From Austrian theory of capital to dissent: Nicholas Kaldor, Friedrich A. Hayek and the way to disequilibrium

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Abstract

Purpose – In the early 1930s, Nicholas Kaldor could be classified as an Austrian economist. The author reconstructs the intertwined paths of Kaldor and Friedrich A. Hayek to disequilibrium economics through the theoretical deficiencies exposed by the Austrian theory of capital and its consequences on equilibrium analysis.

Design/methodology/approach – The author approaches the discussion using a theoretical and historical reconstruction based on published and unpublished materials.

Findings – The integration of capital theory into a business cycle theory by the Austrians and its shortcomings – e.g. criticized by Piero Sraffa and Gunnar Myrdal – called attention to the limitation of the theoretical apparatus of equilibrium analysis in dynamic contexts. This was a central element to Kaldor's emancipation in 1934 and his subsequent conversion to John Maynard Keynes' *The General Theory of Employment, Interest, and Money* (1936). In addition, it was pivotal to Hayek's reformulation of equilibrium as a social coordination problem in "Economics and Knowledge" (1937). It also had implications for Kaldor's mature developments, such as the construction of the post-Keynesian models of growth and distribution, the Cambridge capital controversy, and his critique of neoclassical equilibrium economics.

Originality/value – The close encounter between Kaldor and Hayek in the early 1930s, the developments during that decade and its mature consequences are unexplored in the secondary literature. The author attempts to construct a coherent historical narrative that integrates many intertwined elements and personas (e.g. the reception of Knut Wicksell in the English-speaking world; Piero Sraffa's critique of Hayek; Gunnar Myrdal's critique of Wicksell, Hayek, and Keynes; the Hayek-Knight-Kaldor debate; the Kaldor-Hayek debate, etc.) that were not connected until now by previous commentators.

Keywords Nicholas Kaldor, Friedrich A. Hayek, Knut Wicksell, Gunnar Myrdal, Expectations, Equilibrium, Capital theory

Paper type Research paper

Introduction

It is not easy to imagine two more distinct and antagonist economists in the twentieth century than the Hungarian Nicholas Kaldor (1908–1986) and the Austrian Friedrich A. von Hayek (1899–1992). Indeed, Kaldor is widely known as a joint architect and a leading figure – with

Richard Kahn, Joan Robinson, Luigi Pasinetti, and others – of the Cambridge school of post-Keynesian economics. In the 1950s and 1960s, this group extended the principles of John Maynard Keynes' *The General Theory of Employment, Interest, and Money* (1936) to the long-run analysis of economic growth and income distribution.

Nevertheless, Kaldor started his intellectual career as very sympathetic to the Austrian school as exposed by Lionel Robbins, Hayek, and others. In the 1930s, both Hayek and Kaldor were followers of the so-called Austrian theory of capital, derived from the works of John Stuart Mill, William S. Jevons, Carl Menger, Eugen von Böhm-Bawerk, and Knut Wicksell. It states that the quantity of capital corresponds to the length of time in which primary original factors of production (labor in Böhm-Bawerk's model and labor and land in Wicksell's case) are utilized to produce secondary durable and nondurable (i.e. working) capital goods.

This time length is measured by the average production period (the degree of roundaboutness or capital intensity) which is an increasing monotonic function of the total quantity of capital. The quantity of capital is understood as the length of production stages, the length of time contained in the whole production process, a notion introduced by Menger's *Grundsätze der Volkswirtschaftslehre* (1871). This allowed the extension of marginal productivity theory to the realms of capital. In equilibrium, the marginal productivity of waiting (i.e. the marginal productivity of the average period of production) will be equal to the interest rate.

In this essay, we reconstruct the similar and intertwined paths of Kaldor and Hayek to disequilibrium economics through the theoretical deficiencies exposed by the Austrian theory of capital and its consequences on equilibrium analysis [1]. The critical reaction to the Austrian business cycle theory presented by Hayek in the 1930s revealed the limitations of its theory of capital. More importantly, however, the Austrian integration of capital theory into a business cycle theory and its shortcomings called attention to the limitation of the theoretical apparatus of equilibrium analysis in dynamic contexts. These limitations exposed in the epitome of the equilibrium theoretical edifice, the neoclassical synthesis of the Austrian theory of capital, contributed to Hayek and Kaldor abandoning the neoclassical equilibrium theory *en route* toward dissent.

The critiques made by Piero Sraffa and Gunnar Myrdal (in a sense both later incorporated by Keynes in 1936) to Hayek's business cycle theory emphasized the indeterminateness of equilibrium in a dynamic, monetary, and expectational economy. In particular, Myrdal's 1933 critique of Wicksell's three conditions to monetary equilibrium led to a reaction against the notion of perfect foresight (i.e. perfect knowledge) intrinsic in the traditional (dynamic or intertemporal) equilibrium analysis, proper to the capital accumulation and trade cycle phenomena. This is visible in Hayek's reaction in his Copenhagen lecture in December 1933 and Kaldor's theoretical emancipation in 1934. The conjunction of the intellectual wars on capital and business cycle theories merged with the economic calculation debate under socialism revealed to Hayek the way to the reformulation of equilibrium analysis in terms of social knowledge coordination in his December 1936 presidential address to the London Economic Club, "Economics and Knowledge" (1937).

In 1937, nevertheless, Kaldor entered into the controversy between Hayek and Frank H. Knight on the theory of capital in a middle-ground position, criticizing the use of production periods and roundaboutness in a trade cycle theory but defending in its own right the Austrian theory of capital. Kaldor (1937b) writes to Knight saying that "I think Hayek's trade cycle theory is entirely wrong (at any rate in the *Prices and Production* form); and this is independent of the rights and wrongs of the Austrian theory. That is to say, I don't think Hayek 'follows' from the Austrian theory of capital at all; and would be equally wrong even if Böhm-Bawerk and Wicksell were spotless."

Kaldor's position in this debate is interesting because the main point that Hayek stressed in his controversy with Keynes (which was also influenced by Wicksell) in 1931 was the

logical consequences of a capital theoretical microfoundation to business cycle research. Soon after Kaldor's exchange with Knight, he abandoned the Austrian theory of capital in his conversion process to Keynes. However, many implications of the controversies mentioned above will be noted in his mature writings on the construction of the post-Keynesian growth and distribution models in the 1950s and 1960s (such as his Keynesian income distribution theory used as the solution to the Harrodian instability problem), the Cambridge capital controversy, and his critiques to what he called neoclassical equilibrium economics in the 1970s and 1980s.

This story might appear surprising for many since Kaldor is mainly identified with the Cambridge school. Moreover, as a long-time Fabian socialist, he was an influential voice within the Labour Party in England, performing an important role as Special Adviser to the Chancellor of the Exchequer when the Party came to power in 1964 (until 1968) and later in 1974–6. Not to mention his major contributions in making the two William Beveridge Reports, first the White Paper report on Social Insurance in 1942 and later the extremely influential *Full Employment in a Free Society* (1944). In Beveridge's 1944 book, Kaldor authored the famous appendix C where quantitative revenue and expenditure estimations of an active fiscal policy aimed at full employment were provided. In Hayek's view (1983, pp. 111, 183),

> Kaldor, through the Beveridge Report, has done more to spread Keynesian thinking than almost anybody else. [. . .] I have reason to say that it probably should be called a Kaldorian revolution, not for anything which is connected with Kaldor's name, but what spread it was really Lord Beveridge's book on full employment, and that was written by Mr. Nicholas Kaldor and not by Lord Beveridge, because Lord Beveridge never understood any economics.

Some implications to the long-run analysis of Keynes' principle of effective demand (i.e. that investment determines savings derived from income variation via the marginal propensity to save), which emerged in the early 1930s, were worked on by Roy F. Harrod's path-breaking "An Essay in Dynamic Theory" (1939). The same dynamic instability theory was developed and extended independently a few years later by the Russian American economist Evsey Domar (1946) in the context of the post-Second World War secular stagnation thesis propagated by the "American Keynes" Alvin Hansen (1944, part III), his Ph.D. advisor at Harvard University.

Keynes' short-period income and employment determination analysis ignored the dual character of the investment process, investment both determines present income (present aggregate demand) and increases future productive capacity (future aggregate supply). The attempt of generalizing the *General Theory* beyond the walls of short-period aggregate demand with given capital stock and fixed prices was largely a challenge to the very foundations of neoclassical marginal productivity theory based on factor substitution and diminishing returns. Something that Keynes himself had accepted at least partially from his teacher Marshall, for instance, in the second chapter of *The General Theory*. In particular, as the Cambridge capital controversy famously exposed (a controversy in which Kaldor himself was a protagonist), it was a challenge to the existence of a decreasing monotonic function between the aggregate quantity of capital and interest rates. In other words, an inverse relationship between capital intensity and distributive shares.

A lost generation of Hayekians? Kaldor and the London School of Economics (LSE)

In 1981, Hayek and Kaldor exchanged two letters concerning a dispute over Austria's economic picture. Answering Hayek, Kaldor wrote: "If you talk about the 'lost generations of Keynesians,' what about the (even older) 'lost generations of Hayekians' (Like myself!) who believed in *Prices and Production*?" (Ingrao & Ranchetti, 2005, p. 383). This resentment and

unfriendly tone marked their mature personal relationship. But it was not always like that. In 1925, Kaldor was enrolled in the Humboldt University of Berlin. In April 1927, he departed for the London School of Economics (LSE) as a visiting general student, officially enrolling for the B.Sc. degree in Economics in October. Until his graduation with first-class honors in 1930, Kaldor attended lectures by, just to mention a few, Hugh Dalton, John Hicks, Allyn Young and Lionel Robbins.

In 1927, the American Young was brought by Beveridge from Harvard to LSE to substitute Edwin Cannan, who retired one year before, as the Chair of the Economics Department. At the height of his influence and intellectual powers, Young was the dominant figure in Kaldor's second year at the School, while Robbins exerted a major influence on Kaldor's third and last year. In December 1928, Young had published in the *Economic Journal* his famous article on "Increasing Returns and Economic Progress" (1928). In Kaldor's (1986, p. 4) opinion, Young was his "first real teacher in economics, albeit for a brief period," and caused him a lasting and profound impression. It was due to Young that Kaldor inherited "a basic distrust of abstract systems *per se*, and an awareness of the need to adapt the tools of theoretical analysis to the practical problems which they are intended to illuminate."

However, with Young's sudden death from pneumonia in the winter of 1928–9, Robbins was appointed to the position. Robbins was "young, flamboyant and enthusiastic." It was natural and inevitable, Kaldor (1986, p. 4) recollects, that Robbins' first pupils "should fall completely under his spell." Robbins was very "much influenced by his contacts with Viennese economists, mainly von Mises," and the Lausanne general equilibrium approach. His lectures followed closely the formulation given by Phillip Wicksteed, Wicksell, and Frank Knight's *Risk, Uncertainty, and Profit* (1921) [2]. The neoclassical theoretical keystone in this presentation is the generalized marginal productivity theory of distribution *à la* Wicksell and Wicksteed. In Kaldor's (p. 5) view, Robbins absorbed this theory "with the fervency of a convert and propounded it with the zeal of a missionary."

As a Robbins' protégée, Kaldor's first publications were in the context of a two-year research studentship at LSE where, amongst other things, he went to analyze the economic "Problems of the Danubian Succession States." In researching for his project, Kaldor spent the summer term of 1931 (beginning in May until the end of July) at the University of Vienna as a visiting student. While in Vienna, Kaldor apparently joined the so-called *Geist Kreis*, a circle composed of young scholars created by Hayek, Gottfried Haberler, and Oskar Morgenstern – with the participation of Alfred Schütz, Fritz Machlup, Felix Kaufmann, Karl Menger, Erich Voegelin, and others. Many of these were also members of the *Mises Kreis*, the continuation by Ludwig von Mises of the famous seminar held by Böhm-Bawerk. It is presumed that Kaldor and Hayek had been introduced to each other by Robbins before this summer period in 1931.

In December 1930, Kaldor wrote to Hayek regarding his own offer to translate Hayek's first book, *Geldtheorie und Konjunkturtheorie* (1929a). Hayek thanked Kaldor for his willingness to translate the book into English and made the arrangements for the translation under Robbins' supervision. The book was translated by Kaldor and Honoria M. Croome and published in 1933 as *Monetary Theory and the Trade Cycle* (1933a). Hayek's main goal in this book was to integrate the study of business cycles and industrial fluctuations within a theoretical equilibrium structure. This effort contrasted with the historicist and empirical approach expressed by Wesley Claire Mitchell. Hayek had entered into contact with this approach during his 1923–4 travel to the United States, where he sat in Mitchell's "Types of Economic Theory" class at Columbia University. In 1928, Hayek (1928) had just published his innovative paper on intertemporal equilibrium as an attempt to solidify a business cycle *theory*.

Hayek sought to explain economic cycles as equilibrium phenomena, i.e. as a consequence of the logic of action by economic agents, drawing from the work of the Swedish economist Knut Wicksell and his mentor Mises. *Geldtheorie* was a product of his initial efforts to enter

the German-speaking academic world. To qualify for his *Habilitation*, which allowed a teaching position at the University of Vienna, Hayek had to write a book and make a public defense in a chosen subject related to the book. The subject of his habilitation lecture to *Privatdozent* at Vienna was "*Gibt es einen 'Widersinn des Sparens'*?" (1929b) published in the first volume of *Zeitschrift for Nationalökonomie* in June 1929. The paper was translated by Kaldor and Georg Tugendhat as "The Paradox of Savings" (1931a) and was published in *Economica* in May 1931.

The fact that both the translations of *Geldtheorie* and "*Widersinn des Sparens*?" into English were made by Kaldor jointly with other contemporary students at LSE suggests that Robbins was the mind behind the endeavor. Robbins was fluent in German and widely read and acquainted with the Continental economic literature. He was impressed with the critique exposed in "The Paradox of Savings" of some very influential pre-Keynesian American underconsumption theories championed by William Trufant Foster and Waddill Catchings. A similar intellectual attempt, but in terms of monetary theory, had been made by no one other than Keynes himself in the 1920s within the context of a deflationary post-World War I Britain. This led Robbins to suggest to Beveridge, the long-time director of LSE, that Hayek should be invited to give four advanced lectures at the London School of Economics in the lent term of 1930–1.

"Hayek's triumphal entry on the London stage with his lectures on *Prices and Production,*" as his former student Ludwig Lachmann (1982, p. 630) writes, was stunning. Soon after the lectures, Lachmann continues, "all important economists there [at the LSE] were Hayekians." In his monumental *History of Economic Analysis* (1954, p. 1120), Joseph Schumpeter writes that Hayek's account of the Austrian business cycle theory in *Prices and Production* (1931b), "on being presented to the Anglo-American community of economists, met with a sweeping success that has never been equaled by any strictly theoretical book that failed to make amends for its rigors by including plans and policy recommendations or to make contact in other ways with its readers' loves or hates. A strong critical reaction followed that, at first, but served to underline the success, and then the profession turned away to other leaders and other interests. The social psychology of this is interesting matter for study."

After the success of the lectures, published in *Prices and Production* (1931b), Beveridge invited Hayek to spend one year as a visiting professor at LSE using the long-vacant Tooke Chair. With the refusal of Jacob Viner and Hubert Henderson to take the Tooke Chair, the Chair was offered permanently to Hayek in 1932. In his book, Hayek initially describes the working of a barter economy adopting Böhm-Bawerk's stationary general equilibrium state. Hayek then analyzes the effects of an intertemporal preference change, that is, the transition to a more or less roundabout method of production. In this endeavor, he employs the notion of intertemporal equilibrium under perfect foresight merged with his views on the mechanics of a capital-theoretic barter economy.

In *Monetary Theory and the Trade Cycle* ([1929] 1933a), a barter economy is characterized by a high price-adjustment velocity to changes in external data. Hayek argued that the standard equilibrium theory cannot explain the business cycle or any kind of disequilibrium phenomena. Indeed, a satisfactory explanation of the business cycle, Hayek sustains, can only be found in an endogenous generating and propagating mechanism of disequilibrium. And this mechanism is money. Therefore, a satisfactory investigation into business cycle theory can only be accomplished by the integration of monetary theory into business cycle research, thus the name of the book. In Hayek's judgment, the only instruments available to analyze business cycles (the systematic errors made by entrepreneurs) are the methods of static analysis, in particular, the notion of intertemporal equilibrium. This does not necessarily mean equilibrium as a stationary state, since stochastic, exogenous and particular fluctuations or errors can be sufficiently explained by the adjustments process to irregular changes in external data.

Hayek ([1929] 1933a, pp. 69–70) seems to assume a perfect foresight environment in his delineation of a barter economy, arguing that we "have to assume that the price which entrepreneurs expect to result from a change in demand," which includes the dates and quantities of consumers' goods for which investment is destined, "will more or less coincide with the equilibrium price." No systematic error can be made by the entrepreneurs since they "will generally be in a position to estimate the price that will rule after the changes have taken place." The expected price "is just as likely to be lower than the equilibrium price as to be higher." Therefore, "on the average, it should more or less coincide, since there is no reason to assume that deviations will take place only in one direction." After drawing the intertemporal effects in his benchmark economy, Hayek goes on to contrast this case with a monetary economy in which divergences between the money and natural interest rates transmit false price signals to entrepreneurs, resulting in a failed intertemporal transition to a more roundabout method of production [3].

Kaldor's initial publications were products derived from his research studentship dealing with the economic problems of Danubian succession states. In fact, although never submitted, Kaldor's planned Ph.D. dissertation was on this topic, entitled "Commercial Policy of the Danubian States after the War." In October 1932, Kaldor published in the *Harvard Business Review* his first paper on "The Economic Situation of Austria" (1932e) employing mainly an Austrian approach to the industrial fluctuations in the region. On the occasion already at Harvard, it was Haberler who initiated the submission of Kaldor's paper, initially rejected by Keynes in the *Economic Journal*. The Austrian influence can also be clearly seen in Kaldor's (1932) first letter to *The Times* in March 1932 dealing with the dominance of farming in Danubia and in four anonymous articles published between May and June in *The Economist* on "The Danubian Problem" (Kaldor, 1932b; see also Kaldor, 1932d).

Reviewing Emil Lederer's 1931 book on technological unemployment, Kaldor (1932c, p. 195) argued that unemployment could only be due to the money wage downward rigidities, a "monopolistic interference with the price system" by trade unions. In his review of Carl Landauers's 1931 book *Planned Economy and Market Economy*, which advocated an early German *Marktsozialisten* solution, Kaldor (1932f, p. 279) maintained that Mises' economic calculation problem still would be not resolved in the market socialism "competitive" solution. "Even if we assume that a 'free market' for consumption goods can be preserved, the methods of producing these goods will have to be decided arbitrarily; as the Socialist producer cannot, even if he tried to, find out the true displacement [i.e. opportunity] costs of the factors of production. This problem, which emerged as soon as the conception of 'real costs' was abandoned, has so far proved insoluble."

At the time when Kaldor was appointed Assistant Lecturer at LSE, in 1932, he could fairly be classified as an adherent of the Austrian approach (see also Kaldor, 1935). In his recollections, Kaldor (1986, p. 7) admitted that "[i]n 1932 I was much under the influence of the views not only of Robbins but also of Hayek." As Hayek (1994, p. 86) notes, Kaldor "occasionally freely admitted that in his beginnings he was a Hayekian." In the early 1930s, therefore, Kaldor could be called an Austrian economist. What changed? In Hayek's (ibid.) impression, "it was Keynes' *Treatise* which convinced him, and got him around the other side. And he worked closely with Beveridge. He wrote Beveridge's book on unemployment." However, Kaldor declared that "[m]y enthusiasm for the doctrine of Professor Hayek had already suffered a relapse when as a first year research student I undertook to translate his '*Gibt es einen 'Widersinn des Sparens'*?' article into English, and in the course of struggling with the translation detected various gaps and flaws in the argument." Nevertheless, this state of affairs was only really subverted in 1933 due to two main reasons related to the role of capital, interest and equilibrium in a dynamic economy.

First, Piero Sraffa's (1932a) review of Hayek's *Prices and Production* was a strong blow to the initial intellectual euphoria created by the lectures at LSE. Sraffa argued that outside the

stationary equilibrium there are as many natural interest rates as there are commodities. There are a set of rates in which some will be above, and some will be below, the money rate. Thus, monetary neutrality in Wicksellian terms is far from unproblematic. Second, Hicks introduced Kaldor to the work of the Swedes, particularly Gunnar Myrdal. Kaldor and Hicks were close friends at the time. Kaldor (1983, p. 7) "spent many hours in discussion in our neighbouring flats, on Sunday walks, or occasionally on a Continental holiday." Kaldor (ibid.) writes that "Hicks (unlike me) was an indefatigable reader of books in at least three foreign languages, and it was owing to him that I was put on the track (among others) of the younger Swedish economists, particularly Myrdal, who first made me realise the shortcomings of the 'monetarist' approach of the Austrian School of von Mises and von Hayek and made me such an easy convert to Keynes after the appearance of the *General Theory* three years later."

Both Hicks and Kaldor read the German revised version of Myrdal's "Der Gleichgewichtsberiff als Instrument der Geldtheoretischen Analyse" (1933) published in an "omnibus" book, *Beiträge zur Geldtheorie* (1933b), edited by Hayek. Indeed, they probably read the original German manuscript when Myrdal was visiting the LSE in 1933. Hicks (1934) wrote a very positive review of the book in the November 1934 issue of *Economica*. Myrdal's original article first appeared in 1932 in Swedish under the title "Om penningteoretisk jämvikt" (1932) in *Ekonomisk Tidskrift*.

Originally, the space in Hayek's *Sammelband* book was destined for a contribution by Erik Lindahl but he was unable to deliver the submission in time and suggested Myrdal as a contributor. Although Hayek opposed Myrdal's argument and its implications, he reluctantly accepted it. Finally, in 1939, an English book translation appeared as *Monetary Equilibrium* ([1939] 1965) with some modifications, after Keynes' prophesied revolution. Myrdal's short book, Kaldor (1986, p. 7) notes, "contained many of the features of Keynes' system particularly as regards the role of expectations in investment and the relation of the marginal efficiency of capital to the rate of interest."

Business cycle, capital theory, and equilibrium

In late October 1930, the long-awaited *A Treatise on Money* (1930) by John Maynard Keynes was finally published. The book received great criticism from the contemporary audience. Even within Cambridge corridors, the *Treatise* was widely criticized by established figures such as Arthur C. Pigou and Dennis Robertson. In addition, it was also criticized by more sympathetic younger figures such as the members of the Cambridge Circus around Keynes, composed of Sraffa, Kahn, Joan and Austin Robinson, and James Meade. Meanwhile, at LSE, Robbins had in charge Hayek to do a review of the *Treatise* for *Economica*, which part I was published as "Reflections on the Pure Theory of Money of Mr. J. M. Keynes" (1931c) in August 1931. This, of course, was the beginning of the famous controversy between Keynes (1931) and Hayek (1931d, 1932a). In his early response to the review in the November issue, Keynes attacked Hayek's *Prices and Production* (1931b), published in September 1931, and ultimately asked Sraffa to do a review of the book for the *Economic Journal*.

Hayek's main critique of the *Treatise* is that Keynes attempted to structure a business cycle theory based on monetary causes drawing from Wicksell's cumulative process without working first in the real-based capital infrastructure of a decentralized economy within a relative price coordination system. In his first book on *Value, Capital, and Rent* ([1893] 1954), Wicksell integrated Böhm-Bawerk's capital theory and its average production period into a general equilibrium framework, in what became known as the neoclassical synthesis of the Austrian theory of capital. However, Wicksell's cumulative process developed and worked in his *Geldzins und Güterpreise* ([1898] 1936) is only a matter of the effect of changes in the interest rate on prices in the sense of a general price level. The Austrian business cycle theory

is concerned with the proper capital micro-foundations and their movements caused by relative prices regarding the macro-phenomena of industrial fluctuations.

This contrasts with the aggregate approach that Keynes employed in his *Treatise*, as exemplified by the Fundamental Equations and its average macroeconomic definitions (e.g. average entrepreneurial profit or losses). Indeed, it also contrasts in some sense with Wicksell's (and Keynes') theoretical corollary regarding the stabilization of the price level. The controversy between Hayek and Keynes in 1931 was a controversy regarding the heritage of the Wicksellian legacy, in what Axel Leijonhufvud (1981) called the "Wicksell connection." Hayek's (1931c, p. 279) review of Keynes' *Treatise on Money* is very clear on this point saying that "[i]n Wicksell's system these [cumulative processes] are necessary outgrowths of the most elaborate theory of capital we possess, that of Böhm-Bawerk. It is *a priori* unlikely that an attempt to utilise the conclusions drawn from a certain theory without accepting that theory itself should be successful."

It is in this context that Sraffa's review of *Prices and Production* and Myrdal's critique of Wicksell's conditions of monetary equilibrium are relevant. Indeed, in Lachmann's (1986, p. 226) opinion, "Sraffa's review was an onslaught conducted with unusual ferocity, somewhat out of keeping with the tone ordinarily adopted by reviewers in the *Economic Journal*." According to Sraffa (1932a, b), there is no qualitative difference between *ex ante* voluntary savings and *ex post* forced savings. The only difference is in terms of income distribution from which economic participants the new savings appropriate to the new amount of investment will be generated. Indeed, in both cases, the necessary savings will be generated in the same process through income variation if the transition to the new structure of production is completed.

However, Sraffa went further. He sustained that, in a world without money, even in the long run with capital variability the question of traversing to a new intertemporal equilibrium that Hayek posed would not be a problem. Outside stationary equilibrium, Sraffa argued that the natural rate of interest is a fictitious notion. In his view, Hayek misused the Wicksellian long-run natural interest rate in the construction of his cycle theory. Outside the long-run equilibrium, Sraffa continued, there are as many natural rates as commodities so the question of a supposed traverse to a new equilibrium is misplaced. There would be multiple equilibrium positions compatible with the same physical capital structure and capital goods. Therefore, once the long-run equilibrium is perturbed, the equilibrium position itself would be undetermined.

Hayek (1932b, p. 245) conceded Sraffa's point that there would be as many natural rates as there are commodities, but he maintained his ground that all these would be equilibrium rates. "[T]here would be *no single rate*," but "there might, at any moment, be as many 'natural' rates as there are commodities, *all* of which would be *equilibrium rates*," in an intertemporal equilibrium view. Sraffa was criticizing the Austrian theory of capital which connects a notion of intertemporal equilibrium between consumers' time preference – a rising waiting function rate for the ratio between goods in the present (consumers' goods) and in the future (capital goods) – and the average length of production, which at the margin gives us the marginal productivity of capital of the roundabout period of production. In equilibrium, the marginal productivity of capital is equal to the consumers' intertemporal preference (the waiting rate), this rate is the natural interest rate. For Hayek, divergences between money and natural interest rates implied misallocation in the real capital structure from intertemporal equilibrium – which was the cause of business cycles.

However, Wicksell's neoclassical synthesis of the Austrian capital theory derived from Böhm-Bawerk had some restricted assumptions. Wicksell assumes (1) a stationary state (i.e. a long-run equilibrium), (2) a uniform one-year production period, and (3) the technical impossibility of lengthening or shortening the investment period. Wicksell then proceeds to suppose a rise in the natural rate caused by some exogenous factor (e.g. a rise in the rate of technological progress or population growth) while the money rate remains constant to argue that an upward cumulative process would persist until the gap between the two rates

continues. As Thomas (1936b, p. 292) noted, Lindahl (1930, pp. 36–7) had already called attention that "if the investment period is technically rigid, there can be no 'natural' rate of return on capital which is independent of the loan rate of interest." The notion of the natural rate in Wicksell's cumulative process is grown from his capital theory that assumes only one variable factor of production and one product, therefore, the proportion of output to input varies directly with the period of consumers' waiting.

As Thomas (1936b, p. 292) observed, "a lowering of the money rate brings about a redistribution of income in favour of classes whose ability and willingness to save are relatively high. On this account, therefore, there will be a rise in voluntary saving, while, at the same time, no reduction need necessarily follow a lowering of the rate of interest." This, of course, is part of Sraffa's argument discussed above. Thomas continues saying that, echoing Myrdal and the Swedes, "[t]he upward swing can for some time be fed out of this additional saving. Whether it will develop into an inflationary boom depends to a great extent on the state of entrepreneurs' expectations."

Sraffa's criticism of the Wicksellian long-run natural rate is also a critique of Keynes' *Treatise* foundations. Indeed, in the famous pivotal chapter 17 on "The Essential Properties of Money and Interest" in *The General Theory* (1936), Keynes abandoned his earlier notion of a long-run natural interest rate and developed his new theory of interest based on the liquidity preference drawing from Sraffa's argument against Hayek. Since out of the long-run equilibrium position there are many and different natural rates as there are commodities and capital goods (i.e. many different spots and forward prices for all commodities and heterogeneous capital goods), the greatest of the own-rates is the one that at the margin sets the limit to the level of investment (thus, employment and income). And this rate will always be the money rate due to its low carrying costs and liquidity premium. This allowed Keynes to introduce the essential role of expectations in a radically uncertain environment on the determination of the long-run interest rate in the bonds market. There is no longer a single Wicksellian natural interest rate to conform to some kind of intertemporal equilibrium between consumers' time preference and marginal productivity of capital. Instead, what we find is an extremely fluid expectational and conventional environment where multiple equilibrium positions can arise (see Telles, 2022).

The Swedish connection: Myrdal's critique, equilibrium and expectations
In the second volume of his *Lectures* dealing with money, Wicksell ([1906] 1936) defines the natural rate as being "the rate at which the demand for new capital is exactly covered by simultaneous savings." That is, the natural rate is the rate at which the *ex ante* investment (demand for new capital) is exactly covered by simultaneous *ex ante* savings. Nevertheless, Wicksell did not work out the implications of his new definition (e.g. which necessarily involves anticipations of future prices) to divergences of the natural and money rates. For Wicksell, three conditions to monetary equilibrium are necessary. Namely, (1) the market rate of interest should be equal to the natural rate defined as the technical marginal productivity of the average period of production; (2) the loans fund market should operate as if funds were lent *in natura*, i.e. "as if no use were made of money, and all lending were effected in the form of real capital goods; " and (3) the price level should be constant.

Myrdal's "The Equilibrium Concept as an Instrument of Monetary Analysis" ([1932] 1933) is a devoted, detailed, and immanent critique of Wicksell's analysis, in particular, his three conditions to monetary equilibrium. In his 1934 review, Hicks (1934, pp. 480–1) classified Myrdal's little book as "to me quite the most exciting work on monetary theory which has appeared since Mr. Keynes' *Treatise* and Professor Hayek's *Prices and Production*." Independent of Myrdal's conclusions, Hicks argues that it "marks a very definite step in advance. It is even one of those books one feels loath to criticise, for fear that one's criticisms may perhaps deter some readers from examining the book itself - and that would be a disaster."

It was natural for Myrdal and others from Sweden to address and develop their theories starting from Wicksell's framework. Indeed, in the 1933 German version, Myrdal ([1933]1939, pp. 8–9) complains that in England Wicksell's framework was highly neglected and misunderstood. He mentions Robertson's *Banking Policy and the Price Level* (1926) as an important and "significant little book." However, Robertson, "too, obviously lacks a thorough knowledge of Wicksell and his pupils, and he has therefore been forced unnecessary to think for himself." Moreover, Myrdal (ibid.) continues, "J. M. Keynes' new, brilliant, though not always clear, work *A Treatise on Money*, is completely permeated by Wicksell's influence. Nevertheless Keynes' work, too, suffers somewhat from the attractive Anglo-Saxon kind of unnecessary originality, which has its roots in certain systematic gaps in the knowledge of the German language on the part of the majority of English economists."

Of course, this was emphasized by Hayek in his position against Keynes. Until 1933, as Hicks (1934, p. 479) pointed out, only two streams of thought originating from Wicksell's *Geldzins* were presented and "generally familiar to the English reader. There is the school of Professor Mises and Professor Hayek; there is the school of Mr. Keynes. It is perhaps fortunate that these do not in reality exhaust the list." This is relevant because it showed that a Wicksellian-inspired theory could be very different from the business cycle theory propagated by Mises and Hayek.

After restating Wicksell's conditions to monetary equilibrium, Myrdal ([1933] 1939) submits each of the three conditions to several criticisms. First, following Davidson's argument, he argues that the equality of the money and natural rates and money neutrality does not necessarily imply the price level being unchanged, i.e. conditions (1) and (2) do not necessarily imply condition (3). Second, following Lindahl's steps, Myrdal states that the seemingly objective and technical quality of the equilibrium natural rate is derived exclusively from the simplicity and irrealism of the assumptions that constituted Wicksell's theory of capital, namely, one original factor of production and one finished good. Indeed, as Hicks (1934, p. 481) notes, this is "[a]n argument made familiar to us in England by Mr. Sraffa" in his review of Hayek's *Prices and Production*.

Once the unrealistic hypothesis of the Austrian theory of capital is dropped, e.g. allowing for a multiplicity of finished products, Myrdal argues that the natural rate of capital goods can only be understood as an expected rate of yield or profit, in monetary terms. The natural rate can only be interpreted as the marginal value product, the result of the marginal physical product of the factor multiplied by the expected average revenue or price of the product. This introduces many new elements to monetary equilibrium, especially psychological and expectational factors regarding future prices. In addition, it means the abandonment of the rigid notion of a capital structure defined by a single natural rate of interest. As Hicks (1934, p. 481) writes, "this interpretation not only makes the natural rate dependent on psychological elements (the expected course of prices), but it also raises serious difficulties about 'maintaining capital intact,'" an expression used by Hayek to design the real capital allocation in a scenario of money neutrality.

In face of these modifications, Myrdal argues that the Wicksellian first condition of monetary equilibrium translates to the equality between the value (the new, expected "natural" rate) and cost (the money rate) of production of new capital goods. This value-cost equation is dependent in both terms on the market rate of interest. Concerning the second condition, Myrdal shows that it can only be interpreted as the equality between savings and investment. Moreover, since the natural rate is the rate at which the *ex ante facto* demand for new capital is exactly covered by simultaneous savings, this equality necessarily implies the equality in the value-cost equation of the first condition and *vice versa*. Therefore, Myrdal demonstrates that divergences between savings and investment (i.e. a divergence between the value and cost of capital goods) are always fulfilled by profit and losses by the entrepreneurs.

Savings and investment can be different only *ex ante* when all the different expectations of entrepreneurs and their action plans are simultaneously aggregated. These expectations encompass, for instance, expected income, i.e. income looked forward and anticipated by entrepreneurs and workers. In the workers' case, these expected incomes can in general be counted since they are submitted to nominal contractual arrangements. In contrast, the entrepreneurs bear the risk and uncertainty of contracting labor and inputs for pay when there is nothing that guarantees that their expected revenue product value will be concretized. If their revenue is less than expected, they realize a loss – and, in the aggregate, savings proved to be greater than investment. However, quantities that are registered in the bookkeeping records are quantities seen *ex post facto*. In this sense, savings and investment are always equal by definition and cannot be distinguishable due (in Myrdal's – and also in Keynes' *Treatise* – analysis) to the equilibrating role of variations on prices (profit and losses). In fact, the celebrated Stockholm terms of *ex ante* and *ex post* in Myrdal's analysis were only introduced by the German translator in 1933. This is a rare case of gains of clarity and understanding in translation.

Drawing from his reinterpretation of Wicksell's natural rate as a monetary yield or profit rate involving expectational and psychological elements, Myrdal concludes that any price level could be compatible with monetary equilibrium [4]. There is an indeterminateness of monetary equilibrium in relation to the price level – even if the amplitude of price-level movements is limited by sticky nominal prices such as long-term contracts, wage rates, etc. This led Myrdal to abandon not only Wicksell's price-level stabilization but the inverted relation between the price level and productivity gains in productivity norms to the price level defended by Davidson, Lindahl, Hayek, and others. Therefore, Wicksell's third condition of monetary equilibrium regarding the price-level stability is denied.

For Myrdal, the only concept which is not touched on in his critical remarks is the Wicksellian cumulative process, implied in monetary disequilibrium. However, as Hicks (1934, p. 483) writes in his review, "at the stage he has reached, has he the right to refer back to Wicksell any longer? Just what is the precise difference between such a cumulative process and the sort of inflation which he would consider, theoretically at least, as consistent with monetary equilibrium?" Indeed, Hicks (ibid.) asks, "what is the point of Professor's Myrdal monetary equilibrium?" After this, Hicks notes that there is "nothing which altogether convinces one that the [monetary equilibrium] concept, in the form in which he has left it, remains an essential part of monetary theory."

Myrdal's critique is an imminent criticism of the equilibrium concept as an instrument of monetary analysis. Myrdal emphasizes the fundamental importance of expectations (i.e. anticipations) to the definition of the natural rate of interest. In Myrdal's hands, Wicksell probably would not recognize the natural rate as being his offspring. The internalization of expectations to the natural rate changed the whole character of a supposed unique, long-run equilibrium stable rate. Any price-level dynamics could be compatible with monetary equilibrium.

After reading Myrdal, Kaldor (1934b) used the *ex ante* and *ex post* analysis in his contribution to a debate that occurred in the pages of *The Economist* concerning the objective of monetary policy, namely, "Stable prices or neutral money." In a growing economy with increasing productivity, Hayek argued that aiming for general price stability was not sufficient to guarantee the equality between money and natural interest rates. In this case, the average price stability target implies a situation out of monetary equilibrium in the monetary market (the money rate is lower than the natural rate) and in the real-goods market (investment is greater than voluntary savings). Hayek ([1929] 1933a) had argued that this was precisely the case experienced by the United States in the 1920s, where the average price-level stability in a productivity-increasing economy obscured the expansionist monetary policy practiced by the Federal Reserve System in that decade. A monetary expansion that culminated in the 1929 bust and the Great Depression.

Hayek (1931b, p. 126) was opposed to the aims of monetary policy guided by the "widespread illusion that we only have to stabilise the value of money in order to eliminate all monetary influences in production." Hayek's (1934) policy recommendation was for monetary policy to follow a productivity rule, in which the price level should vary inversely to the productivity gains in a growing economy (e.g. see Selgin, 1999). In Hayek's (1931b, p. 130) framework, neutral money is not necessarily equal to stable prices. Money is neutral if the economic decisions and allocations (in particular, intertemporal decisions and the capital structure) are "as if they were only influenced only by the real factors."

On the other hand, Harrod (1934) argued that the equality of savings and investment is tautological and always true. In particular, this tautology is also valid in the case of a stable price level. Indeed, Harrod believed that the equality between savings and investment is compatible with any behavior of the price level. Therefore, it is also true in the case of money neutrality and stable price level. Kaldor (1934b) entered the debate in a middle-ground position between Hayek and Harrod. Using Myrdal's *ex ante* and *ex post* analysis, Kaldor (1934b) argued that the compatibility between stable prices and money neutrality depends on the correct foresight by economic agents in relation to the price-level dynamic path.

In this sense, both a falling and a stable price level can preserve money neutrality if this scenario is correctly predicted *ex ante*. There is a multiplicity of equilibrium positions that combine different price levels with perfect foresight solutions. In this scenario, any policy can be practiced without falling out of the neutrality of money if the banking policy and prices are correctly predicted. Since the natural rate of interest embodies expectations, the only way to have a monetary disequilibrium is if a divergence occurs between *ex ante* expectations and *ex post* facts.

Myrdal's monetary equilibrium was also, in part, a response to the use by Mises and Hayek of the Wicksellian cumulative process in a business cycle theory – beyond the short-period price-level determination. Indeed, Myrdal ([1933] 1939, p. 32) maintained that the main purpose of his work was to "include anticipations in the monetary system." Something that the recent contributions had completely failed to do – in particular, the theses advanced by Keynes and Hayek. In both Keynes' *Treatise* and Hayek's *Prices and Production*, in his opinion, there was simply "no place for the uncertainty factor or for anticipations" in their theoretical construction. The Swedes showed that a Wicksell-inspired theoretical framework could be very different from the one propagated by the Austrians. Thus, the policy recommendations could also be radically different.

The Welsh economist Brinley Thomas introduced and spread the word of the Swedes at the LSE and in England in general. Thomas completed his Ph.D. at LSE in 1931, being appointed as Assistant Lecturer in the same year. In 1932, he was awarded an Acland Travelling Scholarship to study in Germany (for nine months) and Sweden (for six months) in the period spanning 1932–4. He would return to Sweden many times thereafter. In this period, Thomas was acquainted with the Swedish developments in monetary theory and practice, mastering the advances made by Wicksell, Davidson (who had played a significant part in Swedish economic policy), Gustav Cassel, Lindahl, Myrdal, and others. Thomas (1936a) propagated Myrdal's ideas on monetary equilibrium in his lectures at LSE, using the *ex ante* and *ex post* terminology [5] and soon converted Hicks, Kaldor, and George L. S. Shackle [6].

The London reaction: Hayek, Hicks and Kaldor
Written in the spring of 1932, Myrdal's *Monetary Equilibrium* ([1933] 1939, p. 32) was a direct attack on the perfect foresight assumption. "The main purpose of the subsequent analysis," Myrdal writes, "is to include anticipations in the monetary system. A criticism of Keynes and Hayek would have to begin by pointing out the fact that in their theoretical systems there is no place for the uncertainty factor and for anticipations." In Keynes' *Treatise*, this is explicit

in his Fundamental Equations equilibrium, in particular, in his notion absorbed from John Bates Clark of windfall profits and unexpected losses.

In Hayek's theory, although Myrdal (p. 32) concedes that it has "the merit of a more intensive analysis of the roundabout process of production and consequently of the questions of profitability," the analysis "is stationary or quasi-stationary only." Indeed, in 1931, Hayek compared two processes of capital accumulation. One is a successful traverse between two stationary states financed by voluntary savings, the other is a failed traverse, initiated by a false intertemporal relative price and drastically interrupted in the process of plans revision. In Myrdal's (p. 33) opinion, Hayek developed an "abstract case where among other things anticipations are excluded by assumptions which are fundamental to the whole analysis."

After its publication, Robbins asked Hicks to write a mathematical appendix to Hayek's *Prices and Production*. Hicks struggled with this effort since at the core of its difficulties was the appropriate equilibrium concept to represent a disequilibrium development within equilibrium theory. Indeed, as Hayek stressed in many places, his cycle theory is only comprehensible within the notion of intertemporal equilibrium formulated in his 1928 article. This essay is the starting point to a dynamic equilibrium analysis, where the equilibrium price vector is the one in which demand and supply of different commodities at different dates are equal. Thus, to reach equilibrium, this equilibrium price vector must be anticipated by economic actors, resulting in the perfect foresight condition intrinsically connected with intertemporal equilibrium.

In this vein, in June 1933, Hicks published in *Zeitschrift fur Nationalokonomie* his first work dealing with monetary theory. It was translated into English as "Equilibrium and the Trade Cycle" and published by Robert Clower only in 1980. In this essay, Hicks (1933) tried to generalize an equilibrium notion compatible with money and its relation with the business cycle, beyond stationary equilibrium. Following Frank Knight's (1921) argument, Hicks concludes that a positive demand for money only is justifiable under imperfect foresight, i.e. under intertemporal disequilibrium. Thus, as it is well known in the case of the Walrasian general equilibrium model, monetary theory *stricto sensu* is incompatible with equilibrium theory.

Hicks proposed to incorporate money in the sphere of the theory of value instead of the theory of capital. Under Swedish influence, in particular Myrdal, Hicks (1933, p. 143) substituted the notion of intertemporal equilibrium for his notion of temporary short-run equilibrium with given expectations and constant equipment in his 1935 article on "Wages and Interest" (1935b), *en route* to his "Suggestion to Simplifying Monetary Theory" (1935a). In this temporary sequential equilibrium, expectations are regarded as exogenous, thus the equilibrium in a determined Hicksian week did not imply that individuals' plans are compatible in the future (i.e. it did not imply intertemporal equilibrium with perfect foresight). In this manner, Hicks adapted the Walrasian equilibrium notion to the short period including nonstationary conditions and the existence of money (as a reserve of value).

In response to Myrdal's critique, Hayek gave a lecture on "Price Expectations, Monetary Disturbances and Malinvestments" ([1933] 1935) delivered in December 1933 in the *Sozialökonomisk Samfund* in Copenhagen. The paper was first published in 1935 in German in *Nationalokonomisk Tidsskrift*, reprinted in French also in 1935 but only translated into English and published in his collection of essays *Prices, Interest, and Investment* (1939) in 1939. At the end of his lecture, Hayek ([1933] 1939, p. 155) acknowledged that "I cannot quite agree with Professor Myrdal when he alleges that in my theory there is no room for the role played by expectations - to show how important a place they do play was in fact one of the purposes of this lecture."

It is in his Copenhagen lecture that Hayek first expresses his discontent with the theoretical apparatus of equilibrium analysis to deal with dynamic, expectational, and imperfect foresight situations, problems involved in business cycle theory. In addition, as

Nicolai Foss (1995) called attention, it is in this lecture that Hayek first conceptualized the epistemic distinction between individual objective equilibrium and social intersubjective equilibrium. Moreover, he also articulates for the first time the notion of subjectivity of knowledge and expectations. This would be a crucial building block in Hayek's reformulation of equilibrium analysis in his pivotal essay on "Economics and Knowledge" (1937). As Hayek (1983, p. 425–6) explained in an interview,

> It was, as we just discussed, my essays on socialism, the use in my trade-cycle theory of the prices as guides to production, the current discussion of anticipation, particularly in the discussion with the Swedes on that subject, to some extent perhaps Knight's *Risk, Uncertainty and Profit*, which contains certain suggestions in that direction – all that came together. And it was with a feeling of a sudden illumination, sudden enlightenment, that I wrote that lecture in a certain excitement. I was aware that I was putting down things which were fairly well known in a new form, and perhaps it was the most exciting moment in my career when I saw it in print.

The Copenhagen lecture anticipated many of the discussions that Hayek posed in his 1937 critique of the perfect knowledge assumption of standard equilibrium theory. In "Economics and Knowledge," Hayek (1937, p. 33) begins by reminding the reader of different attempts made "to push theoretical investigation beyond the limits of traditional equilibrium analysis," whose "answer has soon proved to turn on one question which, if not identical with mine is at least part of it, namely the question of foresight."

Hayek mentions the discussions concerning foresight in the theory of risk, especially starting with Irving Fisher's *Appreciation and Interest* (1896) and developing in Knight's (1921) profound work. Moreover, such assumptions are of fundamental importance in the "theory of imperfect competition, the questions of duopoly and oligopoly." This was emphasized by Morgenstern's (1935) famous essay claiming that any perfect foresight process was inconsistent with convergence to equilibrium. Morgenstern illustrates his argument, in this case, a strategic interaction between two agents, with his Holmes-Moriarty paradox.

Hayek (1937, p. 41) refers to this work in his article. More importantly for our purposes, however, is that "it has become more and more obvious that in the treatment of the more 'dynamic' questions of money and industrial fluctuations the assumptions to be made about foresight and 'anticipations' play an equally central role, and that in particular the concepts which were taken over into these fields from pure equilibrium analysis, like those of an equilibrium rate of interest, could be properly defined only in terms of assumptions concerning foresight. The situation seems here to be that before we can explain why people commit mistakes, we must first explain why they should ever be right" (p. 34).

Hayek reformulates equilibrium analysis in terms of compatibility of action plans conducted by different agents with different subjective, dispersed, and tacit knowledge of the same objective reality. Since individual knowledge is "all facts given to the person in question, the things as they are known to (or believed by) him to exist, and not in any sense objective facts" (p. 36), each individual must take into his own action plan the expectations over the other individuals' plans as an objective fact. In this sense, social equilibrium means that each agent has correctly predicted in a special sense all the action plans carried over by the rest of society and the external reality. Hayek ([1937] 1948, p. 42) concludes, in consequence, that "[c]orrect foresight is then not, as it has sometimes been understood, a precondition which must exist in order that equilibrium may be arrived at. It is rather the defining characteristic of a state of equilibrium."

Hayek mentions his Copenhagen lecture in "Economics and Knowledge," referring to it as a concrete example of the meaning of a state of equilibrium defined as the coordination of plans and how it can be disturbed. The intertemporal coordination problem of savings and investment is, in this sense, "the proportion (in terms of relative cost) in which entrepreneurs

provide producers' goods and consumers' goods for a particular date, and the proportion in which consumers in general will at this date distribute their resources between producers' goods and consumers' goods" (p. 42). As he put it ([1933] 1939, pp. 153–4), the consistency between these two sets of independent decisions made by different agents implies the savings-investment equilibrium and "the idea of an equilibrium rate of interest." Assuming a unitary elasticity of expectations, a money rate below the natural rate, Hayek argues, creates unfounded expectations in entrepreneurs concerning the intertemporal consumption behaviors of the society.

Until 1933, the subjective element was not present in Hayek's writings, although the notion of division of knowledge had been incorporated. In his Copenhagen lecture, Hayek ([1933] 1939, p. 139) contrasts individual equilibrium in the realm of the pure logic of choice – something which we can define as "a necessary equilibrium between the decisions which a person will make at a given moment" due to subjective consistency between means and ends – and societal equilibrium, a much more vague notion since individuals' "successive responses to their fellow-beings necessarily take place in time."

In 1933, Kaldor was an active participant in the notable weekly seminar organized by Robbins and Hayek at LSE. It was at the seminar that Kaldor read his paper on "A Classificatory Note on the Determinateness of Equilibrium" (1934). In this important essay, Kaldor (1934, p. 125) describes the conditions in which an equilibrium position can be classified as determinate or indeterminate ("according as the final position is independent of the route followed or not"), unique or multiple ("according as there is one, or more than one, system of equilibrium prices, corresponding to a given set of data"), and definite or indefinite ("according as the actual situation tends to approximate a position of equilibrium or not"). Kaldor was searching for a more rigorous definition of the assumptions utilized in which was possible to determine the existence, stability, and uniqueness of the equilibrium position from a system of data (independent variables).

Kaldor (p. 123) makes six general assumptions under which economic theorists had found it necessary to define an equilibrium position taking into consideration the time dimension. (1) A closed economy (either an isolated individual or a closed self-sufficient community); (2) perfect knowledge, i.e. "all the relevant prices quoted in all markets are known to all individuals; " (3) perfect competition, i.e. "no individual can influence any of the prices which he is confronted; " (4) direct exchange, with all prices expressed in one good working as the *numéraire*; (5) all independent variables remain constant through time; (6) no price -changes are anticipated, i.e. the Hicksian elasticity of expectations is unitary.

In relation to the time-dimension assumptions (5) and (6), Kaldor (p. 123) notes that "[t]he only alternative assumption consistent with the degree of abstractness necessary for the generalisations of pure theory would be the assumption of *complete foresight*: that everybody foresees correctly the future course of prices." Thus, referring to Hicks' 1933 essay on "Equilibrium and the Trade Cycle," Kaldor argues that the complete foresight assumption could be more conveniently adopted as dynamic analysis.

According to Kaldor (1934, pp. 124–5), in the case of determinateness, to secure equilibrium, it is necessary that "(1) an equilibrium system of prices *will* be established immediately, or (2) the set of prices actually established leaves the conditions of equilibrium unaffected (in which case the final position will be independent of the route followed)." Similar to Hayek (1937), Kaldor distinguishes requirements for equilibrium in the case of the isolated individual and a closed community. In the first, Robinson Crusoe must possess "full experience" or full knowledge of his tastes, preferences and the external world. The word experience is used here merely to relate to Crusoe's knowledge. "It excludes any accumulation of knowledge which represents a change in the technical terms at which he can obtain various things."

In a community, the necessary conditions to equilibrium are more rigorous. We must assume not only that all individuals have full knowledge regarding their own tastes, abilities,

and external experience, but that "*all* exchange transactions are undertaken at the same system of prices." Kaldor mentions the *Deus ex machina* devices such as Walras's *tâtonnement* (excluding *ex hypothesi* trading at false, nonequilibrium prices) and Francis Y. Edgeworth's "principle of re-contract" – where provisional contracts operate until no recontracts can be made with advantage to the recontracting parties. Both analytical methods are devices to discover the true equilibrium prices *before* individuals undertake their exchanges. In this sense, equilibrium will always be determinate if it is immediately reached. Thus, Kaldor (p. 127) concludes that one central problem in equilibrium theory is that "[t]he formation of prices must *precede* the process of exchange and not be the result of it."

Kaldor then discusses the implications of the independence of the equilibrium position and the actual path followed to this position for equilibrium to be determinate. At the individual level, Crusoe's system of data in one period must not be affected by his actions in previous periods. It must be assumed, therefore, that there is no – or constant – carryover and that his effective preferences are unaffected between periods. In contrast, Kaldor (p. 128) argues that the effects of learning and experience through time are the elements "which the 'causal-genetic-approach' of the Austrian School ha[ve] been mainly concerned." This approach was defined by Hans Mayer (1932) in which he contrasted the Austrian approach with the Lausanne general equilibrium functional analysis. Mayer (1932) was also referred to in Hayek's 1937 article,

Kaldor summarizes the causal-genetic notion writing that its aim is "to show how, in a given situation, a position of equilibrium is reached - the problem of how prices come into being rather than what system of prices will secure equilibrium. It is, however, only under our present very rigid assumptions that a causal-genetic theory can reach the same conclusions concerning the nature of equilibrium as are evolved, by using a different method, by the 'functional' theories. In the absence of these conditions it is only by means of a 'theory of the path' (a theory showing what determines the actual path followed) that a causal-genetic approach can arrive at generalisations concerning the nature of equilibrium - and such a theory has not hitherto been forthcoming, although the necessity for it has frequently been emphasised by writers of the Austrian School." Indeed, Hayek's equilibrium as a coordination problem is devoted to the expression and reformulation of this problem.

It is curious to note that, discussing the additional assumption of constant marginal utility of money introduced by Marshall in the case of a community case, Kaldor writes that "[i]f we assume that individuals accumulate experience relating not only to their own system of data but also to the 'tastes and obstacles' of others, they will gradually acquire an ability to judge the 'equilibrium prices' of a given market." Nevertheless, Kaldor is anxious to write that it can be argued "that this alternative assumption - that individuals will be able to judge equilibrium prices before any transactions are made - is inconsistent with one of our initial assumptions since it means that they are influenced by expected future prices rather than by prices already ruling. It all depends on how rigidly this assumption is interpreted, and it can easily be shown that under our present assumption of a 'constant carry-over' a *very rigid* interpretation would lead, by a different route, to the same result." A constant carryover can be translated in the consistency of *ex ante* expectations and *ex post* results, i.e. correct foresight.

In the case of definiteness, not only may equilibrium be "indeterminate" but "if the various forces do not react instantaneously on the incentive of price changes, the economic system need not tend towards a position of equilibrium at all. The successive alterations of prices will then merely represent a constant or an expanding range of fluctuations" (p. 125). In Kaldor's view, the question if equilibrium is definite or indefinite (i.e. is stable or not) depends on the velocities of adjustment of the factors in the analysis, i.e. the time required for a full quantity adjustment given a price change. For instance, consider an adjustment completely discontinuous where the full quantity adjustment occurs only after a certain period. In this scenario, the equilibrium stability (its definiteness) will depend on the relative elasticities of demand and supply.

It is here that Kaldor (1934, pp. 133–4) pronounces the novel description of the famous ideas advanced by Henry Schultz and Umberto Ricci, coining for the first time the expression "cobweb theorem," regarding the temporal lag between supply and demand sequential decisions to explain the oscillatory behavior of prices. He concludes that, in this case, "[i]f the velocities of adjustment are greater on the demand side than on the supply side, movements will lead towards an equilibrium, i.e. equilibrium will be 'definite'" (p. 135). Kaldor gives two agricultural examples, rubber and corn, since in agricultural contexts, there is a lag between planting and harvesting.

In the case of multiple equilibria, Kaldor (pp. 131–2) analyzes the intrinsic connection between stages of increasing returns to single industries (i.e. stages of diminishing technical marginal substitution rates) and the indetermination of equilibrium. In these cases, "the final situation will be 'indeterminate' in the sense that it will depend upon the direction which happens to be adopted initially; though equilibrium may still be determinate on our definition of the term, since all the possible equilibrium positions may still be deduced from the data of the initial situation." Of course, the argument reflects the notion of path dependence in which each action predetermines the possible realms in the future. We should note the intimate relation of Young's (1928) influential paper on increasing returns here, an idea that will be very dear to Kaldor.

The age of capital

The Age of Capital: 1848–75 ([1975] 2001) is the title of the second book of the trilogy on "the long nineteenth century" by the well-known Marxist historian Eric Hobsbawm. A similar age could be periodized in relation to the age of the theory of capital in "the long twentieth century" in economics, dating from the marginal revolution in 1871. We could argue that this age should be dated from 1871 to 1941, the year that Hayek finally published his *The Pure Theory of Capital* (1941). In the 1935–6 academic year, Kaldor traveled to the United States on a Rockefeller Research Fellowship, visiting Columbia, Harvard, Chicago and the University of California. He met numerous leading economists, attending the 1935 and 1936 meetings of the Econometric Society. As a product of his fellowship, Kaldor was commissioned to write the 1937 Annual Survey of Economic Theory, published in the Society's *Econometrica*.

In the survey, "The Recent Controversy on the Theory of Capital" (1937), Kaldor reviewed Frank Knight's (1932, 1936a, b) criticism of the "traditional theory" of capital, i.e. that a given index or measurement of capital intensity is positively correlated with roundaboutness of production and inversely correlated with interest rates. This "traditional theory" is nothing more than the Wicksellian neoclassical synthesis of Austrian theory of capital. In Kaldor's (1937a, p. 231–2) view, "the material content of the Austrian theory of capital could be equally well expressed by saying that capital accumulation leads to a reduction in the marginal productivity of the services of those factors whose quantity can be augmented by [. . .] accumulation, as by saying that it increases the investment period of the services of those resources whose quantity remains constant."

With his survey, Kaldor entered into the theory of capital controversy that involved Hayek and Knight in the years before (e.g. see Cohen, 2003). Kaldor adopted the Austrian tradition in the sense that a theory of capital should be characterized by the time dimension of the production period, contrary to Knight's view of a perpetual fund of goods. Knight was following John Bates Clark's concept of capital as a homogeneous social value form, an abstract always existing fund (like land) called jelly. Nevertheless, Kaldor (1937a, p. 213) dropped the average period of production (or investment period) as an index of capital intensity in favor of his favorite alternative, the ratio of initial costs to annual (maintenance) costs.

In their controversy, both Kaldor (1938a) and Knight (1938) agreed on the intrinsic problems that arise in general models with heterogeneous inputs and/or outputs so that the

results of the simple one homogeneous commodity model – namely, a decreasing monotonic function between capital intensity measured by an index of capital quantity and the interest rate – could not be sustained. Indeed, the existence of a well-behaved index measure for capital quantity in an economy in steady-state equilibrium would be revived in the Cambridge controversy on capital in the 1950s and 1960s (e.g. see Harcourt, 1972; Cohen & Harcourt, 2003). The central problem posed by the Cambridge capital controversy is the circularity of the equilibrium notion involved. The *quantum* of capital is determined by the marginal productivity principle and, at the same time, the marginal productivity of capital is determined by the *quantum* of capital. In 1936, Knight (1936a, pp. 434–5) expressed the problem arguing that the

> [d]ifficulty and complexity arise because the relation between capital and interest take different forms and especially because of the danger of circular reasoning. On the one hand, capital is usually and properly defined as 'income' capitalized at some 'rate of return'. But the interest rate is usually thought of as the ratio between the net annual yield and a quantity of capital. On the face of this is a vicious circle; interest cannot be a rate of return; i.e. a ratio to a principal, unless the terms of the ratio are definable independently of the rate return itself; yet in the same units of both numerator and denominator.

Hayek (1941, p. 143) was also conscious of these problems but argued that as a process dynamic story, as a causal-genetic notion, the average period of production and the Austrian theory of capital were relevant. In his words, "[i]n order to arrive at an aggregate figure of the amount of waiting involved in each process we have to assign different weights to the different units of input, and these weights must necessarily be expressed in terms of value. But the relative values of the different kinds of input will inevitably depend on the rate of interest, so that such an aggregate cannot be regarded as something that is independent of, or as a datum determining the rate of interest." Hayek (1994, p. 96) wrote later in life that he "rather hoped that what I'd done in capital theory would be continued by others. [. . .] [Completing it myself] would have meant working for a result which I already knew, but I had to prove [7]."

In his controversy with Keynes, Hayek criticized Keynes' failure in ignoring the Wicksellian roots in capital theory. Hayek soon sensed that the main difference between him and Keynes was grounded in the capital theoretical micro-foundations. Hayek was heavily criticized by Sraffa, Myrdal and others for incorporating in his business cycle theory the Austrian theory of capital in the simple Böhm-Bawerkian model with the average period of production. In Hayek's (1983, p. 46) view, "an elaboration of the still inadequately developed theory of capital was a prerequisite for a thorough disposal of Keynes' argument." Therefore, he went up on a big book project in which he planned a new development on capital theory drawing from and systematizing the roots of Böhm-Bawerk, Wicksell, and Mises in Volume I. Volume II was planned to introduce these new capital theoretical foundations into monetary theory and business cycle.

In the writing process, Hayek (1941, p. vi) perceived that the very simplifications that his predecessors made had "such far-reaching consequences as to make their conceptual tools almost useless in the analysis of more complicated situations." The main deficiency, in his view, was the attempt to introduce the temporal dimension in the capital structure, which resumed in the average period of production. The task showed itself much more painfully difficult than initially foreseen and Hayek did not complete his initial project, only publishing a part of what would be the first part in *The Pure Theory of Capital*. In the end, Hayek also abandoned the notion of the average period of production in 1941.

In *The Pure Theory of Capital* (1941, pp. 23–4), Hayek adopts his reformulation of equilibrium analysis in terms of compatibility of plans. The equilibrium is understood as "a state of complete compatibility of *ex ante* plans," where in consequence "the *ex post* situation

is identical with the *ex ante*." He states, mentioning Myrdal's *Monetary Equilibrium* (1939, p. 46), that this causal analysis "is not fundamentally different from the comparison between the prospective and retrospective (or *ex ante* and *ex post*) views · of a particular situation, as used by the younger Swedish economists since the *ex post* situation can be derived from the *ex ante* only by reference to the degree of correspondence or non-correspondence between individual intentions."

In the Kaldor and Knight controversy, as Avi Cohen (2006, p. 156) documented, the debate focused "on three questions: Is capital a distinct factor of production? Is capital quantifiable in a theoretically consistent manner? Do we need process stories around convergence to, or changes in, equilibrium interest rates? To all questions, Kaldor essentially answers 'yes' to Knight's 'no.'" Kaldor assumed (again) a middle-ground position between Knight and Hayek, but he essentially defended the Austrian capital theory as the only theory known capable of systematizing the causal-genetic relationships and the process dynamic story between the quantity of capital and interest rates. As a positive theory of capital, the Austrian theory was "the only one yet produced."

In the Kaldor and Knight controversy, the long historical points in dispute in the capital theory wars since the controversy between Clark and Böhm-Bawerk in the early twentieth century moved from the adequacy of periods of production to the production function form; and from roundaboutness as a proper index to capital intensity to diminishing returns. This controversy was pivotal to Kaldor's conversion concerning the theoretical shortcomings of a pure theory of capital and its interrelations with equilibrium. As Kaldor (1937) wrote to Knight,

> [T]he Austrian theory was a grand attempt at a 'positive' theory of capital, in fact the only one yet produced. It failed, and the theory must be rejected, for it could not survive the criticisms leveled upon it [. . .]. On the other hand, I do believe that the disappearance of Böhm-Bawerk and his school leaves behind a vacuum in economic theory as we know it and I doubt if it will be filled. To me its failure points to the necessity for the abandonment of the whole system of analysis (of the static equilibrium type) of which the Austrian theory was a part.

Growth, capital accumulation, and distribution

In 1938, Kaldor published "Stability and Full Employment" (1938b) on the question of stability of full employment vis-à-vis the non-variability of the structure of production. He emphasized the crucial aspects of complementarity and specificity of capital goods that composed the structure of the means of production. Indeed, this was precisely the point that Hayek had argued in relation to industrial fluctuations but in terms of the stages of production and capital organicity. As it is well known, in a Leontief production function (which exhibits perfect production factors complementarity), the transition, or the traverse to, different equilibrium states are far from unproblematic and could threaten the possibility of a full employment long-run stability position.

This is precisely the case worked in Harrod's (1939) dynamic instability analysis and posed by the second Harrodian (equilibrium instability) problem. Assuming a complementary production structure, that can be expressed in a Leontief production function, Harrod showed that given the capital–output ratio to be constant there is a unique warranted capital accumulation rate that guarantees the equality between aggregate demand and aggregate supply along the equilibrium dynamic path. However, to secure the full employment position along time with increasing population and technical progress, the warranted growth rate (gW) has to be equal to the natural rate of growth (gN) defined as the rate of growth in which output is constrained at full employment given the population and technological growth rate. Thus, the balanced growth rate with full employment of the labor

force and technological progress must satisfy the following condition, $gN = \frac{s}{v} = gW$ (1), where s is the marginal propensity to save and v is the capital–output ratio.

However, although possible, there is no economic adjustment mechanism that guarantees that the parameters in the equilibrium condition described in Equation (1) will take the necessary values to match the warranted and natural growth rates. Indeed, as the variables s, v, and gN are determined by different exogenous factors, it is highly improbable that the equilibrium conditions will ever be attended to. Moreover, even if a full employment situation is achieved, this position is unstable since any shock or change in the parameters will launch the economy on a dynamic instability path through time. Harrod conjectured an inherent instability of gW, so even if $gN < gW$ full employment will be achieved but it could not be sustained for a long time. In fact, in this case, if gW is stable, the economy would be in an explosive growth trajectory [8]. The reconciliation of the warranted rate of capital accumulation with the natural rate of growth became the basic dynamic economic problem.

There are only two ways to restore the stability of the equilibrium dynamic path. First, the capital–output ratio (the capital intensity) can be the adjustment variable between differences in the warranted and natural growth rates. This solution was exactly the kind of approach that the Austrian theory of capital predicted and that Hayek had worked on in his business cycle theory. In this theory, divergences between the natural and monetary interest rates distort the intertemporal equilibrium between the capital–output ratios defined as the length of production of the average production period, thus the traverse to the new equilibrium would be aborted because of the capital structure maladjustments due to the new required forced savings. Indeed, it was the endogenization of the capital–output ratio via a Cobb-Douglas production function – with the elasticity of substitution equal to one and diminishing returns – the grand neoclassical solution made by the Solow-Swan model to the Harrodian instability dilemma.

Nevertheless, Kaldor used the same argument of complementarity and specificity of capital goods in the structure of production to state that for these same reasons the capital intensity as measured by the capital-output relation is *inelastic* as a medium and long-run adjustment mechanism between gW and gN. Anthony Thirlwall (1991, p. 24) writes that "[t]he paper that gave Kaldor the most intellectual satisfaction, however, and his most notable, but neglected, contribution to the immediate Keynesian revolution, was 'Speculation and Economic Stability' (including 'Keynes's Theory of the Own-Rates of Interest' originally written as an appendix, but published much later) [9]." In a private correspondence with Kaldor, Hicks described this article as the "culmination of the Keynesian revolution in theory. You ought to have had more honour for it" (quoted in Targetti and Thirlwall, 1989, p. 4).

In "Speculation and Economic Stability" (1939b), Kaldor argued that the elasticity of demand for holding stocks is distinct from the elasticities of flows of the ultimate buyers and sellers. Due to speculation forces, prices are stabilized; and the greater the stability of prices, the greater the instability of quantities. According to Kaldor, the most important asset in an economy that speculation forces tend to stabilize is the long-term bonds market canalized by savings. With the long-term bonds' prices stabilized, the adjustment mechanism between savings and investment must be variations in income, securing the conditions for the validity of the income multiplier and Keynes' principle of effective demand. Thus, Keynes' multiplier theory is a result of the stabilizing influences of speculative expectations in stocks [10]. As Kaldor (1980, p. xvii) writes, his intention in the paper was

> to generalise Keynes' theory of the multiplier by demonstrating that it results from the stabilising influence of speculative expectations on prices which applies in all cases in which the elasticity of speculative stocks is high ... [and] to show that Keynes' theory of interest contains two separate propositions. The first regards interest as the price to be paid for parting with liquidity, and it arises on account of the *uncertainty* of the future prices of non-liquid assets. The second concerns the

dependence of the current rate of interest on the interest rates expected in the future. While the first proposition provides an explanation of why long-dated bonds should normally command a higher yield than short-term paper, it is the second which explains why the traditional theory of the working of the capital market was inappropriate – why, in other words, savings and investment are brought into equality by movements in the level of incomes, far more than by movements in interest rates. And this second effect will be the more powerful the *less* is the uncertainty concerning the future, or the greater the firmness with which the idea of 'a normal price' is embedded in the minds of professional speculators and dealers.

In 1939, in addition, Kaldor attempted a theoretical and empirical critique of Hayek's business cycle theory in "Capital Intensity and the Trade Cycle" (1939a), continued in his controversy with Hayek over the so-called Ricardo and Concertina effects in the pages of *Economica* in 1942 (Kaldor, 1940b, 1942; Hayek, 1942). Kaldor (1939a) addresses what determines the optimum degree of capital intensity and its relation with the trade cycle. In 1937, Kaldor argued that the investment period is only one way of measuring the capital/output ratio. Adopting an ordinal measure, he favored an index of the ratio of the initial cost to annual cost in output production. Therefore, what he called *actual* capital intensity is defined by the selling prices and costs ratio. In this sense, actual capital intensity must fall in the boom and rise in the bust period, since in the short run, capital stock is fixed and only labor can be incorporated into the production.

In its turn, *normal* capital intensity increases by more durable equipment and capital goods (which require a lower amortization per unit of output) and more automatic capital goods (which require less labor per unit of output). Kaldor (1939a) maintains that probably the normal capital intensity varies inversely with the trade cycle because real wages fall and the interest rate rises in the boom period, the exact opposite result of the Austrian business cycle theory. Moreover, the optimum capital intensity of *new* investments is determined by the technique which maximizes the area between the Keynesian marginal efficiency of the capital curve and the supply curve of investible funds [11]. In 1940, in his "A Model of the Trade Cycle," Kaldor (1940a) utilized nonlinear investment and savings functions to produce limits to the trade cycles.

In 1947, Hayek refused Kaldor's request for leave of absence, thus Kaldor resigned from LSE to become Director of Research and Planning at the recently founded United Nations Economic Commission for Europe (UNECE) in Geneva [12]. Kaldor was invited by Myrdal, the first Executive Secretary of the Commission. During his time at the Economic Commission for Europe, Kaldor developed with Myrdal the notion of circular cumulative causation (a concept that Myrdal appropriated from Wicksell and that encounters echoes and parallels in Thorstein Veblen's idea on cumulative causation). While Kaldor applied this notion mainly to the demand–supply relationships in the manufacturing sector, Myrdal concentrated on the political economy and social provisioning aspects of underdeveloped regions, arguing that there is no tendency for automatic self-stabilization in the social system. In the same manner, there is no such tendency in the economic system.

Kaldor's use of cumulative causation is closely related to the empirical positive linear long-run relationship between productivity growth and output growth, known as Verdoorn's law. In 1949, drawing from statistics of industrial production, the Dutch economist Petrus J. Verdoorn (1949) argued that output growth increases productivity growth due to increasing returns in an approximate estimated rate of the square root of the output (a Verdoorn coefficient close to 0.5). Verdoorn's article was written while he was a staff member of the Research and Planning division of the UNECE under Kaldor's direction. In his 1966 Cambridge inaugural chair lecture on the "Causes of the Slow Rate of Economic Growth in the United Kingdom" (1966), Kaldor regressed the rate of growth of labor productivity on the rate of growth of manufacturing output using data from several industrialized countries from 1953–4 to 1963–4. Using a modified version of Verdoorn's law, he explained Britain's poor

economic performance – sustaining the strong relationship particularly in manufacturing, public utilities, and construction.

Kaldor argued that the potential productivity growth is limited by the supply of labor which allows the exploration of static and dynamic (on capital accumulation and technical progress) increasing returns. This became known as Kaldor's second growth law, or Kaldor–Verdoorn law, which establishes a positive deterministic relation between the growth of manufacturing productivity and the growth of manufacturing output (see Thirlwall, 1983) [13]. The Kaldor–Verdoorn law became a crucial foundation for the cumulative causal model of economic growth, which places in demand instead of supply (e.g. *à la* Solow-Swan) the drive for growth.

In October 1949, Kaldor would return to academic life at Cambridge University, resuming the offer made after Keynes' death by the Provost of King's College in 1947. In the meantime, his interests moved from the trade cycle to economic growth, stimulated by Harrod's research. The interrelationship between the rate of capital accumulation and the rate of growth of labor productivity led Kaldor (1986, p. 17) to think about the intrinsic connection between technical progress and capital goods investment in the sense that "inventions require to be embodied in 'machines' or equipment of some kind." This means that "it is impossible therefore to isolate the effects of capital accumulation and the effects of 'technical progress' on the productivity of labor." In other words, it is impossible to isolate movements along the production function from shifts of the same function.

Kaldor then used a technical progress function, relating the rate of productivity growth and the rate of new investment per worker, completely rejecting the notion of a production function and the technological frontier of substitution between labor and capital, thus the marginal productivity theory of distribution (between wages and profits). Reflecting on Keynes' widow's cruse parable in the *Treatise on Money*, Kaldor (p. 19) concluded that to aggregate business profits to be positive (an essential fact in a market economy) the outlays of business must largely exceed personal savings and that the "savings out of profits must be large relative both to the total capital outlay and to the total profit." These two basic inequalities resulted in his Keynesian theory of distribution, namely, (2) $sP > sW \geq 0$ and (3) $sP > \frac{I}{Y} > sW$.

Kaldor relied on the endogeneity of the marginal propensity to save as a function of the income distribution (between wages and profits) as the solution for the Harrodian instability dilemma. This endogenization is an outgrowth of Kaldor's perhaps major original contribution, his Keynesian theory of income distribution delineated in the final pages of his "Alternative Theories of Distribution" (1956). Kaldor incorporates Keynes' savings propensities into a framework of income distribution *à la* Ricardo. However, using Keynes' principle of effective demand, Kaldor reversed Ricardo's causal chains, which take wages as an exogenous magnitude determined by workers' subsistence and profits as residual, by taking profits as exogenous (at a level determined by full employment investments) and wages as a residual. This reversed the causality chain of the classical Ricardian and neoclassical marginal productivity distribution theory.

In the 1950s and 1960s, Kaldor combined the technical progress function, the Keynesian savings function, and an investment function *à la* Keynes-Harrod to build his three different versions of a model of economic growth and distribution (Kaldor, 1957, 1961; Kaldor & Mirrlees, 1962), the first with the help of David Champernowne and the last co-authored with James Mirrlees. Kaldor (1986, p. 19) was able to demonstrate that "it is possible to construct a model which has a determinate solution in terms of growth rates, the capital/output ratio, the investment coefficient, the profit share and the profit-rate without involving a 'production function' or indeed marginal analysis of any kind."

The different savings propensities solution proposed by Kaldor (and later Pasinetti) was the building block of the post-Keynesian growth and income distribution models. In this class

of models, the aggregate marginal propensity to save is variable because different income recipients such as wage earners or profit recipients (Kaldor) or different social classes (Pasinetti) have different marginal propensities to save. In this manner, changes in the wages or profits participation in total income can change the total propensity to save – since the aggregate propensity to save is nothing more than a ponderate mean weight of the marginal propensities to save of different income components. Therefore, there is a determined income distribution between wages and profits which will generate precisely a corresponding amount of profit share in national income compatible with full employment predetermined investments.

Epilogue

Kaldor's solution to Harrod's instability dilemma is the forced savings scenario described by Sraffa's critique of Hayek's theory. It is interesting to note that the capital theory wars (between Knight, Hayek and Kaldor) and especially Keynes' *General Theory* killed the Austrian theory of (heterogeneous) capital in favor of Bates Clark's aggregate production function with malleable capital jelly and diminishing returns. Paradoxically, in the Cambridge capital controversy in the 1950s and 1960s, Kaldor and others would deny the existence of a well-behaved inverse relationship between capital accumulation and interest rates in the production function form in growth models, emphasizing capital heterogeneity and capital and labor non-substitutability. However, Kaldor himself abandoned all the capital theoretical issues involved in heterogeneous capital adopting the one good model with flow equilibrium in his models. As Desai (1991, p. 55) wrote, Hayek's "challenge of integrating money and heterogeneous capital in a dynamic cyclical growth model still remains. Kaldor was one of the few if not the only modern economist who knew all the pieces of the jigsaw puzzle."

In the early 1930s, Kaldor was a Hayekian economist working within the Austrian theory of capital and business cycle. In their 1931 controversy, Hayek had criticized Keynes' *Treatise* for adopting Wicksell's ideas but not his Austrian theory of capital. However, Sraffa's (1932a, b) critique of the Wicksellian natural interest rate and the traverse to a new equilibrium in a forced savings scenario, Myrdal's ([1932] 1933) critique of Wicksell's three conditions to monetary equilibrium, and Knight's (1935) reaffirmation of Clark's theory of capital, exposed not only the frailties of the Austrian business cycle theory but the limitations of the Austrian theory of capital.

The Austrian theory of capital was the epitome of the neoclassical generalizing marginal productivity theory, as exposed by Wicksteed and Wicksell. Its limitations revealed in essence the shortcomings of the theoretical apparatus of equilibrium analysis in dynamic contexts, inherent in the theory of capital and business cycle theory. This state of affairs led to Kaldor's theoretical emancipation in 1934 and later to an early conversion to Keynes' new ideas, already in circulation. It also led Hayek to his pivotal 1937 essay on "Economics and Knowledge" where he first stated the fundamental problem of social sciences, the problem of knowledge – a problem that will completely shape his entire intellectual development. These controversies also influenced Kaldor's later dissent developments in the trade cycle theory, the post-Keynesian models of growth and distribution, the Cambridge controversy on capital, and his critical views of neoclassical equilibrium economics.

In the 1970s and 1980s, Kaldor attacked what he called "The Irrelevance of Equilibrium Economics" (1972), claiming that neoclassical equilibrium economics is not a science in the strict sense of the word since the many empirical observations contradicting its assumptions and theoretical hypotheses (e.g. that most firms operate in imperfect markets) are just ignored. Indeed, Kaldor (1986, p. 5) argues that the *a priori* approach of general equilibrium theory meant that "its followers should be pre-occupied with the properties of the notion of

'equilibrium,'" resulting in the acceptance that scientific progress "took the form not of removing the scaffolding [of the simplifying and unreal postulates] but of constantly *adding* to it." In his Arthur M. Okun Lectures delivered in October 1983 at Yale University, Kaldor rather favored *Economics Without Equilibrium* (1983).

Notes

1. The close encounter between Hayek and Kaldor in the early 1930s is relatively unexplored in the secondary literature. The exceptions are Desai (1991) and the very scholarly essay by Klausinger (2011).

2. Knight's book was based on his Ph.D. dissertation at Cornell University under the supervision of Allyn Young.

3. As Hicks (1967, p. 260) put it, "In Wicksell, the 'Cumulative Process' is a matter of prices. When the 'market rate' of interest is reduced below the natural rate, prices rise. Nothing is said about the movement of quantities (inputs and outputs). On the bearing of his construction on the causation of Trade Cycles, Wicksell is open-minded. Hayek was asking the question: what happens to quantities in a Wicksellian process? He took his model very 'pure': much purer than Wicksell himself had been accustomed to take it. Prices (all prices) are perfectly flexible, adjusting instantaneously, or as nearly as matters. Price expectations are not introduced explicitly, for in 1930 their day had not yet come."

4. As it is well-known, any price-level movement pattern is compatible with general equilibrium if agents have perfect foresight.

5. The terms *ex ante* and *ex post* in relation to monetary analysis introduced in the German translation of Myrdal's 1932 article apparently only were written down in English in 1937 by Bertil Ohlin (1937) in his famous article debating with Keynes in the *Economic Journal*.

6. In addition, Thomas documented the successful economic policy experience conducted in Sweden in the economic recovery after the Great War in his important book, *Monetary Policy and Crisis: A Study of the Swedish Experience* (1936). The Swedish successful experience contrasted with the German contractionist policies in the same period. In his book, Thomas also contrasted the Swedish business cycle and monetary theories drawing from Wicksell with the Austrians, suggesting that the country had a successful experience in coordinating economic policies toward the control of the economic cycle.

7. Ian Steedman (1994) discusses in more detail Hayek's *The Pure Theory of Capital* (1941) against the background of the Cambridge capital reswitching controversy.

8. The contrary is true if gN > gW. In this case, there would be technological unemployment and the economy would be on an explosive trajectory to depression and secular stagnation.

9. Ursula Hicks, John Hicks' wife and the editor of *Review of Economic Studies*, cut off the 16-page appendix of the published version since it was already long (King, 2009). Kaldor's revised article on Keynes' theory of interest was only published in 1960 in his *Essays on Economic Stability and Growth* (1960).

10. Kaldor applies this reasoning to Keynes' theory of interest delineated in chapter 17 of *The General Theory* (1936). The term structure of interest rates is composed of a conventional rate of return on money plus a risk premium for different asset maturities. Moreover, money is the asset that sets the investment limit, thus income and employment. Keynes ([1936] 1971, pp. 223–4) claims that the rate that will prevail in the market will necessarily be "the greatest of the own-rates of interest," i.e. the marginal rate which bound the other rates. Money is always the greatest of the own-rates of interest because of its essential liquidity property (i.e. low carrying cost and high liquidity premium), it cannot be negative while all the other own-rates can.

11. The issues involved in the Kaldor and Hayek debate on capital intensity, trade cycle and the Concertina and Ricardo effects deserve a far more detailed discussion and analysis (see, e.g. Moss & Vaughn, 1986; Thirlwall, 1987, pp. 40–7; Desai, 1991).

12. According to Thomas (1991, p. 390), "[t]he ruling powers were passionate believers in freedom, and this included freedom to adjust the constraints within which freedom was exercised by the

nonfavorites ['those who rejected the Hayek-Robbins line']. The main type of adjustment was the postponement of tenure. In my own case I did not receive tenure until, on the advice of Sir Alexander Carr-Saunders, I moved from monetary theory to migration and economic growth." Hayek (1983, p. 370) recollects that one of the few things that he and Robbins disagreed on was who to give the tenure professorship promotion at LSE. Hayek favored Abba Lerner instead of Kaldor, while Robbins favored Kaldor. "Hayek: No, I don't think it would benefit to make it public now. I was going to say simply this: in the end, we had the problem that both Kaldor and Lerner were clearly such exotic figures that we couldn't keep them both in the department. And one of very few points on which Robbins and I ever disagreed was which of the two to retain. [laughter] Alchian: I'd heard that there was a dispute. My impression or recollection — you needn't correct it or say it's right or wrong – was that you favored Lerner and he favored Kaldor. Hayek: Yes, that's correct."

13. Verdoorn's 1949 article was first published in Italian and, although mentioned in some important works in the 1950s and 1960s, did not attract much attention until Kaldor's 1966 inaugural lecture. The paper was only translated into English by Thirlwall in 1993 and published in the second volume of *Italian Economic Papers* (1993), organized by Luigi Pasinetti. The Swedish economist Ingvar Svennilson, in fact, was the first to find the empirical regularity in a 1944 Swedish essay on the occasion of Eli Heckscher's *Festschrift*. Svennilson (1944) stressed the interrelation between technical change, production growth and productivity increases in industrial labor in Sweden, discussing old and new technology distribution in a sector with particular reference to the lags of new technology application (which is longer the slower production growth is). Svennilson (1950, 1954) was also recruited by Myrdal to work at the UNECE, being the first to mention Verdoorn's 1949 article. For a discussion on Svennilson and the Kaldor–Verdoorn law, see Boianovsky (2012).

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