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New Classical and New Keynesian Models of Business Cycles

by Eric Kades

"Not the least misfortune in a prominent falsehood is the fact that tradition is apt to repeat it for truth."

HOSEA BALLOU

The alleged demise of classical economics was greatly exaggerated in the Keynesian era after World War II. The supposed death blow was the seeming inability of the purely competitive model to explain the vagaries of the business cycle. But in the last two decades, a number of articles have demonstrated that fluctuations with many of the central characteristics of observed business cycles can arise in "classical" market-clearing models.[1] Market-clearing notions are among the strongest in economics, and the ***New Classical*** ability to explain business cycles has breathed new life into the equilibrium approach and many of its provocative conclusions. The existence of business cycles is no longer a reason to ring the death knell for classical models.

Keynesian models have never had trouble explaining business cycles. Observed movements of output and prices have shaped Keynesian thinking first and foremost, and their models have always admitted these facts. Perhaps because of this preoccupation with empirical regularities, general equilibrium microfoundations for Keynesian economics failed to arise quickly. Much of the New Classical rebellion against Keynesian orthodoxy in the late 1960s and 1970s was understandably inspired by this lack of a strong choice-theoretic basis for the neoclassic synthesis (the IS-LM and Phillips curve model). Economic theorists of all schools have become less and less willing to accept models not derived from explicit maximizing behavior in a general equilibrium setting.

Such shortcomings led to premature eulogies for Keynesian theories; New Classical economists found the inflation of the late 1960s and the stagflation of the 1970s evidence of the failure of Keynesian ideas and policies. But the theoretical deficiencies have, in large part, been remedied, and indeed, the ***New Keynesian*** tradition employs more precision and adherence to general equilibrium rigor than the New Classical.[2]

Both New Keynesians and New Classical theorists either implicitly or explicitly are searching for the central cause or causes of business fluctuations. Economists of both

1. See for example, Lucas (1972), (1979); Prescott and Kydland (1980); or Long and Plosser (1983).

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schools agree that many factors are involved, but find the ***rough*** equivalence of cycles (in covariances; not in frequencies and amplitudes) striking and believe the essence of the issue can be illustrated in relatively simple models. When examining Classical and Keynesian models of the business cycle, one is weighing the evidence and deciding which fundamental insight best agrees with the data.

For Keynesians, the central cause of the business cycle has always been market failure. The formal definition of ***market clearing*** equilibrium, that prices adjust to the attributes of agents so that trades balance under desired behavior, is employed by all theorists today. This rigorous definition of market clearing did not arise until the 1950s (Debreu and Arrow [1954]), and it was not for another decade that Clower (1965) clarified the Keynesian idea of ***market failure.*** This idea was then formalized and rigorously established as valid in a general equilibrium framework (Benassy [1975] and Dreze [1975]), by the ***New Keynesians*** in the early 1970s. The basic notion of market failure is that quantities adjust faster than prices. Prices then do not clear markets, and the entire market-clearing house of cards collapses. Such Keynesian models are compatible with rational expectations and full information. And they do not rely on "strange" utility or production functions; indeed we will see that, at present, disequilibrium models are more robust than equilibrium models as to the specification of these fundamentals.

One way to highlight the difference between the Keynesian and Classical perspectives is to describe their view of the existing market mechanism. Keynesians view this market structure as an ***endowment*** that, at least over moderate horizons, agents must take as given, much like their endowments of various goods, such as labor, time, assets, etc. Conversely, Classical theorists view the market structure as much more fluid; any possibility for gains from trade between agents (taking into consideration search and transactions costs) can and will be exercised. This is reflected in a price mechanism that works rapidly and effectively. In Keynesian models, the imperfect market structure causes business cycles. For Classical theory, fluctuations must arise from other sources.

The essence of New Classical business cycles lies in agents' intertemporal substitution of consumption and labor in response to technology (supply) or other shocks. Agents desire to smooth their consumption paths and, to achieve this end, substitute between present and future consumption, present and future leisure and, intratemporally, between labor and leisure. Combined with very simple technology shocks, such a model can mimic observed business cycles.

Both schools of thought, then, have constructed models that "explain" business cycles in that they reproduce the basic empirical regularities of observed fluctuations. Transacted quantities of all goods exhibit high positive correlation over time, and quantity movements tend to persist in the same direction for many periods. Further, both generate pro-cyclical real wages. These are the most basic features of observed business cycles.

How are economists to choose which model better explains economic fluctuations? Are the two theories observationally equivalent so that it is impossible to determine which truly describes the real economy? This question is important, since Keynesian models call for activist policy to smooth business cycles, while in Classical models these fluctuations are desired paths for the economy.

We will demonstrate that the New Classical (NC) model is a special case of the New Keynesian (NK) model. Thus, the NC model can be distinguished by the restrictions it places on the more general theory. In the decision-theoretic foundations of statistical scientific inquiry, we can state precisely that there will be less risk in working with the NK model, since it places less ***a priori*** restrictions on parameters. And although testing hypotheses on these

2. ***For a New Keynesian example, see Benassy*** (1976); ***Malinvaud*** (1977); ***Bohm*** (1978); ***or Grandmont*** (1982). ***For a representative New Classical example, compare existence proofs in Dreze*** (1975) ***or in van den Heuvel with Lucas*** (1979) ***or in Long and Plosser*** (1983). ***Although the label "New Keynesian" is not uncontroversial, I feel its use is warranted. First, Keynes states clearly in the General Theory that his model generalizes on the classical perspective. This is a central point of this paper, in reference to present-day theories. Second. market failures are at the root of Keynes's model. New Keynesian theory merely formalizes insights due in large part to the General Theory. Finally, the modern authors who developed this approach (Benassy, Younes, Grandmont, and Dreze) refer to their models as "Keynesian," "neo-Keynesian," etc. Thus the use of "New Keynesian" is historically accurate.***

highly abstract models is controversial (due to lack of desired statistics, problems of aggregation, and other problems with available data), existing empirical evidence casts doubt on the *a priori* restrictions of the NC model.

We illustrate these points by presenting simple, but essentially complete, NC and NK models of the economy and business cycles that illustrate the central forces behind fluctuations in each. We then discuss theoretical and statistical arguments for and against each model. The models examined are intentionally bare-boned; they assume perfect information, rational expectations, and model only labor and goods markets. No assets exist; money is solely a unit of account.

I. Equilibrium Model

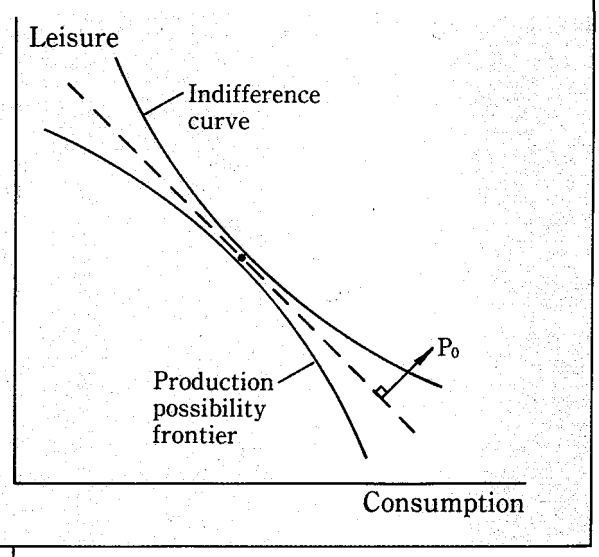
We choose Long and Plosser's (1983) equilibrium model of business cycles for its simplicity; it captures the essence of the New Classical explanation of economic fluctuations. Unlike earlier models, such as Lucas', this formulation requires no monetary authority along with asymmetric information to fool agents and jolt the economy into fluctuations.[3] For clarity, we assume perfect information and rational expectations. Business cycles arise from technology shocks and intertemporal labor, leisure, and consumption substitutions in response to these surprises.

In equilibrium models, the market works instantaneously at every date. Prices, although theoretically exogenous to households and firms, are actually precisely determined by the attributes of these agents. Imagine a representative firm and household with very well-behaved production and utility functions. For this Robinson Crusoe and Friday economy, we have equilibrium at the tangency of the indifference curves and production frontier in leisure-commodity space. (See figure 1.)

The key point is the equating of prices and marginal tradeoffs. Consumers equate the wage with the marginal utility of leisure; firms equalize wages and labor's marginal product. Although there are technical complications in extending the equilibrium model to a world with many periods, economically this approach reduces to applying these marginal equalities over time, while correcting for interest rates and agents' time preference. These marginal conditions are *equivalent to* the traditional notion of efficiency in economics (Pareto optimality); full markets insure that all gains from trade are achieved and that exogenous (government) policy measures cannot improve on this outcome.

Equilibrium prices at time t, then, are determined precisely by the fundamental nature of agents: endowments and utility (or profit) functions. These basic parameters are completely summarized by excess demand (Z). Excess demands of the agents at time t (Z_t) must determine prices *continuously* for market-clearing equilibrium to hold.[4] This may seem obscure, but it is important in understanding the nature of New Classical price adjustments. The idea can be lucidly illustrated by the basic functions involved.

Fig. 1 Equilibrium model
One-Period Solution



3. Lucas (1972, 1979) requires monetary policy measures along with asymmetric information to constantly confound agents to produce cycles. Given the appearance of business cycles under an extremely wide range of monetary policy regimes, in all modern economies, and for hundreds of years, Lucas' model cannot be considered a general explanation of fluctuations.

4. In a discrete time model, prices are set at intervals frequent enough so that excess demands do not change within a period.

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5. In a representative agent model, with only one consumer, the interest rate is determined by his or her rate of time preference, i.e. $p = 1/(1+r)$. This would simplify the equations in (5), since 9 and $(1+r)$ would cancel out in the denominators of (b) and (c). They have been included in (5) to explicitly show the role of r and p in intertemporal optimization.

The excess demands are constructed by the hypothetical process of calculating excess demands (i.e., quantity desired minus endowment level) at all possible price vectors. So we have the function:

$$(1) \quad Z_t = Z_t(p).$$

This function is assumed to have a unique root, p_t^*, which gives an equilibrium. But this equilibrium price vector p is determined by the excess demands. That is:

$$(2) \quad p_t^* = Z_t(p_t^*).$$

Immediately we see that p_t^* is defined by a function of itself. To avoid any time paradox in the determination of p_t^* and the root of Z, these quantities must be determined simultaneously—instantaneous market clearing—at every date.

Long and Plosser do not develop their price dynamics in a full general equilibrium model; they limit most of their study to a simple example. We will carry the analysis of the general case further, since it lucidly illustrates some of the central issues in equilibrium cycles.

Consumers have an unchanging utility function:

$$(3) \quad u(C_t, L_t),$$

where L, represents labor and C, consumption in period t. Instead of a single-period maximization problem, the consumer in this model must solve the multi-period problem:

$$(4) \quad max\ U = \sum_{t=1}^{\infty} \beta^t u(C_t, L_t),$$

subject to labor constraints in each period. β is the discount factor of the representative agent. Although solving this dynamic maximization problem in general is not possible, if the utility function is strictly concave and all markets are perfect so that there are no kinks in the budget set at any date, then there can be no corner solution. In this case, the following first-order conditions must hold:

$$(5a) \quad \frac{W_t}{P_t} = \frac{\partial u/\partial L_t}{\partial u/\partial C_t},$$

$$(5b) \quad \frac{P_{t+1}}{\beta(1+r_t)P_t} = \frac{\partial u/\partial C_{t+1}}{\partial u/\partial C_t},$$

$$(5c) \quad \frac{W_{t+1}}{\beta(1+r_t)W_t} = \frac{\partial u/\partial L_{t+1}}{\partial u/\partial L_t},$$

where r is the interest rate, W is the nominal wage, and P is the nominal price of the consumption good.[5]

These are the extensions of the marginal conditions to a dynamic setting. Equation (a) intratemporally requires the real wage to equal the marginal utility of leisure; (b) equates trade-offs of consumption over successive periods via the rate of time preference β times the price ratio across periods; and (c) requires that the labor/leisure decisions equal the interperiod wage ratio multiplied by the time preference rate. Even though no assets exist in the model, such intertemporal trades are feasible because of the rich market structure of the NC model. For example, there exists a contingent futures market for the consumption good in period t+s if a negative technology shock occurs; contracts on this market can be purchased with labor services in any period between t and $t+s$. Of course, the price on such a market varies over time according to the tastes and technology of the agents. The important point is that the markets do exist, and so all trades are possible. It is not yet clear that this model will produce business cycles. Indeed, since the economy is assumed to have a unique and stable equilibrium, w*, the phase diagram (see figure 2) for this model in the real wage w=W/P seems to indicate that cycles will not occur:

As mentioned above, Long and Plosser do not attempt to show that cycling occurs in the

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unrestricted case. NC models have not, in general, been shown to produce cycles. To derive concrete results, they specify a utility function that embodies the intertemporal substitutions necessary for NC business cycles. Long and Plosser continue their argument with specific utility and production functions:

$$(6) \quad u(C_t, L_t) = \Theta_0 \ln L_t + \sum_{i=1}^{n} \Theta_i \ln C_{it}$$

$$Y_{i,t+1} = \lambda_{i,t+1} L_{it}^{b} \Pi X_{ijt}^{a}$$

The standard logarithmic utility function has elasticities Θ_i which are constrained to be non-negative, ruling out inferior goods. Presumably, if a Θ_i is zero, the good has some use in production. Otherwise, it is superfluous in the economy, since Long and Plosser assume free disposal. The Cobb-Douglas production function is unusual only in the appearance of $\lambda_{i,t+1}$, the stochastic shock to the production of good i in period t. The subscript t+1 refers to the date of completed production; that is, when it is ready for consumption. X is the vector of goods used as productive inputs.

Fig. 2 Phase Diagram for Equilibrium Model

Then, in each period, the consumer maximizes expected utility according to:

$$(7) \quad E(U|S_t) = E\{ \sum \beta^{s-t} [\Theta_0 \ln A_t + \sum \Theta_i \ln c_{it} | S_t]\},$$

where $S_t = (Y_t, A_{i,t+1})$. We require maximization under the expectations operator E, since A is stochastic. A shock in the technology for producing a good will obviously change present consumption. We expect co-movement of most goods, since they are all normal—changes in income call for marginal increments or decrements of each in the equilibrium consumption basket. Because leisure is also a normal good, some of the gain or loss due to the windfall will be taken in increased or decreased work hours. Co-movement is the first empirical regularity of the business cycle captured by the NC model.

Intuitively, persistence arises as consumers spread unexpected income changes over time as well as over all goods within a period. Savings or dissavings due to windfall gains or losses (from shocks) are used to increase or decrease income in many future periods. So, even without serially correlated shocks, we will have persistence in fluctuations.

The utility function has been the source of co-movement and persistence in quantity fluctuations discussed to this point. Production technology is another source of these business cycle characteristics. Since most goods are inputs in the production of some other goods, a technology windfall (disaster) not only increases (decreases) present and future consumption of that good, but also, since all goods are superior, some of the windfall (disaster) is used to produce more (less) of all other goods requiring it as an input. Again, it is all part of the smoothing over time, as well as among commodities of any unexpected change in income. This leads to cycles, even in response to serially uncorrelated technology shocks.

The real wage can easily move pro-cyclically in this model. If tastes are fixed, then any increase in output (which requires more labor input) drives up the real wage required to induce workers to provide necessary labor services. As long as any decrease in labor's marginal product doesn't dominate this effect, the real wage will rise. Since increased output is associated with a windfall of some good that can serve as capital (increasing productivity), a pro-cyclical real wage seems likely. Although observed, it is beyond the scope of simple non-monetary models like this to pro-

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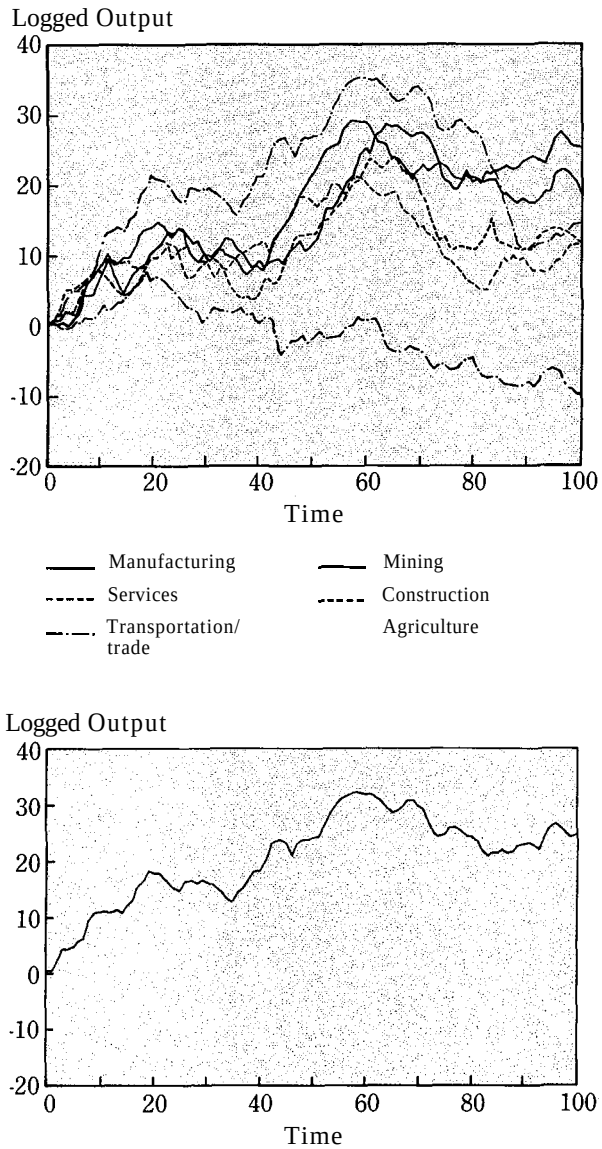
duce co-movement among price for many or all goods.

In an elaborate simulation for a six-sector model of their economy (Long and Plosser [1983], p. 65) observed the paths for sectoral and aggregate output shown in figure 3.

Fig. 3 Simulated Output of Equilibrium Model



SOURCE: Long and Plosser (1983, p. 65).

Co-movement of different goods appears clearly. The long swings in the time series indicates higher degrees of autocorrelation than 1, suggesting persistence.

Long and Plosser's equilibrium model, then, can generate three of the central aspects of observed business cycles: quantities in almost all industries move roughly together, output variations tend to persist for many periods, and the real wage moves pro-cyclically. These characteristics arise from intertemporal tradeoffs to smooth consumption along with shocks to the production function.

Long and Plosser emphasize that these are not the only factors in the business cycle, but claim their model is a "useful benchmark" for evaluating other models. We take this to mean what we said at the outset: they are positing the central driving force of business cycles. They also point out that, in their model, business cycles are preferred paths; any policy attempting to smooth these fluctutations will be at best Pareto-equivalent with the free market outcome and may well be Pareto-dominated.

II. Disequilibrium Model

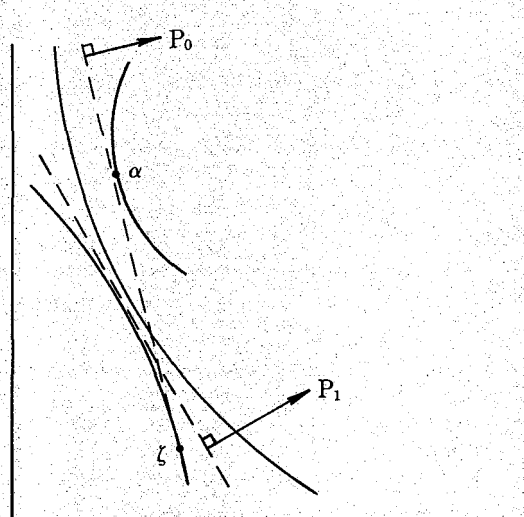
The only departure of disequilibrium models from the purely competitive Arrow-Debreu framework is the supposition that quantities may adjust faster than prices. Taken to the limit, this leads to fixprice models ***in each period*** with quantity rationing to balance trades. The market system that the economy is ***endowed with*** may not permit the perfectly fluid media for trade that exists in classical models. Some mutually desirable trades may simply not be possible under the constraint of an imperfect market structure. Dreze and Benassy (1975) laid the static foundations for this model; dynamic extensions have been numerous (see Bohm [1977] and Kades [1985]).

Here, we outline a simple version of a dynamic fixprice model (as outlined by Grandmont [1982], this is called a temporary equilibrium framework) and show how business cycles arise in it.

In contrast to figure 1 above, a Robinson Crusoe and Friday disequilibrium economy can be illustrated, as in figure 4.

The price vector p_o is exogenous ***within each period,*** so that the unique (under our same assumptions of very well-behaved utility and production functions) Pareto optimal Walrasian price vector p outcome almost never obtains. Under p_o, the consumer will wish to trade to point φ and the producer to point ζ, so it is not an equilibrium. Instead, we will have a new type of equilibrium, a fixprice equilibrium. We explicitly demonstrate this new type of equilibrium below. In this outcome, in general, one or both agents fail to obtain desired quantities at given prices and so are rationed. Note that, if the exogenous price vector is p, we have an equilibrium model. Here we clearly see that in the static world disequilibrium models are more general than equilibrium models; they allow for both equilibrium and rationing outcomes. NC models maintain that agents will always be able to find or create markets that will yield ***market-clearing*** prices.

Fig. 4 Basic Structure of Disequilibrium



Since the marginal rates of substitution in consumption and the marginal rates of transformation in production are not equated to prices, this economy lacks the Pareto optimality of the NC model. Within such a framework, it is likely that government policies could improve the welfare of all agents.

We will more fully specify a dynamic disequilibrium model following Malinvaud (1977) and Kades (1985a). Cycles occur in a more general model here than with Long and Plosser; there is no need to adopt specific utility and production functions.

We use L, C, P, W, and w, as in the equilibrium model. Consumers are described by a utility function U that is constrained only to be quasi-concave. Our representative consumer's sole endowment consists of time that may be "spent" on either labor or leisure. A simple concave stochastic production function, $F(L,) + \xi_b$ describes the activity of the firm. Consumers maximize utility, and firms maximize profits.

Instead of assuming that the very special Walrasian price vector is found, the fixprice approach imagines that the price vector is truly parametric ***at a given trading date*** and will be Walrasian only by accident. Between dates, the price vector moves according to the so-called law of supply and demand; excess demand for a good in period ***t*** (and possibly in previous periods) tends to pull prices up, while excess supply causes prices to fall. This does not restore the auctioneer and the instantaneous achievement of the equilibrium price vector. It more modestly posits that market forces work in the right direction and possibly with lags. Thus, there are other forces beyond current excess demands $Z(p)$ (and specifically, its root) that may enter into the function determining prices.

It is already easy to illustrate that, dynamically, NC models are a special case of NK

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models. The most general form of the price equation is:

(8) $p_t = A(\chi)$,

where χ is the vector of all conceivable state variables in the world. The object of theory is to pare down the size of the vector χ as far as possible *without* ignoring anything of importance. NC models reduce the dimension of χ to only contemporaneous excess demands Z_t:

(9) $p_t = f(Z_t)$.

They further require that f(0) obtain at every date. NK models allow for a broader range of variables to enter, such as lagged excess demands or even lagged prices. Here are some examples:

(10) $p_t = g[\lambda Z_t + (1-\lambda) Z_{t-1}]$
$p_t = h[\lambda f(Z_t) + (1-\lambda) p_{t-1}]$

Further, the Z_t's are allowed to take non-zero values.

If the New Classical special case held in reality, proper econometric estimation of equation (12) would find that A was statistically indistinguishable from 1. And only this singular result could yield direct evidence that New Keynesian theories were over-parametrized.

Returning to the outline of the model, there is no reason to believe that Walrasian supplies and demands will balance at an arbitrary price vector in a disequilibrium world. More structure must be imposed here to define demands and to determine actual transactions. The most basic requirement imposed in fixprice models is voluntary trade: no agent is ever forced to trade (supply or demand) more of a good than he desires—what his preferences dictate. Since markets do not clear and we disallow forced transactions, agents will have to be rationed in quantities at the given price vector to balance trades. This model requires a new definition of "equilibrium."

Fixprice equilibrium means the maximization of quantity-constrained utility and profit functions with trades balancing. Disequilibrium Benassy (1975) demands, which we will refer to (following the ideas of Clower) as *effective* demands, are derived from considering all constraints except the constraint in the individual market where demand is being formed.

Fig. 5 Firm's Demand (Production Function)

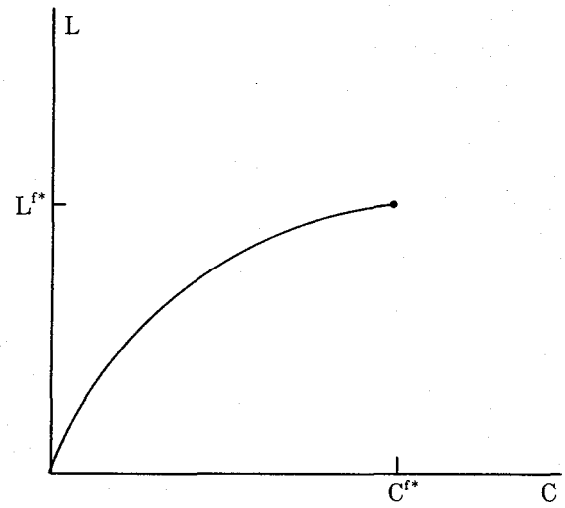
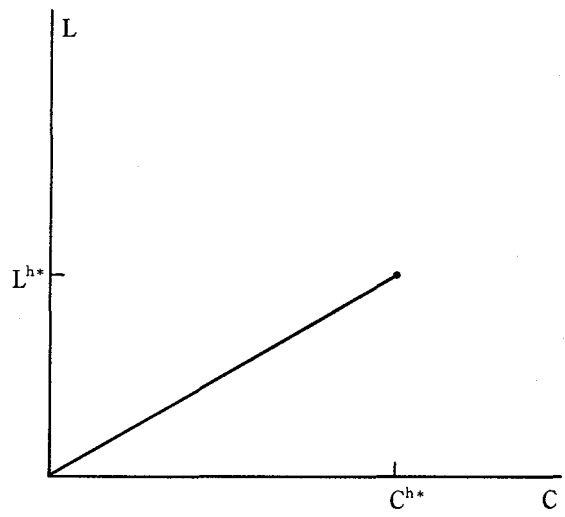


Fig. 6 Household's Demand (Consumption Expansion Line)



We denote them with a + superscript; they are defined from the maximization problems:

(11) Households:
$L^{h+} = MAX\ u(L,C,w)$ subject to $WL < pC$
$C^{h+} = MAX\ u(L,C,w)$ subject to $WL < pC$
Firms:
$L^{f+} = MAX\ r(L,C,w)$ subject to $C < F(L)$
$C^{f+} = MAX\ r(L,C,w)$ subject to $C < F(L)$,

where C and L are perceived constraints on other markets, and r is the profits function.

Benassy showed that, when solved, these demands yield balanced trades while simultaneously determining perceived constraints. The perceived constraints are the minimum of the effective demands when the system of simultaneous demands is solved. Thus agents' maximizing decisions under these constraints balance in the aggregate, yielding a fixprice equilibrium with rationing. The rationing mechanism is usually assumed to be stochastic. Formally, however, this point needn't be addressed in representative agent models.

We develop some graphs to represent this model. (See figures 5 and 6.) We will be using graphs to show the behavior of the household and firm in the trade space (L,C). The firm simply obeys "efficient production" in this model and always produces somewhere along the production function $C = F(L)$. However, the firm will never produce beyond its Walrasian point (L^{f*}, C^{f*}) under the given wage and price (the exogenous parameter x) since, beyond this point, the exogenous wage exceeds labor's marginal product. The shape stems from our assumptions on the production function.

The household obeys "efficient consumption"; it consumes along a line going through the origin (no work, no pay) whose slope is dictated by the real wage rate.
The household will never work beyond its notional quantities (L^{h*}, C^{h*}) since, beyond this point, the marginal utility of the good falls below the marginal utility of leisure.

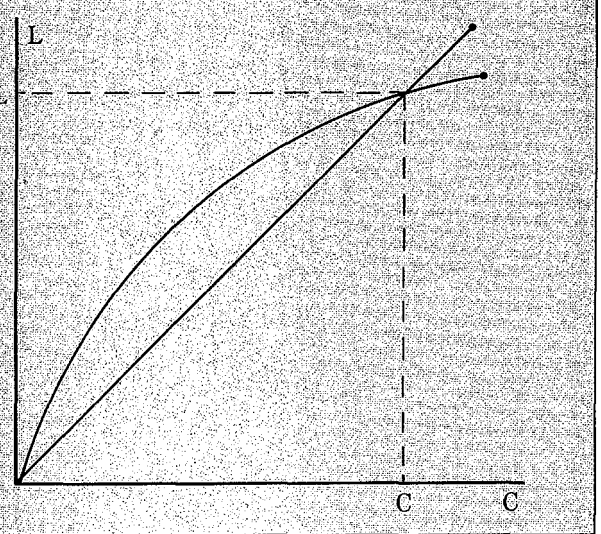
To determine the fixprice equilibrium, we combine the two curves. (See figure 7.)

Beyond the possibility of a Walrasian equilibrium (WE) when notional points coincide, there are two possible outcomes to this model. If consumers are rationed in selling labor and firms in selling the consumption good, then we have general excess supply. This has been labeled a Keynesian equilibrium (KE). If general excess demand prevails, we have an inflationary equilibrium (IE).

Thus, disequilibrium Benassy demands give rise to a much broader range of market outcomes than Walrasian models, where $Z_i = 0$ in all markets. Even at an arbitrary price vector, Walras' Law holds for New Classical demands: excess demand in one market is, by definition of budget constraints, balanced by excess supply in another market. General excess supply or demand cannot arise even hypothetically in an equilibrium model. Clower correctly stressed that the key to disequilibrium models must be to establish a rigorous framework within which Walras' Law did not hold. This is one way to describe the main accomplishment of New Keynesian theorists.

The dynamics of our disequilibrium model are very simple, since there is only one state

Fig. 7 Fixprice Static Equilibrium



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variable, the real wage w. In the state space R^{l}, we have a unique value of w, w*, that gives a Walrasian equilibrium. But the movement of the real wage in KE and IE regions (on either side of the Walrasian equilibrium) is, at first inspection, undetermined. In the case of KE, labor is in excess supply in terms of effective demands, so the nominal wage should fall. But the commodity is also in excess supply, and so its price also should drop. Qualitatively, it seems difficult to determine the direction of real wage movements. The same holds for IE, where we have general excess (effective) demand.

Elsewhere (Kades 1985b), it has been shown that it is likely that steady states exist in both the KE region and the IE region. How does this occur? In Keynesian steady states, the nominal price of both labor and the good fall at the same rate in the price (vector-valued) function. Then the real wage rate is unchanging, and since it is the only state variable in this simple model, a steady state obtains. A symmetric case explains a steady state in the IE region.

Further, all Keynesian steady states of the model are stable (Kades 1985b); in a one-dimensional model, this implies uniqueness. Since lagged demands are generally included, the WE will almost never be an equilibrium (i.e., it is a measure zero event). Inflationary steady states may be either stable or unstable. Figure 8 presents a typical phase diagram for this system.

This system can easily give rise to cycles in the presence of exogenous shocks to the production function. The system can move further and further into either the KE region (a recession) or the IE region (boom). It can move either towards a stable or away from an unstable node until any type of shock moves the system to the other side, changing the cycle. The unstable IE effectively marks the border between the two regimes. White noise shocks can produce outcomes much like those observed in real economies. Figure 9 shows a simulation of this model similar to Long and Plosser's for aggregate output only. Further, this model fully captures the observed co-movement of prices and quantities. By making C a vector, it is easy to show that different quantities move together in the model.

So the fixprice/disequilibrium paradigm explains the most fundamental aspects of observed business cycles, and does so without recourse to special utility and production functions. The only reason for such fluctuations in the model is the general inability of the market mechanism to always find the market-clearing price vector. This economy is endowed with a cumbersome market structure that may or may not accurately reflect reality.

Fig. 8 Phase Diagram for Disequilibrium Model

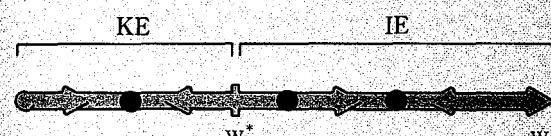
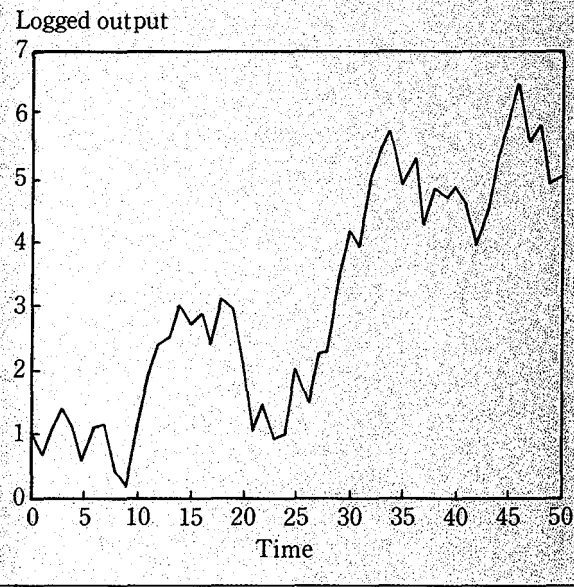


Fig. 9 Simulation of Disequilibrium Model



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III. The Evidence

It is difficult to directly test hypotheses on whether or not all markets clear. But we can heuristically and formally examine evidence and arguments on a number of issues and measure the degree to which equilibrium and disequilibrium business cycle models agree with observation and rigorous thought.

The Great Depression stands as perhaps the most memorable single twentieth-century cyclical swing. The ability of a business cycle theory to plausibly explain this experience is important in establishing its credibility. Therefore, we first discuss the extent to which both models can explain this event.

Pigou and other Classical theorists in the 1930s blamed the Great Depression on an excessive reservation wage rate demanded by laborers. Thus for them, recessions were caused by a market imperfection in labor markets. In a sense, this view stands closer to disequilibrium paradigms, although the classical notion of market failure differs substantially from the New Keynesian view discussed above. For many early Keynesians, this was also seen as the cause of the Great Depression; they disagreed with Classical theorists only on the effectiveness of expansionary policies.

Today's New Classicals must argue that recessions occur when *low* wages are expected; workers then find leisure less costly in terms of wages foregone and bide their time until renumeration rates improve. But can the Great Depression best be explained as a multi-year withdrawal from labor markets by most Americans because they expected an eventual wage rise? The other explanations that New Classical theory can offer seem no more credible. One is that the utility function of most laborers called for a "... spontaneous outburst of demand for leisure ..." from 1929-1939. Another possibility is that a large negative shock to production technology was responsible, but then the problem becomes specifying the source of this shock.

New Keynesian explanations of the Great Depression are likewise unconvincing. Ironically, the most prominent possibility is due to Milton Friedman, a theorist not usually associated with Keynesian ideas. Friedman and Schwartz (1961) argued that a major cause of the Great Depression was the decline in the money supply from 1929-1933. In a slightly modified version of our New Keynesian model with money (Malinvaud 1977), it can be shown that low money-growth rates (or a *fortiori* money declines) are associated with Keynesian recessionary outcomes. But far-reaching questions have been raised about this evidence (Temin 1975) and it is not clear which way causation runs between money and output. Further, as argued in footnote 3, cycle theories based on monetary phenomenon are less robust than real theories since cycles have occurred under a wide range of monetary systems. Perhaps monetary factors contributed to the *severity* of the Great Depression, but their role must be explicitly tied into a general model of cycles to provide a satisfactory story. Like New Classical theories, New Keynesian explanations may point to some particularly violent shock as the root cause of the Great Depression, but then the difficulty becomes uncovering and explaining the shock. No convincing explanation has been presented.

Although some economists find merit in these heuristic arguments, they are based on vague notions and "stylized facts," and lack precision. In a formal econometric study, Mankiw, Rotemberg, and Summers (1985) test the first order conditions in equation (5) for a utility function more general than Long and Plosser's. That is, they test the first-order conditions of consumers' maximization in the NC model. Although not sufficient, the first-order conditions are still *necessary* for any interior solution; if they are rejected, then the model can be rejected. There are, of course, difficult questions of aggregation in treating national data as if it is created by a representative consumer. No consensus on a solution to this issue exists, and this methodology is, at present, the *de-facto* standard for empirical work.

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Mankiw, Rotemberg, and Summers find that the data (NIPA) reject the hypotheses, that these maximizations are carried out by consumers. None of the three over-identifying restrictions in equation (5) placed by equilibrium models is supported by the data. Further, the rejections occur for almost all permutations of the specifications of the hypothesis tests: separable or non-separable utility, annual, or quarterly data. Indeed, many of the restrictions actually force the shape of the utility function to be convex, in which case a maxima would occur at a corner and the Classical tangency conditions illustrated in figure 1 could not hold. When the utility function is concave, either leisure or "consumption" (NIPA) becomes an inferior good—which like convexity casts serious doubt on the model. Simultaneous estimation of all three restrictions in (5) is similarly rejected and produces either a convex utility function or inferiority of either leisure or consumption.

This rejection can be interpreted in two ways. Mankiw, Rotemberg, and Summers argue that the data show that markets (both labor and capital) fail to clear. There is another possibility: the structure of the utility function may be such that intertemporal substitution effects are very weak. In this case, a radically different utility function must be specified to dovetail with observation. At any rate, either explanation leads us to question Long and Plosser's equilibrium paradigm of-business cycles. It seems that either markets fail to clear, or that substantial intertemporal elasticities of substitution do not exist; both interpretations of the evidence reject this NC explanation of business cycles.

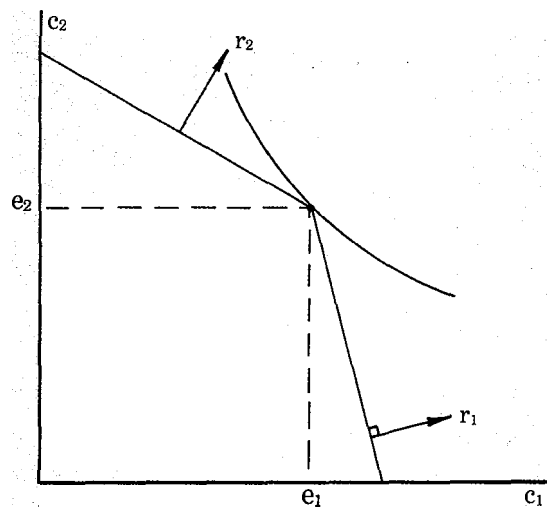
The disequilibrium model cannot be rejected by any such hypotheses concerning the structure of the utility function; it requires only that the utility function be quasi-concave. Beyond this, the disequilibrium model is robust to the form of the utility function.

Apart from rejecting the restricted form of the utility function needed to generate equilibrium business cycles, there is also strong economic evidence that key markets do not clear. Specifically, we shall discuss evidence that capital (lending) markets fail to clear.

Recall from the first-order conditions in the equilibrium model (5) that the interest rate appears in consumers' decisions just as in any other price. Equilibrium models require that agents can buy ***or*** sell as much of a good as they want at a ***uniform*** price, subject only to their endowment constraint. This constraint prevents any kinks from existing in the agents' budget sets so that, with a concave utility function, no corner solutions to maximization problems exist.

Keynesians (Old and New) have long argued that consumers, in reality, face liquidity constraints: either they cannot borrow at all against future income or they must pay an interest rate greater than the rate they receive for lending funds (even accounting for risk premia). Figure 10 shows that if agents lend at one price, but borrow at another, they are likely to solve maximization problems at ***corners*** of their budget set. Here, the equality of prices and intrapersonal utility trade-offs breaks down, and the economy may no longer be efficient.

Fig. 10 Corner Solution for Liquidity-Constrained Consumer



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6. It is interesting to note that asset markets are almost always assumed to more closely approximate the competitive ideal than other markets. If the data show that these markets fail to clear, then it seems dubious to assume that labor and goods markets clear.

Agents are endowed with $e=(e_1, e_2)$ of a good in periods one and two respectively. The interest rate for borrowing in period one is r_1, while the lending rate is less, r_2. With a concave utility map, it is then immediately apparent that a corner solution can occur.

Strong evidence exists that such liquidity constraints have been binding for significant numbers of American consumers. Fumio Hayashi (1985), modifying an idea originally appearing in Kowalewski and Smith (1979), uses cross-sectional data and divides consumers into high-and low-savings groups. He assumes that high-savings households are unlikely to be liquidity-constrained, so they may be used as a control group to be compared to other (potentially liquidity-constrained) households. By estimating consumption behavior for each group separately, and then by comparing the two parameter sets, Hayashi finds a significant difference that can be explained by the existence of liquidity constraints. Although there are other explanations for the result, they require the rejection of either the permanent income hypothesis or of market clearing. Since both market clearing and the permanent income hypothesis embody the New Classical idea of the ***markets'abilities*** to smooth consumption over time, this interpretation too, casts doubt on the equilibrium business cycle model. Flavin (1981) and Kowalewski (1985) provide time series evidence that liquidity constraints have persistently shaped agents' budget sets in the postwar American economy.

On the other hand, the disequilibrium model is robust to either interpretation of Hayashi's results. If liquidity constraints do exist, they are an instance of the imperfect markets of New Keynesian theory.[6] If we view the results as a rejection of all utility functions that give rise to permanent-income consumption paths, we already know that the NK model is not subject to this criticism.

In discussing the compatibility of both models with observed business cycles, we have examined only three central patterns: the co-movement of different quantities, the persistence of trends, and the positive correlation between quantities and the real wage. But there are other empirical regularities in business cycles that both models should similarly mimic if they are to be adequate representations of the central force in business cycles. Although they were raised by Arthur Okun (1980) in objection to Lucas's equilibrium model (Lucas 1972), they also point to shortcomings in Long and Plosser's model and in NC models in general.

First, many secondary aspects of labor markets (beyond pro-cyclical wages) are at odds with the NC model. Productivity may or may not be pro-cyclical in the NC model. It depends on the size of the technology shocks and on the intensity of the disutility of labor. But observed productivity is strongly pro-cyclical. In non-market clearing models, this phenomenon is explained by implicit contract theory, where workers are insured against unemployment by their employers in return for a lower wage. When demand slackens, there are no layoffs; with the same amount of labor and less production, productivity must decline. As demand improves, the same work force is called on to produce more; hence, productivity increases. Implicit contract theory comprises one market imperfection that could be the fundamental source of fixed prices (wages) in the short run. The market clears by a non-price mechanism. No institutional factor (that is, exogenous parameter) explaining market-clearing could produce pro-cyclical productivity in Long and Plosser's model. Similarly, quits induced by pro-cyclical factors, counter-cyclical layoffs (moreover, the existence of layoffs, which involve rationing the sale of labor), and wage increases in recessions seem inexplicable in the present NC model.

Although Long and Plosser examine and discuss only the consumer side of their model, firms as well as the household may seek to

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smooth over time their objective—profits. One rationale for such behavior is that since households own the firms, smoothing profits is simply one part of smoothing income. This motivation is superfluous in an NC model, since in market-clearing models economic profits have, by definition, a zero expected value in each period (under the usual assumption of constant returns to scale). However, we observe very large pro-cyclical fluctuations in profits. New Classical theorists must explain why the value of entrepreneurial talent and risking capital fluctuate so sharply with the business cycle to lend credibility to their paradigm. Conversely, pro-cyclical profits exist under implicit contracts in a New Keynesian framework, since wage costs are constant while productivity varies with business cycles. However, this criticism must be tempered by remembering the substantial controversies in defining and, moreover, in measuring economic profits.

Finally, Fisher (1984) has raised a methodological objection to the equilibrium paradigm. In response to any shock, these models require that prices adjust so rapidly—almost instantly—that agents never face disequilibrium prices. However, even in the world of physics, adjustment to a new shock takes time, and a mechanical system must move out of one equilibrium before a new rest state is attained. Even in the case of a unique equilibrium, New Classical dynamic behavior violates the usual properties of differential equations in avoiding disequilibrium, but we can imagine the shock (ξ_t) and the real wage (w_t) move in tandem precisely to produce continuous market clearing. (See figure 11.) If NC models contain a dynamic structure as rich as the New Keynesian (to avoid the necessity of specifying a restricted class of utility functions to produce cycles), then the hypothesis of continuous market clearing cannot be maintained. (See figure 12.)

The system must move ***through*** the unstable disequilibrium γ and cannot give continuous market clearing. It is not clear why New Classical theorists feel that economic adjustments can be approximated by instantaneous movements from one equilibrium to another. They must provide a plausible mechanism for this behavior before it can be used convincingly. Disequilibrium dynamics call for the economy to adjust along paths more in line with established notions about change over time.

Fig. 11 Continuous Market Clearing with a Unique Stable Equilibria

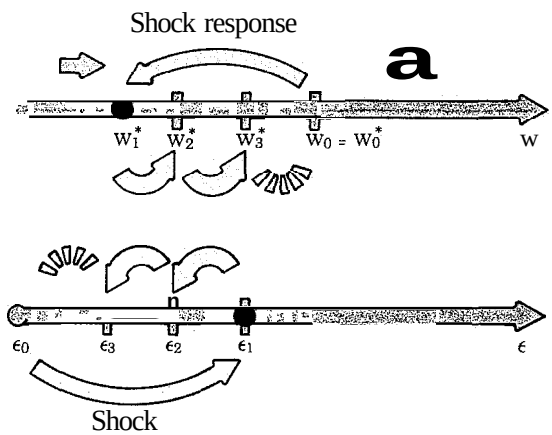
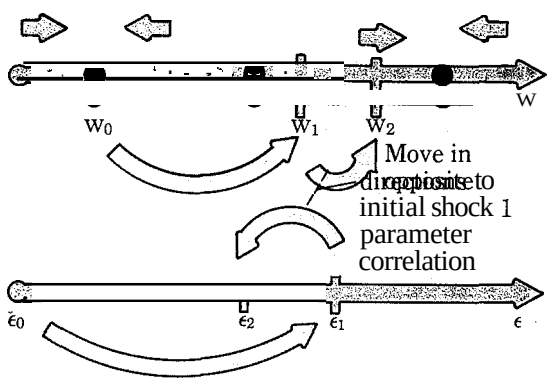


Fig. 12 Failure of Continuous Market Clearing with Multiple Equilibria



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IV. Conclusion

Both equilibrium and disequilibrium theories can construct model economies that mimic the basic behavior of real business cycles: strong co-movement among quantities of different goods, persistence of quantity movements in the same direction for many periods, and pro-cyclical real wages. But existing NC models cannot explain other aspects of observed business cycles, such as pro-cyclical productivity or other observed characteristics of the labor market. Further, evidence exists that capital markets do not clear. Finally, the data reject the New Classical utility function exhibiting strong intertemporal substitutions. Without such a utility function, the model has not been shown to produce persistent output cycles.

The NK model is robust to most of these criticisms. It requires no specific utility function to generate cycles, it fits the observed regularities of business cycles more fully, and it employs a more general model of price movements over time. However, like the NC model, it provides no convincing explanation of the Great Depression. Since equilibrium models:

(1) Comprise a subset of disequilibrium models;

(2) employ identifying restrictions that are not empirically validated; and

(3) require nonstandard dynamical adjustments; it appears that, at present, despite this shortcoming, New Keynesian theories provide a better paradigm of the business cycle.

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