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The traverse, equilibrium analysis and post-Keynesian economics

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Abstract

The Traverse refers to the movement of the economy outside equilibrium. It requires a consideration of how an economy may achieve equilibrium, and how it may navigate towards a new one if conditions change. Analysis of these themes, from the classical economists onwards, leads to the conclusion that it is difficult to envisage any useful role for equilibrium theory in the absence of some evidence that there are forces in the economy which propel it to equilibrium, without influencing the position to which the economy is gravitating towards. Complicating factors, emphasised in the post-Keynesian literature, include the existence of path-dependency, hysteresis, cumulative causation and the evolutionary nature of economic change.

Key words: history of economic thought, post-Keynesian, equilibrium and disequilibrium, path-dependency, hysteresis, cumulative causation and the evolutionary

Introduction

The Traverse defines the movement of the economy outside equilibrium. It plays a particularly important role in post-Keynesian economic analysis, as most post-Keynesian economists deny the relevance and usefulness of equilibrium analysis for understanding actual economies[2], and stress the importance of adjustment paths.

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[1] We would like to thank Geoff Harcourt, Raja Junankar and John Nevile for their helpful comments.
[2] Though it may play a role in doctrinal debates Harcourt 2001 pp. 326-327

The concept of equilibrium has played a central organising role in much of political economy and economics. The way equilibrium is treated has been a major point of methodological differentiation between different groups of economists. The importance of equilibrium in traditional theory has ranged from it being seen as the central organising concept for economic thought, to it being upheld as a description of actual economies which are seen to exhibit strong tendencies towards equilibrium. Despite this central role, the analysis of how the economy achieves equilibrium has often been a secondary consideration.

For equilibrium analysis to serve the central purpose which economists have ascribed to it, there must be forces which push the economy to that equilibrium or to the equilibrium path without affecting the equilibrium itself. In other words, for equilibrium to be a useful concept in the way it is traditionally described, the adjustment path which the economy takes to achieve that equilibrium must not influence the equilibrium to which it is pushing the economy. The need for a theory of the traverse arises *unless* it can be established that the forces (if present) pushing an economy towards equilibrium (i.e. the adjustment path) have no influence on the equilibrium position to which the economy is said to be tending. The necessity for such a theory is perhaps best illustrated by considering the implications arising from its absence within mainstream equilibrium analysis. The difficulties of developing a meaningful treatment of the traverse within this setting in turn highlights fundamental shortcomings inherent in the application of static equilibrium techniques to the analysis of economic issues.

These themes can be illustrated with brief reference to a number of different contexts in which the equilibrium approach has been popularly applied. The next section examines the differing views as to the role of equilibrium and the traverse in economic analysis. We then consider the role of the traverse for the classical political economists and Marx, before turning to its use by Alfred Marshall in his partial equilibrium method. This is contrasted with the notion of equilibrium in general equilibrium theory in the Arrow-Debreu tradition. From here, we present modern Traverse theory beginning with the context in which originated it, in other words, as developed first by John Hicks (1965) and set out in a more comprehensive form by Adolph Lowe (1976). Finally, the paper considers its role in Kaleckian-Keynesian-Goodwin approaches.

The Traverse v Equilibrium

The role that the traverse plays in economic analysis is closely linked to the view of equilibrium. Although most economic theory has traditionally relied on some concept of equilibrium as a central organising concept, there is an important distinction between equilibrium and equilibrium analysis. Equilibrium can be used as a reference point for the analysis, without any requirement that the economy tend towards it. However, in equilibrium analysis, by contrast, there is a presumption of a tendency for the economy to be pushed towards the equilibrium position.

We can distinguish a number of views about the appropriate role of equilibrium analysis in economics:

1. Equilibrium is a useful concept, and the economy will tend towards an equilibrium.
2. The economy is always in equilibrium
3. Equilibrium is not a useful concept, as the economy is always on a dynamic path which does not tend towards any equilibrium.

The first of these views dominates the discipline as, traditionally, most economists have relied on a comparative static method to compare equilibrium positions, drawing inferences from the comparison. These economists accept that the economy may not always be in equilibrium, but, nevertheless argue there is a tendency towards it which makes it a useful concept for analysis. Within this group of economists, we can distinguish two further views. By far the dominant view is that there are strong forces which push the economy to its equilibrium position, without actually influencing that position. In other words, although the economy may experience disequilibrium, this will be temporary as equilibria are stable and independent of the adjustment path. The equilibrium is an attractor, a centre of gravitation, that remains unaffected by the path the economy takes to reach it. Classical economists and most neoclassical economists, as well as some post-Keynesians (including most Sraffians) ascribe to this view. A variant associated with general equilibrium analysis allows for the fact that there may be multiple equilibria so that the path which the economy takes will determine which of these equilibria it will achieve, though the existence of these will not be influenced by the disequilibria path. In this case we have some path-determinacy, in the sense that the final position of the economy will depend on its adjustment path and its starting point;

however, this position, and that of the other equilibria, are determined independently of that path, whose only impact is on which equilibrium is actually achieved. In other words, all the potential equilibria outcomes are independent of the adjustment path.

In contrast to the view just described is the belief that, although the economy may tend towards an equilibrium position, that equilibrium will itself be path determined, in the sense that the path that the economy takes outside equilibrium will influence its final values. The adjustment path influences the equilibrium position by changing the fundamentals of the economy. So, the potential equilibrium outcome cannot be known independent of the adjustment path. Another version of this position is known as hysteresis, according to which "the variable values created by the system depend, in addition to its relations and parameters, on the history of the shocks." (Katzner 1993 p. 324)[3]

The second view, that the economy is always in equilibrium, (even during cycles) is associated with the New Classical Macroeconomics. The addition of the assumption of rational expectations to that of continuing market clearing means that all economic outcomes are, by definition, equilibrium ones.

> "In recent years, a number of economists have worked to develop what I prefer to call *equilibrium* models of business cycles. These are models that utilize the contingent claim point of view ... in which prices and quantities are taken to be always in equilibrium. In these models, the concepts of excess demands and supplies play no observational role and are identified with no observational magnitudes." Lucas 1980 709 (see also Lucas 1983)

The final view is that equilibrium is not a useful method of analysis, as it plays no operational role in actual economies. Equilibrium is not an attractor, and plays no role in the path of the economy, which is a dynamic growth path, subject to cyclical influences. Under this head we would include post-Keynesian economists like Kalecki and Goodwin, and also many evolutionary economists. Although this position is extremely important in understanding the

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[3] For a history of hysteresis in economics see Cross (1993). The Spring, 1993 *Journal of Post Keynesian Economics*, has an interesting symposium on hysteresis, where its relevance to post-Keynesian economics is discussed – see, in particular, Cross (1993a) Davidson (1993) and Katzner (1993).

traverse, as it is dealt with by a number of other chapters in the Handbook, we will not explicitly consider it in the rest of this chapter[4].

Within these positions, the "traverse" is explicitly analysed by economists who use it to consider the movement of economies outside equilibrium. In particular, the adjustment path is analysed to consider the conditions under which it will converge to a new equilibrium.

HISTORICAL ANTECEDENTS

The traverse played an important role in the works of the classical political economists, particularly when they analysed the forces which pushed the economy to its "natural values". These forces are mainly determined by supply, demand and the workings of competition and are, therefore, of a different nature and are therefore determined very differently from natural values, which are mainly determined by cost of production and labour values. As a result the forces which lead market prices to gravitate to (or around) their natural values did not affect those values. In other words, because they are determined fundamentally differently, the forces pushing the economy to its natural values did not influence those natural values, so there was no path determinacy.

However, problems did arise in the consideration of whether there is an endogenous natural adjustment path driven entirely by microeconomic decisions related to changes determined by technical progress or population. These questions arose from the early discussions within political economy. An important case is Ricardo's and Barton's discussion of whether or not the economy can reabsorb the workers made redundant by new technologies. Initially Ricardo believed in a positive outcome but subsequently he, judiciously, changed his mind (Samuelson, 1988)**.** Until the third edition of his *Principles*, Ricardo had, in a number of places, supported the view that the introduction of machinery would not have any long-run impact on the level of unemployment. However, in the third edition, Ricardo introduced a new chapter, "On machinery", in which he changed his mind, and now accepted that the introduction of machinery, while it would be advantageous to the interest of capitalists and landlords, would be "very injurious to the interests of the class of

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[4] See also the discussion in Kriesler (1999)

labourers". (Ricardo 1951 p. 388) He argued that his original mistake was due to his "supposition that whenever the net income of society increased, its gross income would also increase" (ibid). However, he realised that while machinery could increase profits and rents (net income), they may be associated with a lower total output, and therefore lower employment. Ricardo considers a number of other influences of the new machinery on employment, including its impact on reducing the price of necessities. However, he does not fully trace out the traverse implied by its consequences[5].

Within Marxian economics there are at least two major instances involving transitional states which are subject to path-determinacy. The first appears in Marx's notes on the schemes of reproduction. He observes that setting the schemes in a context where the two sectors move apace is dictated by the necessity to derive the essential relations of the system positing a balanced equilibrium state. Yet, he pointed out that sectors would not move apace, the conditions for equilibrium growth are unlikely to be fulfilled, thus generating a cycle in replacement capital and in the proportions between the different branches of the economy. There is no automatic mechanism ensuring the rebalancing process (Sardoni 1981). The second instance relates to the last issue and it occupied a great deal of the thinking of early 20th century Marxists when they started to grapple with the question of effective demand, which they called the realization problem. Some, such as Tugan Baranovsky, argued that underconsumption would not be a factor of crisis nor would be technological unemployment, provided the economy attained the right proportions between the sectors of production. Thus crises would arise from the fact that in a decentralized private economic system it would be difficult to achieve the right balance between the different branches of production (Sweezy, 1942).

From the above examples we can see that the Traverse addresses the question raised by Joan Robinson already in the 1950s, namely, how to get into equilibrium. If, for whatever reason, the economy happens to be already in equilibrium can it traverse to a new one if initial conditions change? The main economic theories developed after the Classics essentially refrained from studying out of equilibrium situations seriously, the exception

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[5] Eltis has argued that Ricardo's analysis of the impact of increased mechanization foreshadows Hicks's traverse in *Capital and Time* (Eltis 1985 p.p. 266-267)

being perhaps Marx and the Marxian debate about crises of disproportionalities (Sweezy, 1942)[6].

Marshall, neoclassical economics and the traverse

In the preface to his *Principles*, Marshall had proclaimed that the Mecca of the economist lies in economic biology, and that 'while frequent use is made of the term "equilibrium" which suggests something of statical analogy', the subject matter is in fact 'concerned throughout with the forces that cause movement: and its key-note is that of dynamics, rather than statics' (Marshall 1920: xiv). The challenge Marshall had set himself was to construct a theory of value within an equilibrium framework that was at the same[7] time in harmony with the 'organic' forces that determine economic change through time. The difficulties Marshall encountered in realising this objective was most apparent in his demand and supply based partial equilibrium analysis of the effects of a change in demand on prices in an industry in the long period, a time period in which plant itself could be remuneratively produced and applied. In this context, Marshall was forced to concede serious limitations to the applicability of the comparative static method:

> It must however be admitted that this theory is out of touch with real conditions of life, in so far as it assumes that, if the normal production of a commodity increases and afterwards again diminishes to its old amount, the demand price and the supply price will return to their old positions for that amount... For, when any casual disturbance has caused a great increase in the production of any commodity, and thereby has led to the introduction of extensive economies, these economies are not readily lost. Developments of mechanical appliances, of division of labour and of the means of transport, and improved organisation of all kinds, when they have been once obtained are not readily abandoned (Marshall 1920: 807-8).

Therefore, the operational meaning that can be attributed to the 'true' long-period supply schedule within an equilibrium framework becomes more than problematic. Shifts in demand schedules cannot be coupled with movements along this supply schedule, as it would infer that economies (or diseconomies for that matter) once introduced can be reversed or

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[6] Also, Keynes in the Preface *to A Treatise on Money*, argued that his "object has been to find a method which is useful in describing not merely the characteristics of static equilibrium, but also those of disequilibrium, and to discover the dynamical laws governing the passage of the monetary system from one position of equilibrium to another." (Keynes 1930 p. xvii)

[7] For a comprehensive discussion of Marshall's dilemma, see Hart 2012.

reconstructed. The 'true' long-period supply schedule in effect shows combination of price-quantity values that *were* on a succession of shifting demand curves. In this sense, as Schumpeter (1954: 995) concluded, the 'true' long-period supply curve in Marshall's system has to be interpreted as a historical phenomenon, not an analytical one. Therefore, while its construction may conceivably be combined with demand schedules to indicate equilibrium positions ex-post, it could not describe the process by which the equilibrium positions may be attained or maintained. In particular, there is an absence of any consideration of the process by which an economy may move between hypothetical equilibrium positions. The nature of the journey the economy may be embarking on as it seeks a new equilibrium position is obscured within the comparative statics that characterised Marshall's, and later conceptualisations of, long-period analysis.

As Marshall acknowledged, the element of time is a chief cause of the difficulties in economic investigations. The significance of this theme was re-stated in Joan Robinson's critical reconsideration of her theory of imperfect competition:

> In my opinion, the greatest weakness of the *Economics of Imperfect Competition* is one which it shares with the class of economic theory to which it belongs – the failure to deal with time. It is only in a metaphorical sense that price, rate of output, wage rate or what not can move in the plane depicted in a price-quantity diagram. Any movement must take place through time, and the position at any moment of time depends upon what it has been in the past. The point is not merely that any adjustment takes a certain time to complete and that (as has always been admitted) events may occur meanwhile which alter the position, so that the equilibrium towards which the system is said to be *tending* itself moves before it can be reached. The point is that the very process of moving has an effect upon the destination of the movement, so that there is no such thing as a position of long-run equilibrium which exists independently of the course which the economy is following at a particular date (Robinson 1953: 234).

The implications for the analysis of economic change were further explained as follows by Nicholas Kaldor:

> There can be no such thing as an equilibrium state with optimum resource allocation, where no further advantageous reorganization is possible, since every such reorganization may create a fresh opportunity for a further reorganization (Kaldor 1975b: 355).

Building on the ideas of Adam Smith, Veblen (1898) and Allyn Young (1928), Kaldor went on to develop the notion of circular and cumulative causation, where a non-

equilibrium process is explicitly involved and in which history is instead intended to take on a pivotal role[8]. Within this approach, circular causation emphases the multi-causal nature of the complex linkages between core variables, while cumulative causation occurs as positive feedback processes magnify and multiply the impact of these interactions through time. As Kaldor also realised, this approach to economic reasoning has links to themes pursued within evolutionary economics, and to Marshall's dictum that the Mecca of the economist lies in economic biology:

> Yet Marshall's *Principles* seem to me an infinitely more valuable work than Walras's *Elements* or Pareto's *Manual*, even though it may not equal to these two as a source of inspiration to later generations. Marshall realized that human societies are subject to continuous evolution, the precise direction of which can never be predicted; and he frequently emphasized that economics has far more in common with biology than with mechanics (Kaldor 1985: 59).

These connections were recognised in Nelson and Winter's seminal contribution to modern evolutionary economics:

> Contemporary commentary on this [Marshall's treatment of increasing returns] tends to rebuke Marshall for his affront to the logic of purely static analysis; the fact that he quite correctly emphasized the role of (informational) increasing returns as an economic mechanism of irreversible change received less attention. On this question and many others, our evolutionary theory is closer to the original Marshallian doctrine than is contemporary orthodoxy (Nelson and Winter 1982 p. 45)[9]

We can contrast these attempts to explicitly incorporate time and path-determinacy into post-Keynesian economic analysis with their treatment in mainstream theory. The relevance of these issues to mainstream general equilibrium analysis, in particular, can be highlighted with reference to the damaging implications arising from the Sonnenschein-Mantel-Debreu [S-M-D] theorem. The general equilibrium theories provided an analytical framework in which the fundamental axioms and intuitions of 'neoclassical economics' could be expressed and confirmed in a rigorous mathematical form, characteristically combining

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[8] The contributions of Myrdal (1957, 1968) must also be recognised. Kaldor's major contributions include Kaldor (1966, 1970, 1972, 1985, 1996). Surveys of this literature can be found in Thirlwall (1983) and O'Hara (2009) while Toner (1999) discusses the evolution of the CC approach more generally, and Forstater and Murray (2009) trace the antecedents in the work of the classical economists and Marx before considering their influence on post-Keynesian economists. Significant extensions to Kaldor's largely descriptive analysis can be found in Setterfield's (1997) formal modelling, as well as in his chapter for this Handbook, and, in an open economy context in Blecker's chapter. Harcourt (1992) explains this in terms of a wolf pack analogy

[9] The linkages between Marshall's proposed scheme of economic biology and modern evolutionary theory are explored most directly in Metcalfe (2007)

the principles of optimisation by economic agents and the coordination of their activities through perfectly competitive markets where relative prices reflected all relevant data about the economy. The S-M-D theorem demonstrated that, with respect to the more sophisticated Arrow-Debreu models, the aggregate excess demand function that characterised competitive equilibria inherited only limited properties from individual's demand functions; continuity, homogeneity of degree zero, and the validity of Walras's law (together with boundary conditions as prices approach zero). These properties are not sufficient to restrict the admissible aggregate excess demand function in a way that would ensure uniqueness or stability of equilibrium[10].

General equilibrium theory has been predominately preoccupied with the question of the existence of equilibrium prices, corresponding to a configuration in which the excess demand is zero for every commodity. Within the assumed perfectly competitive market conditions, it was supposed that prices convey all relevant information about the economy. Clearly, to investigate satisfactorily stability issues, the theorist has to have something substantial to say about the way an economy functions out of equilibrium, which requires an examination of the nature of price adjustments. However, while the general equilibrium models were founded on a system of market prices, there was no meaningful analysis of the processes by which prices may be established beyond vague and erroneous references to the 'Walrasian auctioneer'. What is required is a meaningful analysis of the *changing* institutional environment in which markets operate; the manner in which information is attained and disseminated; and the way in which individuals, groups and economic entities interact with each other. In the absence of a consideration of these themes, the operations of a price system cannot be explained, and a meaningful discussion of the stability issues outlined above is not possible. Without uniqueness and stability guarantees, the idea that policy inferences can be derived from comparative static analysis within the general equilibrium framework is decidedly problematic. Once again, the inability to explain how an economy is said to move between hypothesised equilibrium positions, i.e. the traverse, has led to conceptual difficulties which frustrate attempts at addressing the S-M-D implications in an economically meaningful way.

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[10] For further discussion of the Sonnenschein-Mantel-Debreu results see Kirman (2006), Rizvi (2006) and the Rizvi chapter in this Handbook

Neoclassical economics until relatively recently, and with the occasional relevant exception (see, for example, Hahn 1966 and Fisher 1983), eschewed non-equilibrium situations altogether and it never deals with transitional processes. Robert Solow hit the right note when he observed that the Traverse is one of the most difficult topics in economics (Solow 1984). Indeed the Traverse lies at the very heart of economic theory and it encapsulates the main epistemological questions besetting the discipline.

Origins of the modern Traverse: the context

The term Traverse was coined by John Hicks in *Capital and Growth* published in 1965. It is important that we set the treatment of the Traverse within the context of the book as well as within the theoretical debates of the period. The context of the former was Hicks' abandonment of his own earlier general equilibrium approach, known as the Temporary Equilibrium Method (Hicks, 1939). The context of latter was defined by the Joan Robinson question and by the debates over capital theory as well as on growth theory, to which we must add the development of mark-up fixed price theorising.

Hicks's 1939 *Value and Capital* may well be considered as the book that started the march to dominance of General Equilibrium Theory in the English speaking world. After 1945 with American political and cultural hegemony in the capitalist world, the establishment of the theory of perfectly, always clearing, competitive markets as the idealised, hence ideological, representation of the actual capitalist system came from Paul Samuelson (1947). However, the ground for his *Foundations of Economic Analysis* was prepared by Hicks's work. In *Value and Capital* Hicks determined the conditions for obtaining a Temporary Equilibrium, that is, an equilibrium which does not imply the attainment of a full competitive outcome in the long period. The result is important only in a negative sense, although at the time it was taken to be the usual 'first step' towards something more substantial in a longer run which never came. The method is quite simple. Time is divided into weeks; prices are fixed within each week and fully flexible at the beginning of the next. Each week is treated as self contained. Thus there is no presupposition that the outputs at the end of one week will be those required to get system going onto the next period. There is therefore no need to specify production or reproduction conditions. On the basis of the principle of gross substitutability, entailing a price substitution effect always greater than the income effect, Hicks arrived at a

weekly equilibrium where all the desired demands are equal to all the desired supplies achieved by means of price flexibility. The Temporary Equilibrium method is free from inquiring into paths pertaining to capital accumulation and to its rate of return (profit). The importance of Hicks's method consists in that he separated the conditions of equilibrium in pure exchange from those of production and accumulation. Equilibrium theory has not moved forward from Hicks 1939 work. In many respects it went backward, as it became temporal (Samuelson, 1947) or intertemporal, as in the Arrow-Debreu, constructions. In the latter case we face the absurd assumption that decisions are taken once and for all at the beginning of an agent's lifespan[11].

John Hicks was therefore fully aware that in his weekly equilibrium, prices had to adjust almost instantaneously when the outputs at the end of one week would become the new endowments for the next. Hence 26 years later in *Capital and Growth* he would write:

> The fundamental weakness of Temporary Equilibrium is the assumption, which it is obliged to make, that the market is in equilibrium – actual demand equals desired demand, actual supply equals desired supply – even in the very short period, which is what its single period must be taken to be. This assumption comes down from Marshall, but even in a very competitive economy, such very short-run equilibration is very hard to swallow; in modern manufacturing industry it is hard to swallow indeed. It was inevitable that the time should come when it had to be dropped (Hicks, 1965, p.76).

We may ask why it took Hicks a quarter of a century to come up with the view that industrial prices do not move according to supply and demand relations: a legitimate question since in 1939 the United States Congress published the study headed by Gardiner Means where it emerged that at the onset of the Depression the fall of industrial prices following the fall in demand was rather limited, especially in the highly concentrated sectors (Means 1939). A few years later the famous Oxford Hall and Hitch inquiry argued that for companies marginal cost pricing was a figment of imagination (Hall and Hitch, 1942). Yet by the 1960s the view that mark-up pricing dominated in industry was being corroborated in a stronger manner both in theory and in practice, through the evidence that prices were cost, not demand, determined (Kalecki, 1954; Bain, 1956; Sylos Labini; 1962; Modigliani, 1959). Furthermore, Piero Sraffa (1960) published the most difficult simple looking book ever

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[11] As Kaldor notes, "From period 2 on, life must become very boring!" Kaldor 1996 p. 7

written where competition entailed a price system in which demand played no role at all[12]. The above is in our view the context within which Hicks matured his approach towards the Traverse. The first step required abandoning the constraint imposed by the instantaneous adjustment of supply and demand prices, to be replaced by what?

All that is said about prices is that they must cover costs; more strictly that a thing will not be produced unless it is profitable to produce it. Subject to this condition prices can be what sellers like. It is not a very stringent condition, if it is unaccompanied by any rule about profits being normal; and the normalization of profits (equalization between different sectors) is a complication for which it is difficult to give sufficient time during the lapse of the single period (Hicks, 1965, p.78).

Hicks's new price system is exactly Sraffa's: a two sector economy is built and given the capital and labour coefficients, prices are determined by a uniform rate of profits which multiplies the price per capital coefficient which is then added to the wage rate per labour coefficient. Although there is a uniform rate of profits there is no presupposition that it will converge to a new uniform rate should conditions change. The price system is located in a series of successive periods that define Harrodian dynamics. The latter is nothing but a situation where the economy's composition of output is given, so is its saving rate as it grows along the warranted rate path. In this way the single period is extrapolated into the Harrodian longer period which, we know, is unstable and uncertain. Remarkably, Sraffa's prices, where proportions do not change, constitute the microfoundations of Hicks's version of Harrod's dynamics. Indeed precisely because prices are fixed by the given coefficients of production and the uniformity in wage and rate of profits, they can be used as real output indexes. But Harrodian dynamics is unlikely to continue unless the warranted path coincides with the natural full employment path. Thus the second step requires quitting Harrodian dynamics when growth reaches the ceiling of full employment. It also entails exit from the Sraffa price system because both sectoral proportions and distribution will have to change. We are now entering the realm of the Traverse.

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[12] See also Sraffa's letter to Asimakopulos quoted in Harcourt 2008 p. 75

The Hicksian Classical Traverse

Back in those days the memories of the Great Depression were still alive among economists. The intellectual endeavour was to make the new Keynesian based theories work at the policy level as well. Neoclassical economists themselves did not hail the unregulated free market system, rather they extolled the virtues of the mixed economy, as Paul Samuelson did in the various editions of his textbook. However, despite the concern about the calamity of mass unemployment, a somewhat simplistic attitude prevailed. It was, as Hicks put it, "the fanfare of the Keynesian orchestra" (Hicks 1985 p. 131). It boiled down to viewing the boosting of public expenditure and the budget deficit as a miraculous cure all, without any thoughts being given to whether the structure of production could actually undertake the transition to the new levels of activity.

In 1939, and in 1948 after the end of WW II, Roy Harrod pointed out that while the economy can be brought to full employment, remaining at that level could be quite problematical. As long as there is an ample supply of labour the actual growth path can be higher than the full employment one. Yet when the ceiling is reached the previous path ceases to be sustainable due to the instability of the warranted growth path: any attempt to stay on it will lead to excessive saving – because of the higher than equilibrium investment – and to a Keynesian recession. Harrod intentionally did not offer any solution to the dilemma in order to underscore the instability of the full employment path. The answers to the Harrod problem came simultaneously in both a neoclassical-Keynesian and classical-Keynesian version. The Solow-Swan growth model is the neoclassical response to Harrod. Even by keeping the Keynesian assumption of a given propensity to save, the economy will adjust to long-period growth equilibrium provided the capital-output ratio varies according to the relative abundance of capital and labour[13]. Thus Harrod's too high saving ratio is transformed into an increase in the supply of capital relatively to labour. Under diminishing marginal productivities, the increased supply of capital will entail a lower growth rate and a higher capital intensity of production. There is no intrinsic reason for a Keynesian recession to occur

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[13] Solow-Swan assumed that the government kept the economy at full employment in the short run, Harcourt 2006 pp. 109-110.

since the economy can smoothly move to a lower full employment path[14]. The issue of the Traverse begins with Hicks's critique of Solow's model in chapter 12 of *Capital and Growth*, although the Traverse chapter proper is delayed until chapter 16.

In Solow if the growth rate rises so should the rate of profit, this is true also for Classical economics. But Solow also keeps the saving ratio unchanged. By using Sraffa's price system which requires, at least, a two sector model, Hicks shows that in a two sector model with a given propensity to save, a positive relation between the rate of growth and the rate of profits is possible if and only if in the consumption goods sector the capital to labour ratio is higher than in the capital goods one. This is nothing but the well behaved neoclassical production function in a two sector framework. Hence it yields an absurd result in the opposite case where the capital goods sector is more capital-intensive. Here the rate of growth and the rate of profit are inversely related: the rate of profit falls when the growth rate rises!

The Lowe Traverse and Economic Growth

John Hicks developed the concept of the Traverse essentially for critical purposes, that is in order to show how prices are not much guidance for dynamic non-steady state processes. Importantly, Hicks's conclusion is not conditional upon some kind of rigidities. It suffices that the production coefficients of the two sector model do not fit the special Neoclassical requirements outlined in the early 1960s by three Japanese mathematical economists, Shinkai, Inada, and Uzawa (Gandolfo 1971). These are known in the literature as the Inada-Uzawa conditions which postulate that the capital goods sector has to be more labour-intensive than the consumption goods sector for smooth Neoclassical adjustment to occur[15]. However, Hicks did not integrate into his analysis the principle of effective demand. Also in his most problematical Neo-Austrian version of the Traverse put forward in *Capital*

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[14] Sen argues that if an independent investment function is introduced, Harrod's instability problem quickly reappears in the Solow-Swan model, because instability depends upon reactions to unrealised expectations; Sen (1970)

[15] Interestingly, the Inada-Uzawa conditions and the outcome of Hicks's classical Traverse show that the accusation made against Sraffa that the absence of demand function in the determination of prices is a consequence of fixed production coefficients is plainly wrong. It is equally interesting to observe that the most faithful Sraffians did not notice the help that, only five years after the publication of Sraffa's book, they were receiving from the inventor of Temporary General Equilibrium Theory.

and Time, the issue of effective demand never appears and yet one would have thought that, given Harrod's difficulty regarding the stability of the full employment path, the question would feature prominently in analysis of the traverse. Indeed, the issue has been taken up essentially by a number of scholars writing in the classical and post-Keynesian tradition (Halevi, 1992, Halevi and Kriesler 1991, Henry and Lavoie 1997, Lavoie and Ramirez-Gaston 1997; Nell 1998). Contrary to Hicks's critical use of the concept of the Traverse, Adolph Lowe (1893-1995) developed a form of Traverse analysis oriented to identify the structural phases required for undertaking a process of transition (Lowe, 1976). Although in his 1976 book Lowe borrows the term Traverse from Hicks, greatly acknowledging the latter's contribution, the first Lowe Traverse was set out in 1952, a revised version of which had most notably been reproduced in a pioneering volume on capital formation edited by Moses Abramovitz (Lowe, 1952; 1955).

Lowe further developed the concept of the traverse in an explicit return to the concerns of classical political economics, when analysing the "path of economic growth". Rejecting the idea that growth typically occurs with steady-state equilibrium, he made the traverse and consequent structural change the focus of his analysis. As a result, changes in the structure of production become the focus of attention with the resultant intersectoral relations having an important impact on the growth path.

Lowe's model stressed the importance of historical time and the non-reversibility of economic decisions, particularly investment decisions. Of particular importance in his analysis was the role of the specificity of capital goods[16], with capital goods being seen as being essentially heterogeneous. In order to capture this concept, Lowe developed a three sector model, with a consumption goods sector supplemented with two distinct capital goods producing sectors. One capital goods sector produced the capital goods for the consumption goods sector, while the other produced the capital goods for both capital goods sectors. The capital goods in this latter sector, "are for the industrial sector what seed wheat and the reproductive system in animals are for agricultural production." (Lowe 1976, p. 30)

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[16]. Kaldor, in a much neglected article, Kaldor (1938), explicitly addresses the problems caused by the specificity of factors of production.

In a modern industrial economy structure is defined in terms of the composition of the capital goods sector. The fixed capital stock is characterized by the durability of equipment, by its internal heterogeneity, and by the gestation period needed to produce it. Furthermore, machinery must itself be reproduced and a theory of structural change should account for this fact. Thus the minimal requirement for a proper treatment of dynamic transformations is the existence of a self-reproducing branch within the capital goods sector. Obviously this is a set of sub-sectors which in Lowe are collapsed into a branch called the machine tools industry or primary equipment. Given that in Lowe's model, as much as in Hicks's, consumption goods are aggregated into one single sector, the machine tools industry ends up producing its own capital goods as well as the capital goods needed to produce the machines making the consumption good. This means that the output of the machine tools sector can be allocated in both capital goods sectors, while the output of the capital goods sector producing equipment for the consumption goods sector is non-shiftable. Having presented his stylized facts regarding fixity, specificity and reproducibility of capital, Adolph Lowe does not have to preoccupy himself with the degree of substitutability between machinery and labour. Thus his assumption is that capital to labour ratios and capital to output ratio are given and uniform in all sectors. The attentive reader will recognise here the strong similarity with Marx's schemes of reproduction, acknowledged by Lowe and, indeed, even in value terms Lowe's system corresponds to pure labour values, but only when it works at capacity.

The question that prompted Hicks to formulate the theory of the Traverse was whether a smooth endogenous transition from one steady state growth path to another was at all possible. The answer has been in the negative. For Lowe, the Traverse, as outlined as early as 1952, was formulated to consider the question of what should happen to ensure that the transition is successful. This way of formulating the problem establishes the connection between the Traverse and the problems of realization and effective demand in a manner closer to Kalecki's approach than to Keynes's.

As an example, consider a simple case of a fully stationary economy at simple reproduction, that is, at a zero growth rate. We make the classical assumptions of fixed production co-efficients and that workers consume all their income, while capitalists save all of theirs. Assume that for whatever reason the economy experiences a once and for all increase in the supply of labour. For such an increase to be absorbed by the system it is

necessary that new productive capacity be created. Where will the new capacity come from? Assume that initially we have 1000 employed workers operating 1000 machines, 10 in the machine tools sector producing 10 machines per year, 90 people operating 90 machines in the machine sector producing 90 capital goods for the consumption goods industry, while 900 workers operate 900 machines in the consumption goods sector. With depreciation at 10% per year the production of machines is exactly equal to the numbers that must be replaced year in year out: the machine tools sector produces 10 machines, one goes back to it as replacement and nine replace the equipment worn out in the intermediate investment goods sector. Likewise the intermediate investment sector produces the 90 machines which will replace the 10% worn out of the 900 machines in the consumption goods sector.

Assume now that the labour supply experiences a once over rise of 10%, just to keep the calculations simple. Given the data at our disposal, we know that to absorb the 100 additional people it is necessary to provide 10% more jobs which, in the above model, amounts to producing 100 more machines. Furthermore, the additional machines should be distributed among the three sectors in such a way as to guarantee the stability of the new, final, stationary state. The initial data coupled with the known increase in the supply of labour give us the new final position: every sector should be expanded by 10%.

Let us now consider a market route for the absorption of the extra supply of labour. We assume wage flexibility to perfectly reflect the increase in labour supply: (again for simplicity) we assume that a 10% increase in labour supply will lead to a 10% fall in money wages. The extra labour acts, therefore, as a Marxian reserve army of unemployed workers. In a perfectly competitive market, prices should decline exactly in the same proportion as the fall in money wages, so nothing will change: capacity will not be liberated and the system will be stuck with 10% unemployment due to the fact that there are too few machines relatively to labour. We hit here upon the issue of "capacity liberation" which is at the core of any growth process. Thus for capacity to be liberated in order to create additional capacity, prices of consumption goods should not fall at all, thereby transforming the decline of money wage into one of real wages. Such a situation corresponds to an oligopolistic market form. Individual firms do not operate in relation to an agreed upon macroeconomic goal. Their business is to respond to demand and to defend their profit margins. The latter are strengthened by the fixity of prices, while consumption demand shrinks by exactly 10% due

to the fall in real wages. This means that 90 machines in the consumption goods sector will no longer be utilized. Three sequential events may happen now. First, the consumption goods sector will reduce the replacement demand for capital goods from the intermediate investment goods sector which was supposed to deliver 90 units of replacement equipment. The new investment demand from the consumption goods sector can be anywhere between less than 90 units to zero. The second event is the repercussion on the intermediate investment goods sector of the reduced replacement demand by the consumption goods sector: also the output of the intermediate goods investment sector can fall anywhere between less than 90 to zero. The third event is the further decline in consumption demand due to the lower real wages and lower employment levels which sets in motion another Keynesian round of investment and employment cuts. Although the decline in real wages is exactly what is needed to liberate capacity, increased production is unlikely to be achieved by uncoordinated and structurally constrained firms and sectors. The solution can arise only if there is in the economy a sector that can go against the market trend by generating independent demand based on a macroeconomic dynamic reading of the situation. Such a sector will take goal-oriented decisions.

In the Lowe model outlined above two sectors are passive, they can only react to current demand. They are bounded by the short period and cannot by themselves break out of it. The passive sectors are the consumption goods and the intermediate goods investment sectors since neither have any internal reproduction capacity. The sector that can go beyond the short period is the machine tools sector. It can read the macroeconomic situation correctly and act accordingly. In essence it becomes the planning lever of the economy. As Oscar Lange once pointed out: supply and demand express static situations, developmental processes must be taken out of the static supply and demand context. (Lange 1967)

To see how the asymmetric process unfolds, assume that in the wake of a 10% fall in real wages 90 units of equipment in the consumption goods sector are made idle. The sector will immediately adjust capacity to demand and will reduce its replacement requirements to zero. Hence the output of the intermediate sector falls to zero. It follows that as the consumption goods sector goes into a depression the intermediate sector hits ground zero right away. Yet it does not have to go into a depression provided it is led by the machine tools sector which, we assume, has read the situation correctly and gears up to expand the

whole economy by 10%. The capital stock of the intermediate sector is made of the same equipment as that of the machine tools sector. Since the intermediate sector no longer has to supply machinery to the depressed consumption goods sector, it can allocate part of its own machinery to produce additional machine tools. We know that the new final position is 11 machine tools in the machine tools sector, 99 in the intermediate sector, and 990 units of specific equipment in the consumption goods sector. Employment in the two investment sectors will not fall therefore and, soon afterwards, will start rising as the two capital goods sectors will begin to increase their own stock of capital towards the new terminal level. The expansion in the capital goods sectors will increase the demand for consumption goods thereby enabling the consumption goods sector to recover in terms of output and employment. From this point onward the consumption goods sector expands towards the new stationary state pulled up by the two capital goods sectors. When the final stage is reached money wages will have to have increased at given prices so as to recover the lost ground. Indeed in the absence of technical progress real wages will have to be equal to those ruling before the increase in the supply of labour.

So the structural model is used to analyse the impact of economic growth on an economy from an initial stationary state, as well as examining the effect of changes in important parameters such as changes in the growth rate of the labour force or changes as a result of changes in technology. The implications of these for structural change and for intersectoral relations are considered, in order to see whether a new full employment steady state will emerge. As our example has demonstrated,

> an important conclusion to emerge is Lowe's demonstration that, although there may very well be a traverse which leads to a new full employment steady state, it is unlikely to be achieved within a decentralised market system. This, in part, results from the market transmitting the "wrong" signals in terms of the optimal structure of production and intersectoral flows. (Kriesler 1999 p. 410)

The foregoing example is the simplest case of a Traverse in a Lowe framework and yet it highlights the crucial connections between the changes in the composition of output and effective demand within each transitional phase. However, there are several types of Traverses in Lowe since his book also deals with technological change seen as non-uniformly spread processes. In these cases, issue emerge of capacity liberation and liquidation within the transitional phases taking different forms as to where technical change occurs first. The

focus on what happens within the transitional phases is the main difference between Lowe's and Hicks's Traverses. In the latter attention is centred solely on whether an automatic convergence to equilibrium exists or not. Furthermore, the method of the Lowe Traverse raises once again a point made by Piero Sraffa (1960) regarding how to look at economic processes: either in terms of linear processes going from given resources to final demand, or in terms of circular production flows. A modern economy is a surplus producing one; hence circular flows are more relevant than the one way avenue from resources to final demand. In this context any analysis of a modern economy must contain a set of sectors performing like corn seeds in the Classical corn model, without however obscuring the overall specificity of production (Gehrke and Hagemann 1996). Traverse analysis is also useful in understanding problems associated with developing economies. Lowe type models with a self reproducing primary equipment sector and with a secondary equipment sector producing machines only for consumption goods were used by Raj and Sen (1961) and Naqvi (1963) to map out development patterns for the Indian economy under conditions of stagnant export earnings.

The traverse and macroeconomics

The origin of contemporary macroeconomics is usually associated with the publication of Keynes's *General Theory* (1936), with the subsequent development of macroeconomic theory largely reflecting diverging interpretations of, and reactions towards, the approach formulated by Keynes and his close colleagues at Cambridge. While Keynes's *General Theory* has been routinely represented within a Walrasian style equilibrium framework, Keynes emphasised that his analysis was not founded on the notion of a stationary equilibrium:

> Or, perhaps, we make our line of division between the theory of stationary equilibrium and the theory of shifting equilibrium – meaning by the latter the theory of a system in which changing views about the future are capable of influencing the present situation... We can consider what distribution of resources between different uses will be consistent with equilibrium under the influence of normal economic motives in a world in which our views concerning the future are fixed and reliable in all respects; - with a further division, perhaps, between an economy which is unchanging and one subject to change. Or we can pass from this simplified propaedeutic to the problem of the real world in which our

expectations are liable to disappointment and expectations concerning the future affect what we do today (Keynes 1936: pp. 292-3).

Keynes argued that the state of expectations is liable to constant change, a new expectation being superimposed long before the previous change has fully worked itself out; so that the economic machine is occupied at any given time with a number of overlapping activities, the existence of which is due to various states of expectation (ibid p. 50). As John Hicks (1979 p. 80) observed, equilibrium under the circumstances being described by Keynes could only be perceived narrowly in terms of states in which there were no surprises, such that what happens during the period falls sufficiently within the range of what is expected for no revision of expectations to be necessary. However, while this strict interpretation of equilibrium may leave some room for the theorist to manoeuvre, Hicks in his reconsideration of the IS/LM issued the following caution regarding the use of this apparatus in formulating policy implications:

> When one turns to questions of policy, looking toward the future instead of the past, the use of equilibrium methods is still more suspect. For one cannot prescribe policy without considering at least the possibility that policy may be changed. There can be no change of policy if everything is to go on as expected – if the economy is to remain in what (however approximately) may be regarded as its *existing* equilibrium. It may be hoped that, after the change in policy, the economy will somehow, at some time in the future, settle into what may be regarded, in the same sense, as a new equilibrium; but there must necessarily be a stage before that equilibrium is reached. There must also be a problem of traverse. For the study of a traverse, one has to have recourse to sequential methods of one kind or another[17]. (Hicks 1980-1 pp. 153)

However, the task allocated to the 'sequential method' in explaining the movements of an economy through time within the setting of equilibrium reference points is rather daunting. As Allyn Young (1928) emphasised in his contribution to the Marshallian cost controversies of the 1920s, economic change becomes progressive and propagates itself in a cumulative way, echoing the perspective found in Veblen's writings:

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[17] :However, note Shackle's reservations: 'In his "explanation" Sir John still does not seem to me to acknowledge the essential point: the elemental core of Keynes' conception of economic society is uncertain expectation, and uncertain expectation is wholly incompatible with the notion of equilibrium' (Shackle 1982 pp. 437-8)

The economic life history of the individual is a cumulative process of adaptation of means to ends that cumulatively change as the process goes on, both the agent and his environment being at any point the outcome of the last process (Veblen 1898 p. 391).

This view of the cumulative nature of the traverse is the essence of Kalecki's later analysis. "In fact, the long-run trend is but a slowly changing component of a chain of short run situations; it has no independent entity and the [analysis] should be formulated in such a way as to yield the trend-cum business cycle phenomenon" (Kalecki 1968, p. 435) Kalecki had always rejected the notion of equilibrium, and was not concerned with analysing equilibrium positions. For Kalecki, like Keynes, the main determinant of the level of economic activity and of employment was the level of aggregate of demand. As a result, his analysis concentrated on the structure of demand. For him, the essence of the problem of adjustment of economies, was what happened to the composition of demand particularly as a result of the changes in the distribution of income which occurred during the cycle. As he was concerned with problems associated with realisation in the form of effective demand, Kalecki, like Lowe, disaggregated the economy into three sectors, or departments, though his disaggregation served different purposes. Kalecki divided the economy into a capital goods sector and two consumption goods sectors, differentiating worker's consumption from that of capitalists.

Of particular importance was the role of investment, due to its dual impact on effective demand. In the short-period, investment contributed directly to effective demand so that increased investment in any period directly increased employment and output in that period. However, because investment led to the production of new capital, and, therefore to extra capacity, the higher was the investment in any period, harder would it be to achieve full employment in the next period. This 'paradox', according to Kalecki, struck at the heart of the capitalist system: 'The tragedy of investment is that it causes crisis because it is useful. Doubtless many people will consider this theory paradoxical. But it is not the theory which is paradoxical, but its subject- the capitalist economy' (Kalecki 1939, pp. 148-149).The attempt to reconcile these two aspects of investment was important both for Harrod's dynamic model, but also for Kalecki's analysis of economic growth and cycles (Kriesler and Nevile 2012) , and helps explain his emphasis on path determinacy: "the rate of growth at a given time is a phenomenon rooted in past economic, social, and technological developments rather than

determined fully by the coefficients of our equations as is the case with the business cycle." (Kalecki 1968, p. 450)[18]

Further developments

This survey of the role of the traverse in political economy has focused on the explicit modelling of the traverse by Hicks and Lowe, and has only briefly mentioned subsequent developments. Following the influence of the pioneers of post-Keynesian analysis, many post-Keynesians have worked on dynamic growth analysis, where path determinacy is a key feature. Many of the contributions to this Handbook provide excellent examples of this. In addition, the emphasis on path-determinacy is also an important theme of the work of evolutionary economists, who see the economy and its components as evolving in response to changes in the economic environment, while itself causing changes in that environment. Not surprisingly, there are major overlaps between the work of evolutionary economists and many post-Keynesians, with evolutionary processes and complex dynamics playing key roles in the works of both, see, for example, the chapters by Velupillai and Rosser in this Handbook, Rosser 2002 and Hart (forthcoming).

Lavoie, in a number of papers (Lavoie 1996, Lavoie and Ramirez-Gaston 1997), has considered the problem of the traverse in Kaleckian models. Lavoie (1996) models an adjustment process of the economy to bring the rate of capacity utilization in the long period into equality with its "normal rate". Such an adjustment process if plausible within the model, but both the resultant "fully adjusted position" and the "normal rate of capacity utilization" "can be shown to depend on the path taken during the traverse, i.e. on the adjustment process during the transition". (Lavoie 1996 p. 144)

In addition, there are many aspects of post-Keynesian analysis which utilise path determinacy and traverse methodology which we have not been able to cover adequately, and have been discussed elsewhere in the Handbook, including the structural economic dynamics associated with Goodwin (Goodwin 1982) and Pasinetti (Pasinetti 1981, 1993) and the Kerr and Robert Scazzieri chapter in the Handbook; and, as was discussed above, cumulative

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[18] Fuller discussions of Kalecki and the traverse can be found in Halevi and Kriesler 1992 and Kriesler 1999.

causation and path dependence – discussed in Setterfield's and Blecker's chapters and Setterfield 2002.

Clearly, the traverse is intimately linked to concepts such as path dependency, hysteresis and cumulative causation, all of which highlight the importance of time for economic analysis, as recognised by Marshall, Keynes, Hicks and Joan Robinson, albeit from different theoretical perspectives. Importantly, traverse analysis demonstrates the significance of one of the fundamental principles of post-Keynesian analysis, the importance of analysing processes in historical time: "Once we admit that an economy exists in time, that history goes one way, from irrevocable past into the unknown future, the conception of equilibrium ... becomes untenable" (Robinson 1972 p. 172) and the traverse becomes the key object of economic analysis.

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