopted, and productive capacity expands. Thus, even though Keynes himself was preoccupied with unemployment and stabilization policy, his demand-centred analysis contained the seeds of a theory in which productivity growth depends on macroeconomic conditions rather than being exogenously determined.

Almost contemporaneous with Keynes, Michal Kalecki developed a theory that provided a more explicit link between profits, investment, and growth (Hein and Krämer 2025). His well-known profit equation can be written as

$$P = I + C_c + (X - M) + (G - T)$$

where P denotes profits, I investment, C_c capitalist consumption, $(X - M)$ the trade balance (exports – imports), and $(G - T)$ the fiscal balance (public expenditures – taxes). This expression highlights the endogenous determination of profits by investment: firms' expenditures generate the incomes that validate expected returns (Kalecki 1954). This "investment creates its own profits" principle implied a dynamic mechanism, where higher investment stimulates both demand and productivity growth through capital accumulation and induced innovation. Moreover, Kalecki emphasised that income distribution – the share of wages and profits – determines demand patterns, while the investment of profits conditions long-run growth.

In the post-war period, Nicholas Kaldor, stimulated by Adam Smith's view about the role of the "extent of the market" for productivity, synthesized empirical observations into a set of "stylized facts" about economic growth, of which *Verdoorn's Law* was central. First formulated by P. J. Verdoorn (1949), the law posits a positive relationship between the growth of output, g_q , and the growth of labour productivity, g_p :

$$g_p = a + b g_q$$

where a is a constant and b is the Verdoorn coefficient (empirically found to be between 0.3 and 0.7). This simple relationship captures the idea that faster output expansion propels productivity growth through dynamically increasing returns to scale, learning-by-doing, and cumulative technological improvements (Kaldor 1966). Productivity growth, therefore, is not an

exogenous residual but is endogenously generated by demand-led expansion (McCombie and Thirlwall 1994). From this insight, Kaldor (1970) articulated his “growth laws”: 1. Growth of manufacturing output drives GDP growth. 2. Growth of productivity in manufacturing is positively related to manufacturing output growth (Verdoorn’s Law). 3. Manufacturing productivity growth spills over into the wider economy through structural transformation. Formally, these laws imply that sustained demand-led growth in key sectors generates dynamically increasing returns, in contrast to the neoclassical view of diminishing returns.

Building on Myrdal’s (1957) theory of cumulative causation, Kaldor and other Post-Keynesians extended his analysis to regional and international dynamics. The idea is that regions or countries experiencing higher demand growth attract investment, which in turn accelerates productivity growth, enhances competitiveness, and reinforces further demand expansion. Conversely, economies trapped in low demand growth face sluggish productivity, deteriorating competitiveness, and relative decline. These dynamics can be formalized in balance-of-payments constrained growth models, where long-run growth (g) depends on the income elasticity of exports (σ) and imports (μ):

$$g = \frac{\sigma}{\mu} g^*,$$

with g^* denoting world income growth (Thirlwall 1983). This dynamic view contrasts with neoclassical convergence theory, suggesting instead that productivity growth is path-dependent and susceptible to divergence over time (Setterfield 1997).

Later Post-Keynesian economists systematized these insights into formal models of demand-led growth. Neo-Kaleckian models (Rowthorn 1981, Dutt 1984) highlighted the role of functional income distribution in shaping demand and, consequently, investment and productivity growth. Aggregate demand (AD) can be expressed as a function of the wage share (ω):

$$AD = f(\omega),$$

where the sign of $\frac{\partial AD}{\partial \omega}$ determines whether the economy is wage-led (positive) or profit-led (negative). In wage-led regimes, higher real wages stimulate demand and thereby foster investment and productivity growth; in profit-led regimes, growth depends more on retained profits and export competitiveness (Kalmbach and Kurz 1988, Bhaduri and Marglin 1990, Blecker 2002, Kurz 2010b). Sraffian super multiplier models, in turn, emphasise the role of autonomous demand components, such as government spending or exports, in sustaining long-run growth and productivity (Serrano 1995). These approaches confirm the insight that productivity is not a supply-side residual but is deeply interrelated with levels of macroeconomic demand, the distribution of income, and institutions. State intervention, public investment, and labour market institutions condition the pace and direction of technological change (Lavoie 2014, Hein 2023).

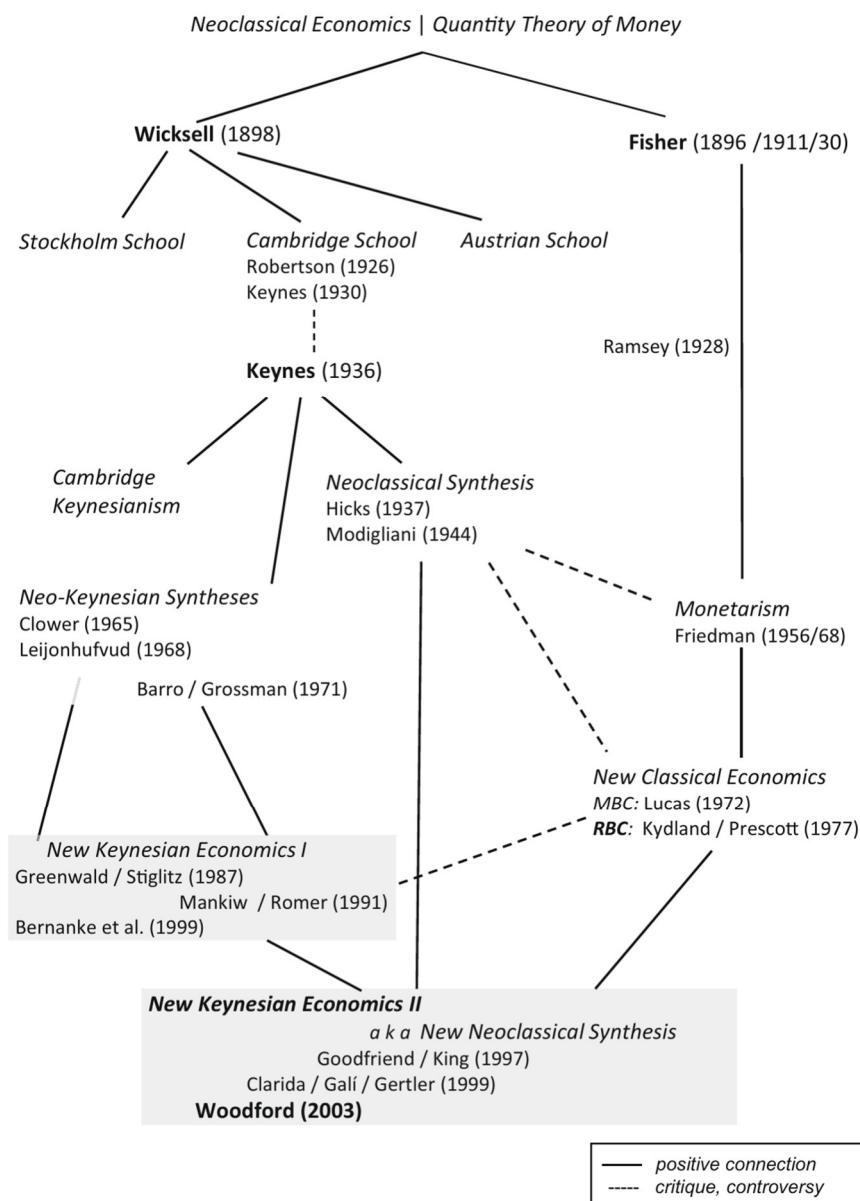
From Keynes’s emphasis on effective demand and investment through Kalecki’s profits–investment mechanism to Kaldor’s growth laws and the Post-Keynesian elaborations of cumulative causation and demand regimes, the Keynesian tradition has consistently rejected the neoclassical portrayal of productivity and its growth as exogenously given. Instead, productivity growth is understood as an endogenous, historically contingent phenomenon shaped by demand, distribution, and institutions. This dual theoretical and historical evolution underscores the distinctive contribution of Keynesian and Post-Keynesian economics to our understanding of long-run productivity dynamics. Empirical studies based on input-output analyses show that productivity

growth depends on diffusion, complementarities, effective demand patterns and sectoral dynamics (Kalmbach and Kurz 1990).

IV. New Keynesian Perspectives on Productivity Growth

The intellectual roots of modern New Keynesian economics can be traced back to the neoclassical tradition and, in particular, to the synthesis of certain Keynesian ideas with neoclassical macroeconomic theory. As illustrated in Figure 1, Keynesian economics developed along several different paths after Keynes (1936), including the Cambridge Keynesian tradition and the neoclassical synthesis associated with Hicks (1937) and Modigliani (1944).

Figure 1



Source: Trautwein (2022), p. 232.

From the 1960s onward, the Keynesian tradition was increasingly challenged by New Classical Economics, particularly through the development of rational expectations and Real Business Cycle (RBC) theory. The latter restored intertemporal optimisation, market-clearing conditions, and general equilibrium to the centre of macroeconomic modelling. New Keynesian economics emerged from the attempt to combine these neoclassical foundations with what was held to be “Keynesian insights” concerning market imperfections and nominal rigidities. The first generation of New Keynesian economics, associated with contributions such as Greenwald and Stiglitz (1987) and Mankiw and Romer (1981), emphasised imperfect competition and price and wage rigidities. This line of thought subsequently converged with the New Classical and RBC traditions, giving rise to the New Neoclassical Synthesis. Contributions by Goodfriend and King (1997), Clarida, Galí and Gertler (1999), and ultimately Woodford (2003) established the modern New Keynesian framework. Thus, today’s New Keynesian economics does not constitute a departure from neoclassical macroeconomics, but rather a synthesis that combines its methodological foundations like intertemporal optimisation, rational expectations, and general equilibrium with purported Keynesian mechanisms such as nominal rigidities, imperfect competition, and an active role for monetary policy. Consequently, the labels New Keynesian economics (NKE) and New Neoclassical Synthesis (NNS) are largely interchangeable (Trautwein 2020, p. 10). This intellectual lineage is important for understanding the treatment of productivity growth: the technological side of the economy is inherited largely from the neoclassical growth framework, while the New Keynesian contribution lies primarily in explaining the short- and medium-run macroeconomic effects of technological and other shocks.

Dynamic Stochastic General Equilibrium models

In the modern macroeconomic mainstream, Dynamic Stochastic General Equilibrium (DSGE) models constitute the dominant approach to analysing macroeconomic fluctuations and stabilization policy of mainstream economics. This framework places macroeconomic stabilization, rather than the explanation of long-run productivity growth, at the centre of analysis. In the standard New Keynesian DSGE model, productivity is generally represented by an exogenous process, typically in the form of an autoregressive total factor productivity or technology shock. Technological change is therefore modelled as a process that originates outside the economic system and is described by a stochastic process such as

$$\log A_t = \rho_A \log A_{t-1} + \varepsilon_t$$

Here, A_t denotes the level of technology or total factor productivity, while ρ_A captures the persistence of the technology process. A_{t-1} represents the previous period’s technology level, and ε_t is an exogenous technology shock. The logarithmic specification expresses technological changes in proportional terms. The technology variable directly affects the production function and thereby determines the long-run growth rate of labour productivity. Technology affects firms’ production possibilities and hence marginal costs, employment, output, and inflation, but the determinants of technological change are located outside the model. This modelling approach is rooted in the tradition of the neoclassical growth model and Real Business Cycle (RBC) theory.

The NKE DSGE model therefore analyses the macroeconomic effects of a change in productivity without explaining why productivity changes in the first place. The treatment is consequently close to the neoclassical growth tradition in which technical progress enters as an external source of growth. In Solow-type growth accounting, technological progress appears as a residual (see section II.3 above); similarly, in the baseline New Keynesian DSGE framework,

the technology process is usually taken as a primitive disturbance rather than as an endogenous economic outcome. Galí's (1999) analysis of technology shocks, for example, examines how exogenous changes in productivity affect employment and output within a model characterized by monopolistic competition and nominal rigidities.

This treatment generates an important conceptual asymmetry. New Keynesian models provide a highly structured explanation of short- and medium-run fluctuations while often leaving the main determinant of long-run growth outside the model. Monetary policy can stabilize inflation and the output gap, but in the baseline framework it has little or no systematic influence on the economy's long-run productive capacity. The distinction between the cyclical and the structural dimensions of economic activity is consequently sharp: technology determines the economy's production frontier, while Keynesian mechanisms explain deviations from the corresponding flexible-price equilibrium. Such a structure might be analytically useful for studying stabilization policy, but it also limits the model's ability to address the economic origins of productivity growth. It leaves unanswered the question of why firms innovate, how research and development generate new technologies, how knowledge accumulates, and how macroeconomic conditions feed back into these processes. While modelling a technology shock allows for a precise analysis of its macroeconomic effects, it does not provide an explanation of its economic causes. As a result, productivity growth remains much like in traditional neoclassical growth theory an unexplained residual.

Endogenous technological change

While standard New Keynesian DSGE models initially treated technology and productivity growth as exogenous processes, more recent extensions have incorporated mechanisms of endogenous technological change, including research and development, innovation incentives, and knowledge spillovers. In the endogenous growth literature, technological change is not an unexplained residual but an outcome of purposeful economic activity. As described already above, Romer (1990), for example, models technological progress as resulting from intentional investment in research, with knowledge characterized by non-rivalry and partial excludability. The allocation of human capital to research therefore affects the rate of technological change and, ultimately, long-run economic growth.

The incorporation of these mechanisms into New Keynesian models represents an important extension of the DSGE approach. Instead of treating total factor productivity as an exogenous state variable, models with endogenous innovation introduce R&D expenditure, innovation decisions, technology adoption, or knowledge accumulation as endogenous state variables. Firms respond not only to current demand and expected marginal costs but also to the expected return on innovation. Monetary and fiscal conditions can consequently affect productivity growth indirectly by changing the profitability and financing conditions of innovative investment. The interaction becomes two-way: technological change affects inflation, marginal costs, output, and the business cycle, while macroeconomic conditions affect the incentives and resources available for innovation.

A notable example is provided by models in which medium-term fluctuations in productivity are linked to endogenous innovation and technology adoption. Comin and Gertler (2006), for instance, explicitly incorporate endogenous technological change into a framework designed to explain both high- and medium-frequency fluctuations. Their approach emphasises that R&D and technological change are procyclical and that productivity dynamics cannot necessarily be treated as independent exogenous disturbances. More recent New Keynesian work makes the

policy implications of this interaction even more explicit. Moran and Queralto (2018) develop a New Keynesian model in which total factor productivity is endogenous and show that monetary policy affects firms' incentives to develop and implement innovations. In a model with exogenous technological progress, monetary policy influences short-run stabilization without systematically altering technological development itself. In a model with endogenous technological progress, monetary policy can have effects extending beyond short-run output and inflation stabilization because it also influences the trajectory of productivity. More restrictive financing conditions or lower expected demand, for example, can reduce the profitability of research and development. Conversely, stable macroeconomic conditions can strengthen incentives for innovative investment. Monetary policy thus potentially acquires effects that go beyond the classical stabilization of inflation and output. This provides a direct theoretical connection between macroeconomic stabilization and endogenous technological change.

Neo-Schumpeterian growth models

The same synthesis can be observed in New Keynesian models that integrate Schumpeterian mechanisms. Here, innovation is modelled as the arrival of new technologies or improvements in the quality of existing technologies, while nominal rigidities and monetary policy determine the short- and medium-run macroeconomic environment in which innovative activity takes place. Neo-Schumpeterian growth models take a different but complementary approach by explaining growth through innovation and creative destruction (cf. section II.5 above). In this tradition, firms invest in research because successful innovation creates temporary rents, while innovation simultaneously displaces existing technologies and firms. The resulting growth process is therefore inseparable from market structure, competition, firm dynamics, and the incentives created by intellectual property rights (Aghion, Akcigit and Howitt 2015).

The resulting framework differs from the canonical New Keynesian model because productivity is no longer an exogenous shock but an endogenous consequence of firms' innovation decisions. Conversely, the Schumpeterian growth mechanism is no longer analysed in isolation from aggregate demand, nominal rigidities, and stabilization policy. Research and development becomes part of the monetary transmission mechanism, while technological change becomes part of the determination of aggregate fluctuations. The literature therefore moves toward a synthesis in which the boundary between short-run stabilization and long-run growth becomes less rigid.

Problems with the treatment of productivity growth

Nevertheless, this synthesis leaves unresolved several major problems that stem from the conventional treatment of productivity growth. First, the incorporation of R&D into DSGE models does not in itself eliminate the highly stylized representation of innovation. Innovation is typically reduced to a mathematically tractable accumulation process governed by optimizing behaviour, patent rents, or a stochastic arrival rate. The institutional, organisational, and historical dimensions of technological change therefore remain difficult to capture. The role of power relations, income distribution, public institutions, and structural change is likewise only partially accounted for in many formalized models.

Second, knowledge spillovers create an inherent tension between private and social returns to innovation. Because knowledge is partly non-rival and innovative activity can generate benefits for other firms, the decentralized equilibrium may involve too little R&D from a social point of view. The endogenization of technological progress therefore not only expands growth theory

but also leads to a reassessment of the role of economic policy interventions. This is precisely where important entry points for innovation and industrial policy arise (Mazzucato 2026).

Third, endogenizing productivity within a DSGE framework does not imply that all the societal causes of technological change are fully explained. Even if research and development are now modelled as deliberate choices of economic agents, these decisions themselves remain embedded in a system of expectations, institutions, and historically evolved technological possibilities. The formal endogenization of technological progress is therefore not equivalent to a comprehensive explanation of its historical and social determinants.

Fourth, Schumpeterian approaches emphasise that innovation is associated not only with the creation of new technologies but also with the destruction and reallocation of existing productive structures. A representative-agent framework can capture the aggregate consequences of this process only imperfectly because the heterogeneous firm-level dynamics underlying creative destruction are largely compressed into aggregate relationships.

The fifth criticism concerns multi-factor productivity (MFP), an important empirical counterpart to the technology component in New Keynesian DSGE models, although its interpretation remains subject to several substantive objections.⁶ MFP, as operationalised within a neoclassical aggregate production-function framework, faces both theoretical and practical limitations (Felipe and McCombie 2013; Toner and Richardson 2026). Its interpretation as a measure of technological progress relies on restrictive assumptions concerning competition, returns to scale, the separability and measurement of inputs, and the efficient use of productive factors. In practice, the measured residual may therefore reflect not only technological change but also measurement error, mismeasured inputs, variations in capacity utilisation, and cyclical effects. From a theoretical perspective, the Cambridge capital controversies highlighted fundamental difficulties in aggregating heterogeneous capital goods into a single scalar measure of capital and in assuming a stable monotonic relationship between factor prices and factor ratios (Harcourt 1972). Reswitching and capital-reversing phenomena demonstrate that such relationships cannot be taken for granted, thereby challenging the interpretation of the aggregate production function and the associated measurement of capital. Empirically, limitations in the quality of capital-stock data, the use of inconsistent deflators, and unobserved variations in capacity utilisation and markups can further affect MFP estimates and make cross-country and cross-period comparisons fragile. Finally, because MFP is essentially a residual measure, it provides limited causal insight into the sources of productivity growth, including innovation, organisational change, and demand-led dynamics.⁷ It therefore tends to leave aside the institutional, structural, and distributional mechanisms emphasised in post-Keynesian and evolutionary approaches.

Finally, a further problem stems from the interpretation of causality between macroeconomic conditions and technological progress. Once productivity is endogenous, technology can no longer be treated merely as an independent source of fluctuations. Weak demand, tighter financial conditions, or restrictive monetary policy may reduce firms' incentives or ability to invest

⁶ It is important to distinguish, however, between MFP as an empirical residual and the technology variable A_t employed in DSGE models: the former is constructed from observed output and inputs, whereas the latter is a theoretical state variable whose economic determinants are not necessarily specified within the model.

⁷ Andreoni and Guarascio (2026) analyse the relationship between productivity growth and the demand side, an important issue that is often overlooked in the productivity-growth literature, where demand-related mechanisms are frequently relegated to the background despite their relevance for long-term growth dynamics.

in R&D, thereby affecting productivity with a considerable lag. Conversely, innovation can alter firms' costs, investment opportunities, market shares, and aggregate production capacity. Recent research explicitly models such feedback effects and thereby questions a strict separation between the cyclical and the long-run components of economic growth. The resulting perspective is closer to an integrated view of macroeconomic dynamics in which stabilization policy and innovation policy can interact.

From this perspective, the evolution of New Keynesian modelling represents more than a technical modification of the DSGE framework. It reflects a broader shift in the understanding of productivity growth: from an externally given technological residual toward a process that is partly generated by economic incentives, investment decisions, market structures, and macroeconomic conditions. Yet the incorporation of endogenous innovation into otherwise neoclassical DSGE structures also reveals the limits of the synthesis. The formal models can establish theoretically relevant links between monetary policy, innovation, and productivity, but they frequently retain strong assumptions about rational expectations, representative optimisation, market equilibrium, and the functional representation of knowledge accumulation. Technological change is thereby made endogenous only in a formal sense, while important historical, institutional, and distributional determinants of innovation may remain outside the analytical core.

To sum up, it is highly doubtful that productivity growth can be adequately captured within the New Keynesian paradigm, and especially within the DSGE world, unless institutions, demand conditions, structural change, firm heterogeneity, and the historically contingent nature of innovation receive substantially greater analytical attention.

V. Concluding Remarks

The paper argued that the different traditions considered here offer fundamentally different explanations of productivity growth. Classical political economy treated productivity growth as a major source of rising wealth and structural transformation, while Marx focused on the capital-using bias of technical change and its contradictory social consequences, particularly labour displacement and class conflict. Schumpeter, in turn, placed the entrepreneur, the banking system, innovation, and creative destruction at the centre of the process, linking technological change to structural transformation and long waves of development.

By contrast, neoclassical growth theory and growth accounting, most prominently associated with Robert Solow, largely treated technological progress as an exogenous residual. Solow's growth-accounting framework attributed the "unexplained rest" of output growth to technological progress within a constant-returns-to-scale aggregate production function, without providing a theory of its underlying causes. This raises a fundamental question: what is the status of the residual if the assumed production function does not adequately capture the nature of returns to scale? The irony is that an approach that largely left the sources of productivity growth unexplained nevertheless became highly influential in the discipline.

Endogenous growth theory subsequently sought to internalise technological change, innovation, and human capital formation within formal optimisation frameworks. In this respect, it addressed questions that had already been raised by classical political economy, Marx, and Schumpeter, but employed analytical tools largely derived from the marginalist and neoclassical tradition. The New Keynesian framework inherited much of this methodological foundation.

Its canonical models place macroeconomic stabilisation rather than the explanation of long-run productivity growth at the centre of analysis. Initially, technological progress was typically represented as an exogenous process within DSGE models. More recent New Keynesian and Schumpeterian models have increasingly incorporated endogenous mechanisms of technological change, including R&D, innovation incentives, and knowledge spillovers.

Post-Keynesian approaches take a fundamentally different position on the determinants of productivity growth. Building on Keynes, Kalecki, and Kaldor, they reject the treatment of productivity growth as an autonomous or purely technological process and instead emphasise effective demand, investment dynamics, income distribution, expectations, uncertainty, and institutional structures. From this perspective, productivity growth is an endogenous and cumulative process in which macroeconomic conditions and structural change interact to shape long-run growth trajectories. Taken together, these approaches reveal that productivity growth cannot be reduced to a single technical residual or explained independently of the broader economic system. Moreover, the historical development of economic thought thus reveals a recurring tension between approaches that treat technological progress as an exogenous force and those that seek to explain it as an endogenous outcome of investment, innovation, demand, institutions, and structural change. It should be noted that measurement challenges persist to this day, such as aggregating heterogeneous labour and capital and capturing qualitative change (André, Gal & Mourougane, 2026). However, the central issue is not merely how productivity is measured, but what is understood to generate it.

The history of productivity growth in economic thought reveals a continuous tension between aspiration and measurement, between normative hopes for universal prosperity and the realities of social conflict, technological displacement, and institutional constraints. From the triumphs of the First Industrial Revolution's mechanisation to contemporary debates on platform economies and artificial intelligence, each era has produced its particular perspective on the problems encountered. As the transition into the AI age unfolds, productivity gains may accelerate, but so may labour displacement, inequality, and unintended consequences. History therefore cautions against both technological determinism and static equilibrium thinking, calling instead for a pluralistic approach that combines rigorous measurement, economic theory, and historical awareness to promote broadly shared prosperity, while mitigating its social risks (Krämer, Proaño, and Setterfield 2023). Acemoğlu (2026, p. 16) emphasises that restoring countervailing powers is essential for the politics of shared prosperity to succeed. Equally crucial is the question of sustainability: whether rising productivity is possible without ecological degradation, pollution and resource depletion. Environmental limits must be taken into account in an analysis of economic growth, ensuring that productivity advances support not only economic but also planetary well-being (Jackson, 2017).

In sum, productivity growth cannot be adequately understood through purely technical or equilibrium-based approaches. Instead, it must be analysed as a historically contingent and institutionally embedded process shaped by demand, innovation, distributional conflict, and public policy. Therefore, productivity remains a central yet multifaceted concept in economics. Its evolution reflects changing technological paradigms, methodological innovations, and the perennial challenge of aligning economic dynamism with social equity. Future advances in measurement techniques, data availability, and interdisciplinary collaboration will be essential for deepening our understanding – and to guide productivity growth toward inclusive, sustainable outcomes.

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