

Scheide, Joachim (1986) 'New Classical and Austrian Business Cycle Theory: Is There a Difference?' *Weltwirtschaftliches Archiv* 122: 575-98.

Hayek, Co-ordination and  
Evolution

Edited by Jack Beiner and  
Rudy van Zijp

Routledge

London and New York

1994

## MATHEMATICAL FORMALIZATION AND THE DOMAIN OF ECONOMICS

The case of Hayek and  
New Classical Economics

*Rudy van Zijp and Hans Visser*

The 1970s and 1980s saw a revival of interest in economic research traditions which were highly critical of the then prevalent Keynesian orthodoxy. The main reason for this revival may be found in the fact that Keynesianism could not provide a satisfactory explanation of the phenomenon of stagflation, and hence could not suggest policy measures that would alleviate its undesirable consequences. Quite naturally, the Keynesian failure to deal with stagflation gave rival approaches the opportunity to come to the forefront. The main rival approach in this regard has been monetarism, as propounded by the Chicago School. This research tradition did provide an explanation of stagflation, thereby stressing the rationality of economic agents and the allocative efficiency of the price system. Deviations of the full-information 'natural-rate equilibrium' were considered to be caused by expectational errors on the part of the economic agents. Consequently, monetarists argued that economic, or rather monetary, policy should be as predictable as possible in order to prevent these errors. New Classical Economics (NCE) continued to pursue this line of reasoning. It also stressed the rationality of economic agents, and argued that such agents will take changes in economic policy into account. It even developed a formal model in which it 'demonstrated' the ineffectiveness of anticipated economic policy in stabilizing economic activity. Deviations of the natural-rate equilibrium, and hence business cycles, were caused by unanticipated changes in the money supply. Following Friedman, New Classicals concluded that the monetary authorities should refrain from active stabilization policy and instead should adopt a fixed-percentage money growth rule. Under such a rule, it was claimed, economic agents could easily determine whether changes in prices were caused by real or by monetary factors, and act accordingly.

A second rival to the Keynesian approach, the Austrian School, is a rather old one. Its rivalry with Keynesianism, and particularly Hayek's controversy with Keynes and Sraffa, dates back to the early

1930s. The Keynesian revolution of the late 1930s dealt a serious blow to Austrian economics, which had given one of the most prominent and promising explanations of cyclical fluctuations. By the late 1970s, the Austrian School had recovered from this blow, although it has never regained the prominent position it occupied almost half a century before. The Austrian revival can be decomposed into two developments. First, in the early 1970s it criticized mainstream (neoclassical) economics for completely eliminating entrepreneurship from the domain of economics. Without a theory of entrepreneurship, mainstream economics could not make clear that market economies differ fundamentally from centrally planned economic systems. The second development that reflects the Austrian revival consists of an increase in the attention given to the business cycle theories of Mises and particularly Hayek. These theorists argued that cyclical fluctuations result from price distortions that are brought about by disturbances of monetary equilibrium. These disturbances affect relative prices and market rates of interest. The resulting investments are not in accordance with real (rates of) productivity and time preferences. Mises and Hayek suggested that the monetary authorities should refrain from active stabilization policies, because these would only prolong the inevitable depression, thus hampering the adjustment process during which unprofitable investment projects are eliminated.

Austrians and New Classics thus both explain cyclical fluctuations in terms of price distortions. Furthermore, they both play down the effectiveness of active monetary stabilization policy. This has led several economists to adopt the so-called common-roots claim, which holds that New Classics not only stand in the monetarist tradition, but also share common roots with the Austrian School, with the communicative function of the price system as the underlying and unifying theme.<sup>1</sup> However, the similarities between Hayekian and New Classical business cycle theories hide fundamental methodological and economic-theoretical differences.<sup>2</sup> The present chapter is concerned with one of these differences, namely the role to be played in economics by mathematical formalization. It argues that this difference leads to analytical differences. In the case of Austrian and New Classical Economics, the heuristic prescription of mathematical formalization thus affects the domain of economics.

The paper starts from the common-roots claim, as expounded above. The analysis is restricted to monetary business-cycle theories, which use the notion of monetary neutrality as a benchmark. However, this notion is somewhat ambiguous, in the sense that two concepts of monetary neutrality can be discerned. Both are discussed in section 1. Section 2 subsequently covers Hayek's business cycle theory,

which can be seen as a complex synthesis of Menger's structure of production, Wicksell's distinction between the natural and the market rate of interest, Mises's monetary theory, Cantillon's distribution effects and Hayek's own views on the dispersion of knowledge. Section 3 discusses New Classical monetary business-cycle theory in general, and its modelling strategies in particular. Section 4 lists the simplifying assumptions introduced by the NCE, and discusses the way in which they preclude the analysis of distribution effects.

## 1. MONETARY (NON-)NEUTRALITY

In the discussion of the neutrality of money two strands can be discerned. First of all we have the quantity theory proposition that *ceteris paribus* a change in the money supply only influences the price level. Neutrality in this case means that changes in the money supply in a comparative-static analysis leave relative prices and real magnitudes unaffected.<sup>3</sup> However, during the adjustment process from one equilibrium state to another money is seen as affecting relative prices and quantities. Second, attempts have been made to identify the conditions under which money would not affect relative prices and quantities at all (not even in the short term). Neutrality in this case means that monetary equilibrium is maintained at all times.<sup>4</sup> We shall first discuss neutrality of money in the second (monetary equilibrium) sense and then dwell somewhat longer on neutrality in the first (comparative-static) sense.

The idea of neutrality of money in the sense of uninterrupted monetary equilibrium is commonly traced back to Wicksell's *Geldzins und Güterpreise* (1898 (1962): 102), even if Wicksell did not use the term *neutral money*.<sup>5</sup> However, his definition of *neutral interest* was tantamount to neutrality of money in the second sense.<sup>6</sup> Wicksell maintained that neutrality implied a stable price level. His Swedish colleague Davidson was quick to point out that in an economy with increasing factor productivity monetary equilibrium, or neutral money, implied a falling price level.<sup>7</sup> Hayek refined Wicksell's analysis, first seeing a constant money supply and later a constant money flow per unit of time as the criterion for the neutrality of money, until Koopmans finally showed that no empirical yardstick can be found for monetary equilibrium.<sup>8</sup>

The aim of the monetary equilibrium theorists was to find the conditions under which a monetary economy would function as if money did not exist and relative prices consequently were only determined in the real sector.<sup>9</sup> A monetary economy was thus compared with a barter economy. However, this comparison was based on the assumption that markets function without frictions.<sup>10</sup> This amounts

to a wild goose chase, because if markets function without frictions, no reason can be found why people would ever decide to use money in the first place. Money that is no more than a veil will be blown away and if it is indeed the 'oil which renders the motion of the wheels [of trade] more smooth and easy', as Hume (1752: 33) put it, the wheels of trade will run much faster and further with money than without. In other words, a monetary economy has a different transactions technology than a barter economy. Now, the likes of Koopmans realized full well that money is used just because barter exchange is *not* frictionless and their construct of a frictionless barter economy was only a thought experiment.<sup>11</sup> Lutz (1969: 105) sees this as an attempt to express the idea that, if a general depression is to be avoided in a monetary economy, it should behave like a barter economy because in a barter economy Say's Law applies.<sup>12</sup> Still, this could not disguise the futility of the whole operation. Leaving on one side the question whether there is much sense in analysing money in a general equilibrium model where all goods exchange against all goods, the analysis of neutral money in the sense of monetary equilibrium at all times can better remain confined to the model of a monetary economy. There is no need to make a comparison with a barter economy.<sup>13</sup> Incidentally, if barter trade is not frictionless, even Say's Law would not suffice to prevent depressions. With frictions, in particular imperfect information on other agents' supply and demand functions, some goods offered in the market may fail to find a taker and economic activity declines, even if all excess demands neatly sum up to zero. In a general equilibrium model with money, the conditions under which monetary equilibrium is maintained can be analysed with exactly the results which Wicksell, Davidson, Hayek and Koopmans came up with. If monetary equilibrium is maintained at all times, Say's Equality holds true, that is, there is no excess demand or excess supply on all goods markets combined (if we neglect the markets for other financial assets than money). Still, equilibrium relative prices in goods markets are also dependent on monetary factors, as has been made clear by the discussion of the classical dichotomy.<sup>14</sup> If the monetary and real sectors are completely separate, the price level is indeterminate and the quantity theory cannot hold good.

The discussion on the neutrality of money in the monetary equilibrium sense focused on the conditions necessary for maintaining monetary equilibrium in the face of specific changes in the real sector of the economy. The excess demand functions in the real sector of the economy and with it the demand functions for real cash balances were assumed to change. By contrast, the quantity-theory comparative-statics approach to the neutrality of money can be said to study the effects of changes in the money supply with constant excess demand

functions in the real sectors of the economy and consequently a constant demand function for real cash balances. The interesting question here is whether, and if so to what extent, developments in the monetary sphere can have lasting effects on relative prices and hence quantities in the real sector.<sup>15</sup> The conditions for neutrality in the comparative-statics sense have been shown to be quite strict. First of all, money should be intrinsically valueless paper money or bank money. A change in the volume of full-blooded silver or gold money would not only have an impact on the general price level, but would also change relative prices of goods produced from silver or gold and other goods. Aschheim and Hsieh (1969: 213-15) formulate six further conditions for neutrality of money in the comparative-statics sense: (1) price flexibility, (2) absence of money illusion, (3) absence of distribution effects, (4) static price-expectations, (5) absence of a combination of internal and external money, or credit money and base money and (6) absence of government debt and open-market policies.<sup>16</sup> Aschheim (1973: 78) even goes so far as to claim that the conditions for neutrality of money imply, again, the absence of money (as a unit of account). Static price-expectations are in his view incompatible with perfectly flexible prices, freedom from money illusion and the absence of uncompensated distribution effects of price level changes.<sup>17</sup> The condition of static price-expectations may, however, be too strict.<sup>18</sup> Conditions 5 and 6 are based on the idea that changes in the money supply alter the composition of asset holders' wealth portfolios and with it the rate of interest.<sup>19</sup> These conditions could be reformulated in the sense that portfolio composition should not change, so that if the money supply changes, the volume of nominal debt changes proportionally. Likewise, condition 3 could be broadened to include the neutrality of distribution effects, as Aschheim in fact did in his 1973 article. Finally, the long-term inflation rate in the economy should be constant, as both the Mundell-Tobin effect and non-neutral tax effects preclude superneutrality.<sup>20</sup> Neutrality in the comparative-statics sense therefore can only be restricted to stepwise changes in the money supply, not to changes in the growth rate of money. This case could be subsumed under the condition of the neutrality of distribution effects.

The distribution effects call for further comment. As will be discussed more extensively below, Hayek's analysis follows Cantillon and emphasizes that money enters into circulation in specific ways, affecting the structure of spending and consequently relative prices, including the rate of interest, and quantities. It follows that money, especially if created through credit but also from an international payments balance, changes demand and supply functions in the real

sector.<sup>21</sup> Cantillon explained that money that enters into circulation through money-lenders brings with it a lowering of the rate of interest, while money that enters into circulation through consumptive expenditure by the rich makes the rate of interest rise, because the producers of consumption goods face an increase in demand and have to borrow money in order to increase production (Cantillon 1955, Part 2, Ch. 10). One expression of distribution effects is the phenomenon of *forced savings*. This follows if the expenditure of entrepreneurs who borrow money to increase production makes prices rise and in that way brings about a reduction in real consumption.<sup>22</sup> Another case of distribution effects is the redistribution of real wealth between debtors and creditors in the case of (unforeseen) price level changes, a redistribution that according to Fisher (1933) and Keynes (1936: 264) could seriously worsen a depression, once started. A special kind of distribution effect, which has only recently received serious attention (Bikker 1991a, 1991b), concerns the redistribution of interest income when the rate of interest changes.

New developments in growth theory serve to underline the likelihood of non-neutrality of money supply changes. In general-equilibrium models, demand and supply functions usually are well-behaved linear functions and the system is stable or assumed to be stable: after the business cycle has run its course everybody is back on his or her unchanged demand or supply curve. With nonlinearities, as emphasized by the new growth theory, any temporary expansion in an industry may perpetuate itself because relative prices between goods are changed in the process. The new growth economics thus holds that investment may recreate investment opportunities, and that success breeds success.<sup>23</sup> Distribution effects are then even more likely to result in lasting changes in the real sectors. More generally it is acknowledged that deviations from an equilibrium growth path through their impact on investments and technology, may change the equilibrium growth path itself if technological growth is endogenous.<sup>24</sup> This ties in with chaos theory, which shows that in nonlinear systems a small change in initial conditions will lead to significant changes in the time path of a function.<sup>25</sup> The result is hysteresis, or the phenomenon that deviations from an equilibrium path change the equilibrium path itself. New developments in economic theory thus tend to emphasize the deviation-amplifying tendencies of shocks rather than the stability of any growth path.

The above indicates that recently economists have increasingly recognized the importance of forces that affect the comparative-statics

neutrality of money. In the 1930s Hayek already focused on a subset of these forces. As was stated above, his business cycle theory interprets cyclical fluctuations in output and investment in terms of non-neutral monetary injections in a specific market. The ensuing Cantillon effects distort the so-called 'structure of production'.<sup>26</sup> The next section will discuss this theory in more detail.

## 2. THE ANALYSIS OF CANTILLON EFFECTS: HAYEKIAN BUSINESS CYCLE THEORY

Hayek's business cycle theory starts from an intertemporal perfect-information general equilibrium, which he defined as a series of situations in which economic agents have complete information and perfect foresight about preferences and the means of production at every point of time during the planning period (Hayek 1982: 76). Such an equilibrium is maintained if the agents do not make expectational errors (ibid.: 85). However, Hayek (1933c) recognized that in reality agents do not have complete information, and hence cannot avoid making such errors. In fact, he claimed that 'Every explanation of economic crisis [and, more generally, of business cycles] must include the assumption that entrepreneurs have committed errors' (ibid.: 141). He added that cycles will only arise when these economic agents make *similar* expectational errors, suggesting that this similarity follows from the fact that the agents base their actions on signals which as a rule prove reliable (ibid., 141). The most important signals in this regard are provided by the price system.

Disregarding the fact that Hayek's business cycle theory has been formulated in several versions, it can be reconstructed as follows. The theory concentrates on the variable which figures most prominently in investment decisions, namely the interest rate. Hayek adopted Wicksell's distinction between the natural and the market rate of interest.<sup>27</sup> The former is defined as the long-run equilibrium rate of interest, which reflects the time-preferences of the economic agents. The 'market' (or money) rate of interest is the rate at which the supply of loanable funds equals the demand for loans. It need not equal the natural rate, and thus need not reflect the agents' time-preferences. The difference results from either a change in the natural rate, or a change in the market rate. Hayek argued that the process resulting from the former change must be interpreted as a mere adjustment process to a new equilibrium situation instead of a business cycle. In his view, business cycles thus follow from changes in the market rate of interest which (initially) do not affect the natural rate. This means

that they are by definition caused by monetary expansion, that is, by the absence of monetary neutrality in a monetary-equilibrium sense. The expansion may result from (1) changes in the volume of cash, caused by the in- and outflow of gold, (2) changes in the volume of money, as regulated by the monetary authorities (i.e. the government and the central bank), and/or (3) the creation of credit by private banks.<sup>28</sup> As Hayek shifted emphasis in time, we shall discuss monetary expansion in general, disregarding its source.<sup>29</sup> Hayekian business cycle theory assumes that such an expansion enters the economy on the loan market. The market rate of interest then falls below the natural rate, which raises the present value of all investment projects. As O'Driscoll and Rizzo (1985: 205) showed, this rise in present value is a result of three effects: (1) a discount rate effect, (2) cost effects, and (3) derived-demand (or relative-price) effects. The third effect is most characteristic for Hayek's business cycle theory. But before discussing it, we briefly discuss the other two effects.

The discount rate effect starts from the fact that the market rate of interest is used as a discount rate, so that the present value of the expected future returns of investment projects increases. The cost effect reflects that the market rate is also the price to be paid for loans. A fall in this rate reduces the costs of investment projects, and therefore increases their net present value. Both the discount rate and cost effect thus result in general *over*investment, which will exist as long as entrepreneurs find it worthwhile to invest (i.e. as long as they expect that the process of monetary expansion continues).<sup>30</sup> The ensuing gap between planned investment and planned savings is filled by forced savings. As noted in the previous section, this phenomenon results from redistributions in income.<sup>31</sup> It presupposes that some individuals will experience a rise in income earlier than others, because their productive activities are more in demand. This can only be the case if their (productive) activities differ from those of others. Furthermore, the non-simultaneity of the rise in their respective incomes also reflects Hayek's assumption that money does not spread immediately throughout the economy. Instead, production is a time-consuming activity, in the sense that it takes place in successive stages of production (see below).

The discount-rate and cost effects work in the same direction, namely by increasing the present value of all investment projects, thus explaining the emergence of a boom. However, they do not suffice to explain the upper turning-point of the business cycle. Hayek distinguished two reasons why this turn is inevitable. First, he argued that the boom would come to an end when the additional money stops flowing into the economy. Entrepreneurs will then recognize that they have made expectational errors about the profitability of their

overinvestments. Consequently, these overinvestments will be eliminated. This leads to a fall in the demand for producer goods, which will spread throughout the economy, reducing economic activity. As Wilson (1940) pointed out, though, this recession is by no means inevitable, because it can be postponed by continuing to increase the money supply.<sup>32</sup> Hayek's second explanation of the upper turning-point was less easy to refute. It builds on the derived-demand effect, which holds that the initial fall in the market rate of interest does not only affect the volume of investment but also its composition. Before discussing this effect, we must first discuss the framework in which it takes place.

Following Menger (1871: 8-10), Hayek adopted the structure of production as his framework of analysis. Menger had classified capital goods according to the functions they perform in the process of production, using their 'remoteness' from consumption as a criterion for classification. Consumer goods are called 'goods of the first order', capital goods which are used in the production of these first-order goods are called second-order goods, capital goods which produce second-order goods are called third-order goods, and so forth. Hence there is a vertical relationship between heterogeneous capital goods. It is then possible to distinguish stages of production which can be classified in a manner similar to that of capital goods. Taken together, these stages form a structure of production. This structure is vertical, in the sense that production takes place in successive stages: production in a given stage depends on production in a higher-order stage.

The derived-demand effect can now be explained as follows. The fall in the market rate of interest does not affect all investment projects to the same degree, or even in the same manner. Different orders of goods, and hence different stages of production, are affected differently. If entrepreneurs mistakenly interpret the fall in the market rate of interest as reflecting a fall in the natural rate, they will conclude that the agents' time-preferences have decreased. This means that they expect current consumption demand to fall and future consumption demand to rise. It will then appear to be more profitable to invest in productive activities which yield consumption output in the more distant future. In other words, the present value of investment projects which involve higher order goods has increased, whereas that of others has decreased. This induces entrepreneurs to reallocate capital from the lower to the higher stages of production. In Austrian language, the structure of production is 'lengthened' (or has become more 'roundabout'). However, eventually this process of lengthening will be checked by a shortage of resources. Hayek argued that during the later stages of the boom 'the prices of consumer goods do as a rule rise and real wages fall' (Hayek 1939: 11).<sup>33</sup> The rise in consumer

prices increases the profit margins on these goods, and hence induces entrepreneurs to reallocate capital from the production of capital goods to that of consumer goods. The fall in real wages makes 'shorter' methods of production more profitable, so that there will be a tendency to use more labour with the existing machinery (by working overtime, double shifts, etc.), and to invest in less expensive, less labour-saving or less durable machinery. Hayek argued that the implied decrease in the demand for capital goods will become so strong as to turn the boom into a recession. This effect is called the Ricardo effect.<sup>34</sup> During the recession entrepreneurs will correct their investment errors by reallocating their capital from higher- to lower-order goods.<sup>35</sup> The recession ends either because of an increase in the supply of money or because of the reverse operation of the Ricardo effect.

The above suggests that Hayek's business cycle theory contains at least two unique features. First, it adopts the Mengerian framework of the structure of production. This means that capital goods are heterogeneous, and that they stand in a vertical, time-consuming relationship to each other. Second, the theory incorporates Cantillon effects, in the sense that an increase in the supply of money leads to redistributions between the owners of different factors of production and between the entrepreneurs in different stages of production. As Foss pointed out, 'Hayek's argument is . . . dependent . . . on the time path of real factor incomes relative to the linear representation of productive activities [i.e. the vertical structure of production] and the lags *this* implies' (Foss 1990: 6, original emphasis). It takes time before the additional money is spread out evenly throughout the economy.<sup>36</sup> The ensuing distortion of the structure of relative prices follows from the fact that economic agents differ from each other. These differences may concern: (1) their utility functions, (2) their abilities to gather information (and hence their information sets), (3) their expectations formation functions, and/or (4) their productive activities (i.e. the order of goods which they produce). In his work on business cycles, Hayek did not explicitly discuss the heterogeneity of the first three issues, but merely stressed the fourth. The heterogeneity of production goods and productive activities accounts for the *mal*investments and the ensuing distortion of the structure of production. In his later work, Hayek increasingly recognized the importance of the dispersion of knowledge, which implies heterogeneity of information as well as expectations.

### 3. THE ROLE OF MATHEMATICAL FORMALIZATION IN HAYEKIAN AND NEW CLASSICAL ECONOMICS

The above exposition of Hayek's business cycle theory indicates that business cycles are highly complex phenomena. According to Hayek (1952), this complexity reduces the scope of mathematical formalization. He argued that mathematics is the appropriate language for those sciences which adopt the so-called analytic method. This method derives the unobservable behaviour of the elements of a system from the observable behaviour of the system as a whole. For instance, the unobservable behaviour of atoms in some substance is derived from the observable behaviour of that substance. According to Hayek, the usefulness of mathematics for explanatory purposes in the natural sciences follows from the fact that it is 'the discipline developed to describe complexes of relationships between elements which have no attributes except these relations' (ibid.: 33). The relationships and hence the system as a whole implicitly define the elements.<sup>37</sup> If transposed to the social sciences, the analytic method would mean that the behaviour of the elements is explained in terms of inductively obtained developmental laws for the social system as a whole. Hayek rejected this transposition, and instead proposed that the social sciences should adopt the compositive method (ibid.: 43). This method holds that the behaviour of the system as a whole should be composed from the behaviour of the elements, whereby knowledge about the latter is derived from introspection. Consequently, unlike the natural scientist, the social scientist reconstructs social phenomena from the known properties of the elements (ibid.: 67). However, it should be noted that this reconstruction is confronted with the inevitable imperfection of the human mind. According to Hayek, 'The number of separate variables which in any particular social phenomenon will determine the result of a given change will as a rule be far too large for any human mind to master and manipulate effectively' (ibid.: 73). Instead, he claimed that mathematical models show merely the principle of coherence between the composing elements of the system, and cannot yield precise predictions without knowledge of the numerical values of all its constants. Quoting similar observations by Cournot and Pareto, he concluded that this would practically exceed the power of algebraic analysis. Stated differently, he opposed the heuristic prescription of building mathematical models which can be solved analytically (ibid.: 75, n. 8), because this prescription could only be adhered to by imposing restrictions on economic theory that exclude relevant aspects of economic reality from analysis. This is not to say that Hayek rejected abstraction and simplification. After all, all theorizing implies the introduction of simplifying assumptions.

Instead, Hayek argued that such mathematical models *oversimplify* social reality. Consequently, they affect the domain of economic analysis, eliminating those problems from that domain that cannot be formalized in analytically solvable models.

Hayek thus downplayed the appropriateness and usefulness of mathematical formalization. Nevertheless, in recent years some attempts have been undertaken to formalize his views mathematically. For instance, Thalenhorst and Wenig offer such a formalization of Hayek's *Prices and Production* (1931), but they assume that the rate of profit is identical for each stage of production (Thalenhorst and Wenig 1984: 217). This absence of inter-stage profit opportunities means that there are no distortions of the structure of production and hence that there cannot have been malinvestments. As Thalenhorst and Wenig acknowledge, their analysis cannot discuss Hayekian monetary dynamics (*ibid.*: 215). It should be noted, though, that their mathematical model may serve as a starting-point for a mathematical analysis. Relaxation of some of its assumptions may render the analysis of Hayekian monetary dynamics possible. Nevertheless, until now Hayek's business cycle theory has never been formalized as a mathematical model.

In contrast, New Classics adopt the heuristic prescription that economics should build analogue models which mimic the behaviour of (the time series as generated by) actual economies. One of its main proponents, Robert E. Lucas, defined a theory as 'an explicit set of instructions for building a parallel or analogue system - a mechanical, imitation economy' (Lucas 1980: 272). This 'fully articulated artificial economy [should] behave through time so as to imitate closely the time series behavior of actual economies' (Lucas 1977: 219). Arguing that advances in mathematical problem-solving techniques constitute a main source of scientific progress, Lucas implied that such models should be analytically solvable (1980: 272). This led Butos to conclude that 'new classical economists limit their conceptualization by the techniques available, while for Hayek the conceptualization of a problem points to the limitations of the available techniques' (Butos 1986: 337). The limitations of these techniques force New Classics to introduce additional simplifying assumptions. More particularly, they lead to the elimination of Cantillon effects.

#### 4. THE ELIMINATION OF CANTILLON EFFECTS: NEW CLASSICAL BUSINESS CYCLE THEORY

New Classical Economics (NCE) started as an attempt to formalize Friedman's (1968) and Phelps's (1967) explanation of the relationship between the rate of inflation and (the rate of change of) the

unemployment rate, the so-called Phillips curve.<sup>38</sup> This explanation adopts the Natural Rate Hypothesis (NRH), according to which the economy will tend towards its 'natural rate of output' or 'natural rate of unemployment'.<sup>39</sup> The resulting full-information general equilibrium is called the Natural Rate Equilibrium (NRE). Given the absence of money illusion on the part of the economic agents, it implies that there is no relationship between real and purely monetary variables, so that money is neutral in the comparative-static sense.<sup>40</sup> However, this clearly conflicts with the Phillips curve, which does reflect such a relationship. Friedman and Phelps had argued that deviations of the NRE reflect expectational errors, due to incomplete information. Phelps (1970) additionally suggested that this incompleteness of information could be explained in a general-equilibrium framework in which local markets are spatially and informationally separated. The NCE would elaborate this suggestion.

New Classics adopt at least four crucial assumptions. First, economic agents are considered to be price-takers. A Walrasian *tâtonnement* process is assumed to ensure perfect price flexibility and hence continuous market-clearing. As a corollary, New Classical business cycle theory is also called equilibrium business cycle theory. Second, aggregate real output is formulated as the 'Lucas supply function'. This function holds that deviations from the NRE can only result from unanticipated nominal price changes and hence from expectational errors. However, these errors are rational in the sense that they only differ randomly from actual realizations of economic variables. This Rational Expectations Hypothesis (REH) is the third assumption. The fourth assumption is that economic agents have incomplete information about relevant economic variables.

The NCE explains expectational errors in terms of exogenous shocks, which are either real or monetary in nature. The shocks are reflected in the prices which agents observe. Given the fourth (informational) assumption, agents must act on the basis of incomplete information. This means that they will make expectational errors. According to the REH, rational economic agents do not make systematic expectational errors, because such errors are easily detectable. The problem then arises how unsystematic, serially uncorrelated, shocks can account for the persistence which characterizes the economic data over the business cycle. The NCE solves this problem by adopting a solution which had already been given in the 1930s. Slutsky (1937) and Frisch (1933) had already shown that random shocks could lead to serially correlated movements of the variables in the system under consideration, due to some propagation mechanism. Thus, the crucial distinction, as Lucas and Sargent (1978: 313) noted, is that between sources of impulses and propagation

mechanisms. The latter ensure that serially uncorrelated disturbances will have serially correlated effects. Instances of such mechanisms have been provided by Lucas (1975), Blinder and Fischer (1981) and Kydland and Prescott (1980), among others.<sup>41</sup> These mechanisms are instances of what Barro called 'adjustment-costs explanations' of persistence (Barro 1981b: 48). They explain persistence by introducing friction into the economic system.

The above description of New Classical business cycle theory already reflects that New Classics formulate their views as mathematical models. However, mathematical formalization usually involves the introduction of additional simplifying assumptions. These assumptions will depend on the modelling strategy followed. New Classics use two such strategies, namely the representative-agent approach and the islands approach.

### The representative-agent approach

Early New Classical models were so-called 'representative-agent models'. The concept of the representative agent was first explicitly introduced by Marshall (1890), whose 'representative firm' is some sort of non-mathematical, fictitious average entity.<sup>42</sup> In contrast, the NCE defines the representative agent (individual, household, firm) as the mathematical mean of the (sub)system as a whole.<sup>43</sup> This means that the concept is used as a hypostatization of this system.<sup>44</sup> As Hoover (1988: 242) observed, New Classics treat aggregates and index numbers as if they obey the principles of microeconomics. They restrict their analyses to the mathematical mean, accounting for deviations from this mean by adding a probability distribution. As stated above, the NCE uses Friedman's (1968) natural rate of output (unemployment) as its benchmark. The Lucas supply function can therefore be formulated as follows:

$$y_t = z + \alpha(1 - \beta)(p_t - p_t^e) \quad (4.1)$$

in which  $y$  is the actual aggregated level of real output,  $z$  is the 'natural rate of output,  $p_t$  is the actual general price level,  $p_t^e$  is the expected general price level,  $\alpha$  is a parameter indicating the extent to which a deviation of  $p_t^e$  from  $p_t$  influences  $y_t$ , and  $\beta$  is a parameter indicating that the higher the volatility of changes in  $p_t$  the less output differs from its natural rate.

The Lucas supply function shows that an unanticipated change in the general price level will induce the representative agent to change his output. Given the New Classical assumption of comparative-static neutrality of money, this indicates that unanticipated changes in the money supply can raise actual output above its natural rate (and

equivalently actual unemployment below its natural rate). In this case, the incompleteness of information ensures that the representative agent makes an expectational error about the nature of the change in the actual general price level, believing that it reflects real instead of monetary changes in the economy. However, the agent will adjust his actions as soon as the correct information becomes available. This does not mean, though, that the economy immediately returns to its new NRE, because propagation mechanisms may hamper this adjustment by transmitting the effects of the random expectational errors to subsequent periods. This transmission yields a business cycle.

Incomplete information may thus explain why monetary changes have real effects. The representative agent's information set therefore plays a crucial role in the New Classical approach under consideration.<sup>45</sup> Given this set, the representative agent by definition forms rational expectations which equal the mathematical mean of the aggregate expectations, albeit in a probabilistic sense. That is, the 'representative agent approach' assumes away systematic differences between economic agents. This may be based on the argument that the expectational deviations will cancel out, presumably due to the 'Law of Large Numbers'.<sup>46</sup> This 'law' is a statistical regularity which applies only if the elements of the population under consideration belong to the same 'class', that is, if they do not differ from each other in any relevant aspect. The assumption that the agents are identical will be called the homogeneity postulate. This postulate is adopted in the New Classical representative-agent models, so that these models concentrate on the magnitude of aggregates, disregarding (changes in) their composition. This implies that redistributions between economic agents are considered to be irrelevant in the explanation of industrial fluctuations. This restriction of the domain of New Classical Economics could be circumvented by introducing several 'representative agents'. This strategy is adopted in the 'islands approach', which can be regarded as a more sophisticated version of the representative-agent approach.

### The islands approach

The 'islands approach' uses Phelps's (1970) suggestion that markets can be seen as islands. In particular, it was adopted by Lucas (1972, 1975), Lucas and Prescott (1974) and Barro (1976, 1980). These models consider an economy in which a single output is produced, which must be divided between private consumption, government consumption, and next period's capital. The population consists of identical households, so that their utility functions do not differ. The conjunction of these two assumptions implies that economic agents are also



identical with respect to their productive activities. However, this does not mean that there are no differences at all between them. As Lucas stated, the 'islands' or markets are 'imperfectly linked both physically and informationally' (1975: 180), so that information is assumed to be homogeneous across agents in a given market, but heterogeneous across markets.<sup>47</sup> The 'islands approach' thus assumes that economic agents only differ from each other as regards their information sets. Hence, it disregards 'intra-market' distributional effects. The study of such effects *between* markets, however, appears to remain possible.

As was stated above, New Classical business cycle theory explains industrial fluctuations in terms of expectational errors. These errors are caused by discrepancies between changes in the relative prices and in the general price level. That is, the economic agents must determine how much of a given change in their respective local prices must be attributed to a change in the general price level, and how much of the change in local prices reflects changes in real factors. Agents must therefore form expectations about the difference between their local price level and the general (global) price level. Given the assumption of complete local and incomplete global information, the agents' information sets include  $p_t(z)$  but not  $p_t$ . They must then form expectations about the latter, so that their output decision can be described as follows:

$$y_t(z) = z + \alpha (1 - \beta) (p_t(z) - p_t^e) \quad (4.2)$$

where the subscripts denote the time period under consideration, and  $z$  is an index of location. Since expectations are rational, agents are assumed to know the 'true' probability distribution of  $p_t^e$  and hence the difference between  $p_t(z)$  and  $p_t^e$ .<sup>48</sup> According to Pesaran (1989: 57), this means that the problem of heterogeneity of information across markets is circumvented. After all, the relevant decision variable is  $d_t(z) = p_t(z) - p_t$ , and all agents are assumed to know its 'true' distribution. As there can only be one 'true' distribution, this means that their respective information sets do not differ in any relevant (i.e. systematic) manner.<sup>49</sup> Information about the relevant decision variable turns out to be homogeneous across markets. The problem of the heterogeneity of information across markets in the 'islands models' is thus circumvented by assuming that all economic agents know the 'true' probability distribution of  $d_t(z)$ .<sup>50</sup>

In conclusion, the islands approach and the representative-agent approach assume that economic agents do not differ with respect to their utility functions, their abilities to gather information (and hence their relevant information sets), their expectations formation functions (and, given the information sets, their expectations) and their productive activities. This means that distribution effects, such as

Cantillon effects, cannot be analysed. Their elimination from the domain of economics is the price to be paid by New Classical for their particular version of the heuristic prescription of mathematical formalization.

## 5. CONCLUSIONS

According to Blaug 'the Cantillon effect . . . denies "the homogeneity postulate"' by asserting that changes in prices produced by cash injections vary with the nature of the injection and, moreover, that changes in absolute prices are almost always associated with alterations in relative prices' (Blaug 1962: 155). Our analysis allows for a more explicit formulation of this homogeneity postulate. In particular, the NCE assumes that agents are homogeneous with respect to:

- 1 the utility functions,
- 2 the abilities to gather information (and hence the information sets),
- 3 the expectations formation processes (and, given (2), the expectations), and
- 4 their productive activities (i.e. the order of goods they produce).

These assumptions reflect that New Classical business cycle theory explains cyclical fluctuations in terms of aggregate variables, thereby implying that distributional effects do not play an important role. In contrast, Hayekian business cycle theory also incorporates changes in the composition of aggregate variables. It stresses the complexity of social reality, but in doing so it completely surrenders to the impossibility of modelling the economy in full.<sup>51</sup> Hayek's business cycle theory allows for the inclusion of Cantillon effects and the ensuing (comparative-static) non-neutrality of money, but it does so at the cost of mathematical rigour. In contrast, the NCE attempts to build analytically solvable models that mimic the behaviour of actual economies. In doing so it introduces simplifying assumptions which eliminate Cantillon and other distribution effects from this domain. In this sense the New Classical heuristic prescription of mathematical formalization adversely affects the domain of economic explanation as compared with Hayek's analysis.

## NOTES

The authors wish to thank Jack Birner, Ben Elzas, Harry Garretsen, Maarten Janssen and Emiel Wubben for their useful comments on an earlier version of this paper. Of course, the authors remain responsible for any errors.

- 1 For example, see Kantor (1979), Colander and Guthrie (1980), Laidler (1982) and Scheide (1986).

- 2 Cf. Butois (1986) and van Zijp (1990). For an analysis of the respective developments in and differences between Austrian and New Classical Economics, see van Zijp (1993).
- 3 Some writers see this as the more recent definition of neutral money, cf. Lutz (1969: 112) and Klausinger (1989: 177). But it was implied in the quantity theory all along and thus predates the other connotation of neutral money by a couple of centuries.
- 4 Monetary equilibrium is defined as the situation in which the money supply at any moment in time equals the volume of money demanded. In Dutch discussions of the 1950s the term was also used within the framework of period analysis, in the sense that income earned in one period and available in the next period is equal to income earned in the next period. In other words, national income is constant. This connotation of the term is not applied here. See for references Visser (1971: 404).
- 5 The term 'neutral money' appears to have been introduced by L. von Bortkiewicz in 1919; see de Jong (1973: 8n) and Patinkin and Steiger (1989: 135).
- 6 Wicksell (1898: 102) defines the natural rate of interest as 'the rate of interest which would be determined by supply and demand if no use were made of money and all lending were effected in the form of real capital goods'.
- 7 Cf. Myrdal (1933: 436) and Thomas (1935: 37-40).
- 8 The discussion has been admirably summarized by de Jong (1973). See also Visser (1971).
- 9 Cf. Hayek (1967: 31; 1933b: 159) and Koopmans (1933: 228).
- 10 In a letter to Robertson (reprinted in Fase 1983: 322-8) Koopmans explained that his frame of reference was an *ideal* equilibrium economy where, in his words, no stocks of goods had to be held for mere liquidity purposes, i.e. a frictionless barter economy.
- 11 Koopmans (1933: 230) talks about an hypothetical situation that could not exist in reality, a '*hypothetische, in der Realität wohl überhaupt nicht denkbare Zustand*'.
- 12 Hayek defined the problem as 'one of isolating the one-sided effects of money . . . which will appear when, after the division of the barter transaction into two separate transactions, one of these takes place without the other complementary transaction' (Hayek 1967: 130). This supports Lutz's view.
- 13 Patinkin attempted to 'conceive of a barter economy as the limiting position of a money economy whose nominal quantity of money is made smaller and smaller' (Patinkin 1965: 75). He could not but concede that the price level falls in the process, leaving the real quantity of money unchanged, but still maintained, then and also a quarter of a century later that 'This drawback notwithstanding, there does not seem to be any other meaningful way of comparing the respective equilibrium positions of a barter and money economy' (Patinkin and Steiger 1989: 138). We would suggest that there is no meaningful way at all to compare these equilibrium positions.
- 14 See Becker and Baumol (1962) and Patinkin (1965: 75, 175).
- 15 Few, if any, quantity theorists denied that money is non-neutral in the short period, see Visser (1974: 135-6) and Humphrey (1991).
- 16 Cf. the seminal article by Metzler (1951).

- 17 Conditions 5 and 6 are not mentioned in Aschheim's 1973 article and condition 3 is reformulated as the absence of *uncompensated* distribution effects. Presumably he subsumed conditions 5 and 6 under 3.
- 18 See Visser (1971: 423-5; 1974: 176-7).
- 19 See on this Patinkin (1965: 288-94), who notes that neutrality is retained if government bonds are not seen as net wealth. See also Patinkin (1989).
- 20 Cf. Tobin (1965).
- 21 Post-Keynesian analysis also emphasizes distribution effects, but it tends to play down the impact of money on other economic variables, stressing instead the residual character of money. None the less, money is considered far from neutral, as its creation is dependent on the borrowing needs of all kinds of economic actors and borrowing is influenced by the central bank's interest rate policies. See Arestis (1988).
- 22 The phenomenon of 'forced savings' was already discerned by Ricardo, who considered it relevant for the short run only. Other economists have acknowledged that forced savings could also change the natural rate of interest. For a history of this phenomenon, see Hayek (1932), Viner (1964: 187-97) and Humphrey (1991: 9-11).
- 23 See FitzGerald Scott (1989, in particular p. 159), Lucas (1988), and Romer (1986).
- 24 Cf. Solow (1988, in particular pp. 311-12).
- 25 See, for example, Butler (1990) and Kelsey (1990).
- 26 It appears that Blaug (1962: 21) was the first to use the term 'Cantillon effect'.
- 27 Wicksell (1898) was not the first to use the concept of a natural rate. As Haberler (1946: 36, n. 1) observed, this concept (and even the term) can be found in earlier English economic writings. For instance, Smith (1776, I. vii, p. 65) argued that 'The natural price . . . is, as it were, the central price, to which the prices of all commodities are continually gravitating'. More importantly, Thornton (1802: 253-5) already explicated the so-called indirect mechanism, which holds that an increase in the supply of money is translated in a rise in the general price level through a fall in the market rate of interest and the ensuing increase in investment. He thereby identified an equilibrium rate of interest, using the adjective 'natural' as early as 1811. However, as Wicksell's student Carl Uhr (1960: 200) pointed out, Wicksell had not been directly exposed to Thornton's ideas, and the influence has been merely indirect, through Ricardo.
- 28 This process of credit creation will result in a process of 'credit multiplication' if the initial credit expansion is (partly) deposited at another private bank, which in turn increases its loans. This process of 'credit multiplication' presupposes that banks adhere to a fractional reserve ratio, and it can go on as long as the additional credit is not used in a way which leads quickly to the market for consumer goods.
- 29 Contrary to his Austrian forerunner Mises, Hayek (1933a: 150) considered the first influence empirically less important and the second a rather special case. Mises had criticized the monetary policy of the 1920s, which were highly inflationist, thus explaining cyclical fluctuations as the result of exogenous disturbances. In contrast, Hayek attempted to elaborate an *endogenous* business cycle theory, thereby concentrating on the third influence. However, in the 1970s he considered the second influence

- to be the most important. He then proposed to denationalize money which would render it impossible for the monetary authorities to pursue inflationary policy. This changed his explanation of business cycles from an endogenous into an exogenous one.
- 30 Note that this result not only applies to unanticipated but also to anticipated monetary expansion.
- 31 Note that when preferences and patterns of expenditure differ between economic agents, the redistributions of income also imply shifts in the relevant general equilibrium, and hence changes in the natural rate of interest. Moreover, the effects of the redistributions depend on the route according to which the additional money spreads throughout the economy. It seems therefore correct to infer that the relevant general equilibrium changes continuously: 'the target is moving'.
- 32 Hayek (1933d: 180) considered this possibility very unlikely.
- 33 He defined the real wage rate as the ratio of the money wage rate and the prices of the consumer goods produced by the labour under consideration (p. 8).
- 34 This effect derives its name from Ricardo's statement that 'with every rise in the price of labour, new temptations are offered to the use of machinery' (1817, Ch. I, Section V, pp. 26 ff.). It is designed to show that the boom will come to an end even if the market rate of interest were to remain constant. Hayek (1931) had already shown that the boom would cease in a situation in which the market rate of interest was perfectly flexible.
- 35 It should be noted that the Ricardo effect assumes that entrepreneurs expect the relatively higher prices of consumer goods and the relatively lower real wages to persist for a period of time that is long enough to make it worthwhile to change their methods of production. Hayek, (1939: 16-18) acknowledged this. Moreover, he also addressed the case in which entrepreneurs expect that the prices of consumer goods continue to rise. This will merely reinforce the effect, due to the continuing fall in real wages.
- 36 In order to clarify his views Hayek compared a situation of continuous credit creation to a situation in which a viscous liquid, such as honey (read: money), is poured into a vessel (the economy): 'if the stream hits the surface at one point, a little mound will form there from which the additional matter will slowly spread outward' (Hayek 1969: 281). This analogy reflects that there is no such thing as 'helicopter money'. It leaves the question unanswered why the liquid is viscous (i.e. why it takes so long for the additional money to spread throughout the economy).
- 37 In this sense, the natural sciences create a 'new world', consisting of implicitly defined elements which cannot be perceived by man's senses. According to Hayek, the significance of the theories of these sciences 'is due to the fact that we possess rules, a "key", which enables us to translate them into statements about perceptible phenomena' (Hayek 1952: 34).
- 38 The main New Classical proponents are Robert Lucas, Jr, Thomas Sargent, Neil Wallace, Robert Barro, Edward Prescott and Finn Kydland.
- 39 As Maddock observed, 'It is quite common in this [i.e. New Classical] literature to switch back and forth between income and unemployment by replacing log unemployment for log income minus log trend income'

- (Maddock 1979; 158, n. 4). Therefore the natural rate of output (NRO) and the natural rate of unemployment (NRU) are considered to be reciprocal.
- 40 For instance, see Sargent and Wallace (1975: 221-4).
- 41 Lucas (1975) accounted for persistence effects by incorporating physical capital, which is affected by random changes in the growth rate of money and the ensuing Mundell-Tobin effect. Once installed, the physical capital stock can only be adjusted at the rate of depreciation. Blinder and Fischer (1981) used the gradual adjustment of inventory stocks of finished goods as a mechanism to ensure serial correlation. Kydland and Prescott explain persistence by arguing that 'there are long lags from the time when changes in its determinants call for an increase in the capital stock until the time when the new capital starts yielding services' (Kydland and Prescott 1980: 175).
- 42 In Marshall's view, 'a Representative firm is that particular average sort of firm, at which we need to look in order to see how far the economies, *internal and external*, of production on a large scale have extended generally in the industry and country in question' (Marshall 1890: 317-18, original emphasis.).
- 43 For instance, Lucas and Rapping (1969: 25) deflate the aggregate labour supply function by an index of the number of households, Lucas (1972: 68) assumes that each period  $N$  identical individuals are born who each supply  $n$  units of labour which yield  $n$  units of output. Sargent (1972, 1973, 1976) uses aggregates only. His work builds on the microfoundations as provided by Lucas.
- 44 This was already stressed by Runde and Torr (1985: 217), who argued that the rational expectations approach (i.e. the NCE) does not analyse individual, but rather the market's behaviour. In a general-equilibrium analysis this means that the representative individual is merely another way of depicting the system as a whole.
- 45 Lucas emphasized this property of the NCE when discussing the (New-) Keynesian assumption that nominal prices are rigid because of some form of collective bargaining. He objected that 'The central issue for a theory of nominal price rigidity . . . is not the nature of the game agents are assumed to be engaged in, but rather the *information* agents are assumed to have about the state of the system at each date' (Lucas 1987: 94).
- 46 Haltiwanger and Waldman (1989) argue that this will only hold under very special circumstances which concern the nature and intensity of the interrelations between the actions of the individuals. They distinguish two types of interrelations, namely *congestion* and *synergism*. The former applies when the incentive for agent  $i$  to engage in an activity will be lower if the number of participants is higher. In the case of synergism the reverse holds. Agent  $i$ 's costs and benefits of participating in an activity can therefore be modelled as a function of the number of participants. Their analysis comes to the conclusion that 'Only under very special conditions do standard [i.e. micro-type] rational expectations and aggregate rational expectations yield equivalent results' (ibid.: 631). It turns out that 'The size of the difference [between the two equilibria] will be larger (i) the larger is the divergence in expectations under aggregate rational expectations, and (ii) the more synergistic is the environment' (ibid.). This means that New Classics implicitly assume

- that there is no congestion or synergism. The number of participants does not influence the individuals' cost-benefit analysis.
- 47 According to Pesaran, this feature follows from the New Classical assumption that 'All firms (or individuals) observe current equilibrium prices in their local markets' (Pesaran 1989: 57). Such prices clear the market under consideration, thus conveying all information on that market. As on a given market individuals derive their information from observing the same equilibrium price, they will have identical information. That is, information will be homogeneous on that market, but heterogeneous across markets.
- 48 The fact that the agents know the 'true' probability distributions of changes in the money supply, and in the distribution of individuals over both markets is merely another way of stating that expectations are formed rationally in the sense of Muth (1961). Muth's REH holds that 'expectations of firms (or, more generally, the subjective probability distribution of outcomes) tend to be distributed, for the same information set, about the prediction of the theory (or the "objective" probability distributions of outcomes)' (ibid.: 316).
- 49 For instance, Barro explicitly assumed that 'all markets have the same *ex ante* distribution of price (Barro 1976: 85).
- 50 McCallum (1979) and Machlup (1983) have criticized the New Classical assumption that economic agents know the 'true' probability distributions, because it implies that they also know the 'correct' structure ('model') of the economy. It is not even clear why all agents would use the same (New Classical) 'model', and hence why expectations would be Muth-rational. Frydman concluded that 'the assumption that agents form rational expectations appears to conflict with the fact that the economy is decentralized' (Frydman 1983: 115).
- 51 This emphasis is consistent with the Austrian view that economic agents differ from each other in relevant aspects. These differences may even concern the 'models' which agents use.

## REFERENCES

- Arestis, Ph. (ed.) (1988) *Post-Keynesian Monetary Economics*, Aldershot: Edward Elgar.
- Aschheim, J. (1973) 'Neutral money reconsidered', *Banca Nazionale del Lavoro Quarterly Review* 105: 75-83.
- Aschheim, J., and C.-Y. Hsieh (1969) *Macroeconomics, Income and Monetary Theory*, Columbus, Ohio: Charles E. Merrill.
- Barro, R.J. (1976) 'Rational expectations and the role of monetary policy', *Journal of Monetary Economics* 2: 1-32. Reprinted in R.J. Barro (1981), pp. 79-110.
- (1980) 'A capital market in an equilibrium business cycle model', *Econometrica* 48: 1393-417. Reprinted in R.J. Barro (1981a) pp. 111-36.
- (1981a) *Money, Expectations, and Business Cycles*, New York: Academic Press.
- (1981b) 'The equilibrium approach to business cycles', in R.J. Barro *Money, Expectations, and Business Cycles*, New York: Academic Press, 1981, pp. 41-78.
- Becker, G.S. and W.J. Baumol (1962) 'The Classical monetary theory: the outcome of the discussion', in J.J. Spengler and W.R. Allen (eds), *Essays in*

- Economic Thought*, 2nd edn, Chicago: Rand McNally.
- Bikker, J.A. (1991a) 'Rente- en dividendstromen tussen sectoren', *Maand-schrift Economie* 55(3): 207-25.
- (1991b) 'Reële rente en sectorale verdeling van inkomen en vermogen', in A. Knoester and H. Visser (eds) *De borge reële rente en de Nederlandse economie*, Leiden-Antwerpen: Stenfert Kroese.
- Blaug, M. (1962) *Economic Theory in Retrospect*, Cambridge: Cambridge University Press, 1990.
- Blinder, A.S., and S. Fischer (1981) 'Inventories, rational expectations, and the business cycle', *Journal of Monetary Economics* 8: 277-304.
- Butler, A. (1990) 'A Methodological approach to chaos: are economists missing the point?', *Review*, Federal Reserve Bank of St Louis, 72: 36-48.
- Butos, W. (1986) 'Hayek and general equilibrium analysis', *Southern Economic Journal* 52: 332-43.
- Cantillon, R. (1755) *Essai sur la nature du commerce en général* (edited and translated into English by H. Higgs), New York: A.M. Kelley, 1964. Reprint of a 1931 edition. Originally written between 1730 and 1734.
- Colander, D. and Guthrie, R. (1980) 'Great expectations: What the Dickens do rational expectations mean?', *Journal of Post-Keynesian Economics* 3: 219-34.
- Fase, M.M.G. (1983) 'The 1930 correspondence between Koopmans, Robertson and Gregory', *De Economist*, 131(3): 305-43.
- Fisher, I. (1933) 'The debt-deflation theory of great depressions', *Econometrica* 1: 337-57.
- FitzGerald Scott, M. (1989) *A New View of Economic Growth*, Oxford: Oxford University Press.
- Foss, N.J. (1990) 'A note on the lag-structure in Austrian business cycle theory', unpublished paper, Copenhagen: Center for Educational Research.
- Friedman, M. (1968) 'The role of monetary policy', *American Economic Review* 58: 1-17.
- Frisch, R.A. (1933) 'Propagation problems and impulses problems in dynamic economics', in *Economic Essays in Honour of Gustav Cassel*, London: Allen & Unwin, pp. 171-205.
- Frydman, R. (1983) 'Individual rationality, decentralization, and the rational expectations hypothesis', in R. Frydman and E.S. Phelps (eds) *Individual Forecasting and Aggregate Outcomes*, Cambridge: Cambridge University Press.
- Haberler, G. (1946) *Prosperity and Depression*, New York: United Nations, Lake Success.
- Haltiwanger, J.C., and M. Waldman (1989) 'Rational expectations in the aggregate', *Economic Inquiry* 27: 619-36.
- Hayek, F.A. (1928) 'Intertemporal price equilibrium and movements in the value of money', in F.A. Hayek *Money, Capital and Fluctuations*, ed. R. McCloughry, London: Routledge, 1984, pp. 71-117.
- (1931) *Prices and Production*, London: Routledge & Kegan Paul, 1935.
- (1932) 'A note on the development of the doctrine of "forced saving"', *Quarterly Journal of Economics* 47(3). Reprinted in F.A. von Hayek (1939) 183-98.
- (1933a) *Monetary Theory and the Trade Cycle*, New York: August Kelley, 1966. First published in German as *Geldtheorie und Konjunkturtheorie*, Wien: Hölder-Pichler-Tempski (reprint Salzburg: Wolfgang Neugebauer, 1976).

- (1933b) 'Über "neutrales Geld"', *Zeitschrift für Nationalökonomie* 4. Reprinted as 'On "neutral money"', in F.A. Hayek *Money, Capital and Fluctuations*, ed. R. McCloughry, London: Routledge, 1984.
- (1933c) 'Price expectations, monetary disturbances and malinvestments', in F.A. Hayek (1939), pp. 135-56.
- (1933d) 'The present state and immediate prospects of the study of industrial fluctuations', in F.A. Hayek (1939), pp. 171-82.
- (1939) *Profits, Interest and Investment*, London: Routledge & Kegan Paul, 1950.
- (1942) 'The Ricardo effect', *Economica* IX, 127-52. Reprinted in F.A. Hayek (1949) *Individualism and Economic Order*, London: Routledge & Kegan Paul, 1976.
- (1952) *The Counter-Revolution of Science*, Part I, Indianapolis, Liberty Press, 1979. First published in *Economica* IX: 267-91, and *Economica* X: 34-63.
- (1967) 'The theory of complex phenomena', in F.A. Hayek *Studies in Philosophy, Politics and Economics*, Chicago: University of Chicago Press.
- (1969) 'Three elucidations of the Ricardo effect', *Journal of Political Economy* 77: 274-85. Reprinted in F.A. Hayek *New Studies in Philosophy, Politics, Economics and the History of Ideas*, London: Routledge & Kegan Paul, 1978, pp. 165-78.
- Hoover, K.D. (1988) *The New Classical Macroeconomics*, Oxford: Blackwell.
- Hume, D. (1752) 'Of money', in *Political Discourses*, Edinburgh. Reprinted in D. Hume, *Writings in Economics*, ed. E. Rotwein, Edinburgh: Nelson, 1955.
- Humphrey, T.M. (1991) 'Nonneutrality of money in Classical monetary thought', *Economic Review*, Federal Reserve Bank of Richmond, 77(2) 3-15.
- de Jong, F.J. (1973) *Developments of Monetary Theory in the Netherlands*, Rotterdam: Rotterdam University Press.
- Kantor, B. (1979) 'Rational expectations and economic thought', *Journal of Economic Literature* 17: 1422-41.
- Kelsey, D. (1990) 'An introduction to nonlinear dynamics and its application to economics', in F. Hahn (ed.) *The Economics of Missing Markets, Information, and Games*, Oxford: Oxford University Press.
- Keynes, J.M. (1936) *The General Theory of Employment, Interest and Money*, London: Macmillan, 1961.
- Klausinger, H. (1989) 'On the history of neutral money', in D.A. Walker (ed.) *Perspectives on the History of Economic Thought; Volume II: Twentieth-Century Economic Thought*, Aldershot: Edward Elgar.
- Koopmans, J.G. (1933) 'Zum Problem des "neutralen" Geldes', in F.A. von Hayek (ed.) *Beiträge zur Geldtheorie*, Vienna: Springer.
- Kydland, F.E., and E.C. Prescott (1980) 'A competitive theory of fluctuations and the feasibility and desirability of stabilization policy', in S. Fisher (ed.) *Rational Expectations and Economic Policy*, Chicago: University of Chicago Press.
- Laidler, D. (1982) *Monetarist Perspectives*, Oxford: Philip Allan.
- Lucas, R.E., Jr (1972) 'Expectations and the neutrality of money', *Journal of Political Economy* 83: 1113-44. Reprinted in R.E. Lucas, Jr (1981), pp. 66-89.
- (1975) 'An equilibrium model of the business cycle', *Journal of Political*

- Economy* 83: 1113-44. Reprinted in R.E. Lucas, Jr (1981), pp. 179-214.
- (1977) 'Understanding business cycles', in R.E. Lucas, Jr (1981), pp. 215-39.
- (1980) 'Methods and problems in business cycle theory', *Journal of Money, Credit and Banking* 12: 696-715. Reprinted in R.E. Lucas, Jr (1981), pp. 271-96.
- (1981) *Studies in Business-Cycle Theory*, Oxford: Blackwell.
- (1987) *Models of Business Cycles*, Oxford: Blackwell.
- (1988) 'On the mechanism of economic development', *Journal of Monetary Economics* 22(1) 3-42.
- Lucas, R.E., Jr and E.C. Prescott (1974) 'Equilibrium search and unemployment', *Journal of Economic Theory* 7, 188-209. Reprinted in Lucas (1981), pp. 156-78.
- Lucas, R.E., Jr and L.E. Rapping (1969) 'Real wages, employment, and inflation', *Journal of Political Economy* 77: 721-54. Reprinted in Lucas (1981), pp. 19-58.
- Lucas, R.E., Jr and T.J. Sargent (1978) 'After Keynesian macroeconomics', *After the Phillips Curve: Persistence of High Inflation and High Unemployment*, Boston: Federal Reserve Bank of Boston. Reprinted in Lucas and Sargent (1981), pp. 295-319.
- Lucas, R.E., Jr and T.J. Sargent (eds) (1981) *Rational Expectations and Econometric Practice*, London: Allen & Unwin.
- Lutz, F.A. (1969) 'On neutral money', in E. Streissler et al., *Roads to Freedom: Essays in Honour of Friedrich A. von Hayek*, London: Routledge & Kegan Paul.
- Machlup, F. (1983) 'The rationality of "rational expectations"', *Kredit und Kapital* 16: 72-83.
- Maddock, R. (1979) 'Rational Expectations, Political Business Cycles and the Course of Macroeconomic Theory', unpublished Ph.D. dissertation, Duke University, Durham (NC).
- Marshall, A. (1890) *Principles of Economics*, London: Macmillan, 1947.
- McCallum, B. (1979) 'The current state of the policy-ineffectiveness debate', *American Economic Review* 69: 240-5.
- Menger, C. (1871) *Grundsätze der Volkswirtschaftslehre*, Gesammelte Werke, Band I, Tübingen: J.C.B. Mohr (Paul Siebeck), 1968.
- Metzler, L.A. (1951) 'Wealth, saving, and the rate of interest', *Journal of Political Economy* 59(2): 93-116.
- Muth, J. (1961) 'Rational expectations and the theory of price movements', *Econometrica* 29: 315-35.
- Myrdal, G. (1933) 'Der Gleichgewichtsbegriff als Instrument der geldtheoretischen Analyse', in F.A. von Hayek (ed.) (1933) *Beiträge zur Geldtheorie*, Vienna: Springer.
- O'Driscoll, G.P., Jr and M. Rizzo (1985) *The Economics of Time and Ignorance*, Oxford: Blackwell.
- Patinkin, D. (1965) *Money, Interest, and Prices*, 2nd edn, New York: Harper & Row.
- (1989) 'Neutrality of money', in J. Eatwell, M. Milgate and P. Newman (eds) *Money (The New Palgrave)*, London: Macmillan.
- Patinkin, D. and O. Steiger (1989) 'In search of the "veil of money" and the "neutrality of money": a note on the origin of terms', *Scandinavian Journal of Economics* 91: 131-46.

- Pesaran, M.H. (1989) *The Limits of Rational Expectations*, Oxford: Blackwell, 2nd revised printing.
- Phelps, E.S. (1967) 'Phillips curves, expectations of inflation and optimal unemployment over time', *Economica* 34: 254-81.
- (1970) 'The new microeconomics in employment and inflation theory', in E.S. Phelps (ed.) *Microeconomic Foundations of Employment and Inflation Theory*, New York: Norton.
- Ricardo, D. (1817) *The Principles of Political Economy and Taxation*, London: Everyman's Library, 1978.
- Romer, P.M. (1986) 'Increasing returns and long-run growth', *Journal of Political Economy* 94(5): 1002-37.
- Runde, J. and C. Torr (1985) 'Divergent expectations and rational expectations', *South African Journal of Economics* 53: 217-25.
- Sargent, T.J. (1972) 'Anticipated inflation and the nominal rate of interest', *Quarterly Journal of Economics* 86: 212-25.
- (1973) 'Rational expectations, the real rate of interest, and the natural rate of unemployment', *Brookings Papers on Economic Activity* 2: 429-72. Reprinted in Lucas and Sargent (1981), pp. 159-98.
- (1976) 'A classical macroeconomic model for the United States', *Journal of Political Economy* 84: 207-38. Reprinted in Lucas and Sargent (1981), pp. 521-51.
- Sargent, T.J. and N. Wallace (1975) "'Rational" expectations, the optimal monetary instrument and the optimal money supply rule', *Journal of Political Economy* 83: 241-54. Reprinted in Lucas and Sargent (1981), pp. 215-28.
- Scheide, J. (1986) 'New Classical and Austrian business cycle theory: is there a difference?', *Weltwirtschaftliches Archiv* 122: 575-98.
- Slutzky, E. (1937) 'The summation of random causes as the source of cyclical processes', *Econometrica* 5: 105-46.
- Smith, A. (1776) *An Inquiry into the Nature and Causes of the Wealth of Nations*, 2 vols, Chicago: University of Chicago Press, 1976.
- Solow, R.M. (198) 'Growth theory and after', *American Economic Review* 78(3): 307-17.
- Thalenhorst, J. and A. Wenig (1984) 'F.A. Hayek's "Prices and Production" re-analyzed', *Jahrbücher für Nationalökonomie und Statistik* 199: 213-36.
- Thomas, B. (1935) 'The monetary doctrines of Professor Davidson', *Economic Journal* 45: 36-50.
- Thornton, H. (1802) *An Enquiry into the Nature and Effects of the Paper Credit of Great Britain*, London: J. Hatchard and F. and C. Rivington. Reprinted 1939 by Allen & Unwin, London, and 1978 by A.M. Kelley, Fairfield, NJ.
- Tobin, J. (1965) 'Money and economic growth', *Econometrica* 33: 671-84.
- Uhr, C.G. (1960) *Economic Doctrines of Knut Wicksell*, Berkeley: University of California Press.
- Viner, J. (1964) *Studies in the Theory of International Trade*, London: George Allen & Unwin.
- Visser, H. (1971) 'Neutraal geld, een overzicht', *De Economist* 119: 169-79.
- (1974) *The Quantity of Money*, London: Martin Robertson.
- Wicksell, K. (1898) *Geldzins und Güterpreise*, Jena: Gustav Fischer. Translated

- in English as *Interest and Prices* (1936). Reprinted 1962 by A.M. Kelley, New York.
- Wilson, T. (1940) 'Capital theory and the trade cycle', *Review of Economic Studies* 7: 169-79.
- Zijp, R.W. van (1990) 'Hayek en Lucas: een vergelijking', *Maandschrift Economie* 54: 128-39.
- (1993) *Austrian and New Classical Business Cycle Theories*, Aldershot: Edward Elgar.