Old Keynesian Economics*

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Abstract

I provide an outline of how a modern theory of search, modelled by a two-sided matching function, can be used to form a microfoundation to Keynesian economics. This search theory of the labor market has one less equation than unknown and, when combined with the idea that investment is driven exogenously by 'animal spirits,' the marriage leads to a microfounded theory of business cycles. This alternative theory has very different implications from the standard interpretations of Keynes that has become enshrined in new-Keynesian economics. I call the alternative, 'old-Keynesian economics' and I show that it leads to a model with multiple belief driven steady states.

1 Keynes and the Keynesians

In his (1966) book, *On Keynesian Economics and the Economics of Keynes,* Axel Leijonhufvud made the distinction between the economics of the *General Theory* (Keynes 1936) and the interpretation of Keynesian economics by Hicks and Hansen that was incorporated into the IS-LM model and that forms the basis for new-Keynesian economics. In that book, he pointed out that although the new-Keynesians give a central role to the assumption of sticky prices, the sticky-price assumption is a part of the mythology of Keynesian economics that is inessential to the main themes of the *General Theory.* In this paper I will sketch an alternative microfoundation to Keynesian

*This paper was prepared for a Conference in honor of Axel Leijonhufvud held at UCLA on August 30th - 31st 2006. Although I am certain that Axel will not agree with everything that I say in this essay, I hope that he will recognize a trace of the Leijonhufvud influence creeping through the pages.

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economics that formalizes this argument by providing a microfoundation that does not rely on sticky prices. I call this alternative microfoundation, old-Keynesian economics.

It is fitting that this paper should appear in a volume in honor of Axel Leijonhufvud since the ideas I will describe owe much to his influence. Although Axel's thesis was written at Northwestern University, his work on Keynes came to fruition at UCLA; the location of his first academic appointment. In the 1960's, UCLA had developed a healthy tradition of tolerance for non mainstream ideas and, as the beneficiary of that same atmosphere of tolerance, it is a privilege to be able to use this occasion to acknowledge the debt that I owe to Axel as both a mentor and a friend.

In the following paragraphs, I will describe a plan to embed a version of search theory into a general equilibrium model in a way that provides a microfoundation to the economics of the *General Theory.* Since UCLA has a some claim to be the birthplace of search theory (with the work of Armen Alchian (1970) and John McCall (1970)), this project is the continuation of a rich UCLA tradition in more ways than one.

Whereas Keynes argued that the general level of economic activity is determined *in equilibrium* by aggregate demand, this idea is not present in new-Keynesian economics which views unemployment as a short-run phenomenon that arises when prices are temporarily away from their long-run equilibrium levels. Since the appearance of the work of Edmund Phelps (1970) and Milton Friedman (1968) the concept of demand failure as a purely temporary phenomenon has been enshrined in the concept of the natural rate of unemployment and although the natural rate hypothesis has become a central part of all of modern macroeconomics it is not a component of the theory I will develop here. As a consequence the welfare and policy implications of old and new-Keynesian economics are very different.

I begin, in Section 2, by sketching a simple one period model that captures the essence of my argument. The idea is to model the process of moving workers from unemployment to employment with a neoclassical search technology of the kind introduced to the literature by Phelps (1968). I will argue that this technology cannot easily be decentralized because moral hazard prevents the creation of markets for the search inputs. Instead, I will introduce a market in which workers post wages in advance and I will assume that all workers post the same wage. This leads to a model with one less equation than unknown since the two markets for search inputs must be cleared by a single price. This underdetermined labor market is a perfect match for a Keynesian theory of demand determination in which the quantity of output produced and the volume of labor employed is determined by aggregate demand. I call this a demand constrained equilibrium. In Section 3 I provide a sketch of how the equilibrium concept of a demand constrained equilibrium can be extended to a full-blown dynamic stochastic general equilibrium model.

2 A One Period Model

This section describes my main idea. Its purpose is to lay out a simple environment in which one can compare the socially efficient allocation of resources to the allocation that occurs in a decentralized equilibrium. In more sophisticated versions of the theory, described in Section 3, I introduce investment as a key determinant of demand. In the current section, all economic activity takes place in a single period. In this one-period model, government purchases take the place of investment spending as an exogenous determinant of the level of economic activity. Although this environment abstracts from many important elements of the real world it is rich enough to capture the basic idea; that a modified search-theoretic-model (MS-model) leads to inefficient equilibria because of a missing market.

2.1 The economic environment

Consider a one-period model with a large number of workers and firms. Firms produce output using a constant-returns-to-scale technology in which labor is the sole input. Labor is transferred from households to firms using a convex matching technology with unemployment and vacancies as inputs.

There is a unit measure of entrepreneurs each of whom runs a firm. Each entrepreneur has access to a technology that produces output Y from labor input L:

$$Y = AL \tag{1}$$

where $A > 0$ is the marginal product of an extra unit of labor input. Entrepreneurs are identical and, the symbols Y and L refer interchangeably to average aggregate variables and to individual variables. The utility of the entrepreneur is captured by a continuous increasing concave function $J^E\left(X^E\right)$, where

$$X^E = C^E - V \tag{2}$$

is the sum of the entrepreneur's consumption C^E, and V measures the disutility of posting vacancies. The cost of vacancies is measured in consumption units.

In addition to the mass of entrepreneurs there is a continuum of workers with preferences $J^W\left(C^W\right)$ where J^W is a concave increasing utility function and C^W is workers' consumption. Each worker supplies one unit of effort inelastically to a constant-returns-to-scale matching technology:

$$m = BU^{\theta}V^{1-\theta} \tag{3}$$

where m is the measure of workers that find jobs when U unemployed workers search for jobs and V vacancies are posted by entrepreneurs. B is a scaling parameter. Since $U = 1$ (all workers are initially unemployed) this reduces to the expression

$$m = BV^{1-\theta}. \tag{4}$$

In a dynamic model, employment will appear as a state variable in a programming problem since it takes time to recruit new workers. In this section, I abstract from this aspect of labor market dynamics by assuming that all workers must be recruited in the current period. This assumption implies that employment, equal to the number of matches, is represented by the equation:

$$L = m. \tag{5}$$

This completes a description of preferences and technology. Next I turn to the problem solved by a benevolent social planner whose goal is to maximize a weighted sum of the utilities of the two agents.

2.2 The social planning problem

The social planner faces the following problem:

$$\max \lambda J^W\left(C^W\right) + (1-\lambda)\, J^E\left(C^E - V\right) \tag{6}$$

such that

$$L = BV^{1-\theta} \tag{7}$$

$$C^E + C^W \leq AL. \tag{8}$$

This problem has the following solution for the optimal quantity of employment, L^*

$$L^* = B^{\frac{1}{\theta}}\left(A\left(1-\theta\right)\right)^{\frac{1-\theta}{\theta}}. \tag{9}$$

Since workers do not receive disutility from work, all unemployed workers search all of the time. Entrepreneurs do not like to search and optimal employment balances the disutility of search against increased output from greater employment.

In the planning optimum, employment depends on three parameters, A, B and θ. A measures the productivity of the production technology and B the productivity of the search technology. If either of these parameters increases, search effort becomes more productive and the social planner will choose more of it. A decrease in θ also makes the search of the entrepreneur more productive and has the same qualitative effect as an increase in B.

The allocation of output between workers and entrepreneurs is determined by the parameter λ which is a number between 0 and 1 that represents the weight placed by the planner on the worker in social utility.

2.3 A decentralized solution

In order to discuss the role of government policy, in this section I will add a government to the model that taxes output with a proportional tax τ and purchases commodities G. I will assume that commodities purchased by government do not directly yield utility in order to make the point that apparently socially inefficient government expenditure can be Pareto improving.

Since the environment I have described satisfies all the desiderata of the welfare theorems, standard results from general equilibrium theory imply that the social planning solution could be decentralized by a complete set of competitive markets. To achieve this decentralization one would need to treat the matching technology in the same way as the production function and to assume the existence of a set of profit maximizing employment agencies that purchases, from workers the exclusive right to be matched with an entrepreneur and from entrepreneurs, the exclusive right to be matched with a worker. There are good reasons why these markets do not exist; for example, an unemployed worker could easily cheat and sign employment contracts with multiple agencies. On being matched, the worker would have an incentive to claim incompatibility with the employer and to continue being paid for further search activity.

Consider instead the following decentralized environment which is based on the idea of a competitive search equilibrium due to Espen Moen (1997). In this environment, firms post wages in advance and, in equilibrium, all firms post the same wage. Firms and workers meet randomly and on meeting, the entrepreneur and worker form a matched pair and produce output using the technology described by Equation (1). The worker receives wage income from the match and the entrepreneur receives profit Π where:

$$\Pi = AL - \omega L. \tag{10}$$

The worker and the firm take the numbers p^u and p^v as given. p^u is the probability a worker receives a job and p^v is the measure of workers hired by an entrepreneur that posts 1 vacancy. Later, I will describe how these variables are determined in equilibrium. Each worker secures a job with probability p^u. The worker is paid an after tax wage which he spends on consumption C^W. Each entrepreneur posts V vacancies and hires a measure of workers of size Vp^v. Each vacancy posted yields one unit of disutility.

The worker's problem is trivial since he needs only to search for a job and to spend his after-tax income on consumption. The utility maximizing entrepreneur will choose V, L and C^E to solve the problem,

$$\max J^E \left(C^E - V\right) \tag{11}$$

such that

$$C^E \leq \Pi \left(1 - \tau\right) \tag{12}$$

$$\Pi = AL - \omega L \tag{13}$$

$$L = p^v V \tag{14}$$

where the rate of tax on profit is the same as the rate on labor income. The solution to the entrepreneur's problem is given by the correspondence:

$$V = \begin{cases} \infty & \text{if} \quad (A - \omega) p^v (1 - \tau) > 1 \\ [0, \infty] & \text{if} \quad (A - \omega) p^v (1 - \tau) = 1 \\ 0 & \text{if} \quad (A - \omega) p^v (1 - \tau) < 1. \end{cases} \tag{15}$$

Government chooses a tax rate τ and a level of purchases G.

2.4 The equilibrium concept

This section introduces my equilibrium concept. To describe it, I have appropriated a term, *demand constrained equilibrium*, that was used in a literature on general equilibrium with fixed prices that evolved in the 1970's from the work of Jean Pascal Benassy (1975), Jacques Dreze (1975) and Edmond Malinvaud (1977). Although fixed-price models with rationing of the kind studied by these authors are sometimes called demand constrained equilibria; that is not what I mean here. Instead I will use the term to refer to a competitive search model that is closed with a materials balance condition. The common heritage of both usages of demand constrained equilibrium is the idea of effective demand from Keynes' *General Theory*.

Definition 1 *(Demand Constrained Equilibrium) For any given τ and G a demand constrained equilibrium (DCE) is a real wage ω, an allocation $\{C^W, C^E, V, L\}$ and a pair of matching probabilities, p^u and p^v, with the following properties.*
1) Feasibility:

$$C^E + C^W \leq AL \tag{16}$$

$$L \leq BV^{1-\theta} \tag{17}$$

$$G \leq (1-\tau) AL. \tag{18}$$

2) Consistency with optimal choice:

$$V = \begin{cases} \infty & \text{if} \quad (A-\omega) p^v (1-\tau) > 1 \\ [0,\infty] & \text{if} \quad (A-\omega) p^v (1-\tau) = 1 \\ 0 & \text{if} \quad (A-\omega) p^v (1-\tau) < 1. \end{cases} \tag{19}$$

3) Consistency of matching probabilities:

$$p^u = L \tag{20}$$

$$p^v = \frac{L}{V}. \tag{21}$$

Property 3) needs some explanation. The probability of contacting a partner is determined by how many others are searching. Let $\bar{V}$ represent the average number of vacancies posted by entrepreneurs and let $\bar{L}$ represent the aggregate number of successful matches (equal to aggregate employment). The probability that a worker finds a job, and the measure of workers hired by an entrepreneur who posts V vacancies, are determined by the conditions

$$p^u = \bar{L}, \quad p^v = \frac{\bar{L}}{\bar{V}}. \tag{22}$$

In a symmetric equilibrium, the search intensities must be the same across agents and hence

$$V = \bar{V}, \quad L = \bar{L}. \tag{23}$$

2.5 The Keynesian cross

In modern DSGE models the government is assumed to choose expenditure and taxes subject to a constraint. Models that incorporate a constraint of this kind were dubbed Ricardian by Robert Barro (1974). But in models with multiple equilibria there is no reason to impose a government budget constraint and Eric Leeper (1991), discussing models of monetary and fiscal policy, has argued that one should allow government to choose both taxes and expenditure and that this choice selects an equilibrium. He calls a policy in which the government choose both taxes and expenditure, an 'active fiscal regime.' The modified-search model of the labor market is one with multiple equilibria and hence, one can close the model in the way advocated by Leeper.

In textbook descriptions of simple Keynesian models, equilibrium is typically described by the diagram pictured in Figure 1. The 45 degree line in this diagram is a supply curve, representing the assumption that whatever is demanded will be supplied. The second upward sloping line is a Keynesian demand curve obtained by combining the equations

$$Y = C + G, \tag{24}$$

$$C = (1 - \tau) Y, \tag{25}$$

to yield the equilibrium condition

$$Y = \frac{G}{\tau}. \tag{26}$$

It is precisely this pair of equations that determine determine equilibrium output in the current model.

The central difficulty faced by old Keynesian economics was that the Keynesian model as expounded by John Hicks and Alvin Hansen had no microfoundation. They could not answer the question: Why doesn't the real wage fall to establish equilibrium in the labor market? The answer I propose to that question is that there is a missing market. A complete decentralization of the search process as a competitive equilibrium would require a market for vacancies and a separate market for the search time of entrepreneurs. In practice there is a single competitive search market in which competition forces all firms to post the same wage.

2.6 Determining the equilibrium wage

Standard competitive theory does not have a good explanation of the process by which an equilibrium is established. Nor will I. Instead, I will argue that

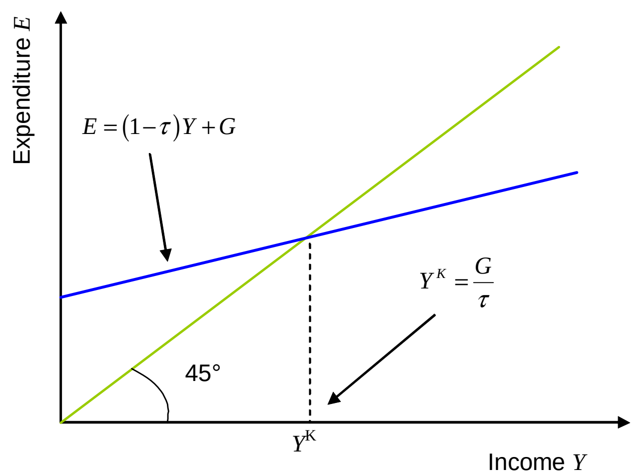

Figure 1: The Keynesian Cross

equilibrium in the labor market is determined by the aggregate demand for commodities and that the equilibrium wage will adjust to the point where neither firms not workers have an incentive to vary their search intensities.

Replacing the equilibrium values of the probabilities from Equations (20) and (21) into the first order condition, Equation (19), leads to the following equation:

$$(A-\omega)\frac{L}{V}(1-\tau)=1. \tag{27}$$

Combining Equation (27) with the matching function leads to the expression:

$$L=B^{\frac{1}{\theta}}\left[(A-\omega)(1-\tau)\right]^{\frac{1-\theta}{\theta}}. \tag{28}$$

Equation (28), graphed in Figure 2, defines a relationship between the real wage and employment similar to the supply relationship in a Walrasian model. Unlike the Walrasian case, in a demand constrained equilibrium there does not exist a corresponding demand relationship to simultaneously determine price and quantity. Instead, demand is determined by aggregate materials balance.

To summarize, the modified-search model of the labor market provides a micro-foundation to the Keynesian cross that characterized textbook de-

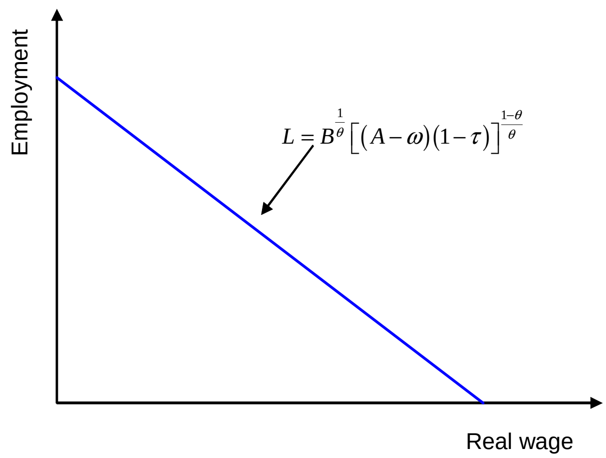

Figure 2: The Wage Function

scriptions of Keynesian economics in the 1960's. Income, equal to output, is demand determined and is equal to a multiple of exogenous expenditure. Since I have abstracted in the one period model from saving and investment, aggregate expenditure is determined by government purchases and output is determined as a multiple of government purchases where the multiplier is the inverse of the tax rate.

2.7 Fiscal policy and social welfare

Contrast the DCE allocation with the socially efficient level of employment, given by the expression

$$L^* = B^{\frac{1}{\theta}} \left(A\left(1-\theta\right)\right)^{\frac{1-\theta}{\theta}}. \tag{29}$$

Since the welfare of an entrepreneur is linear in the sum of consumption and vacancies, the social planner operates by first maximizing the sum

$$U = AL - V \tag{30}$$

which I will refer to as social utility. By replacing V with the expression $V = \left(\frac{L}{B}\right)^{\frac{1}{1-\theta}}$ from the matching function this expression can be written as a function of L,

$$U = AL - \left(\frac{L}{B}\right)^{\frac{1}{1-\theta}}. \tag{31}$$

Given the maximal value of U, the social planner distributes consumption across entrepreneurs and workers to maximize a weighted sum of individual utilities. Notice that the maximization of social utility leads to the expression given in Eq (29).

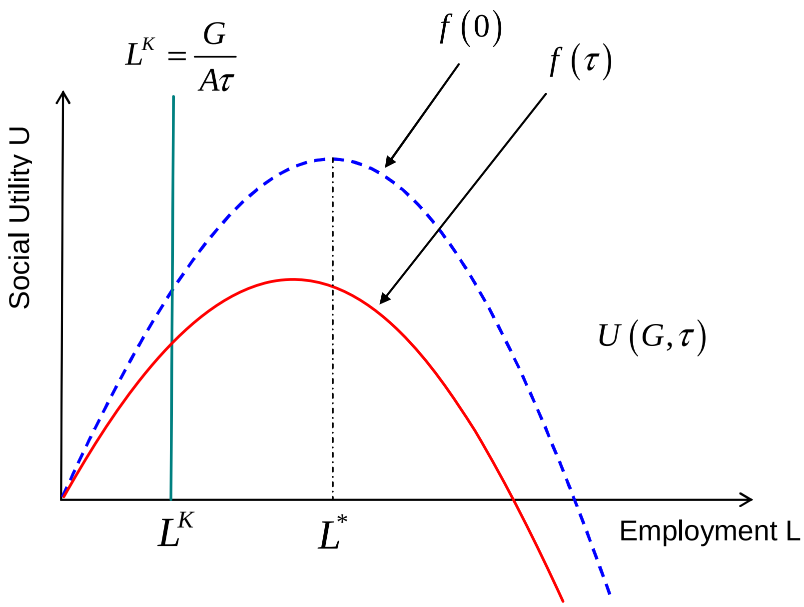

Figure 3: Social Utility

In a demand constrained equilibrium, employment (the superscript K is for Keynes) is given by the expression

$$L^K = \frac{G}{A\tau} \tag{32}$$

and social utility by

$$U = (1-\tau)AL - \left(\frac{L}{B}\right)^{\frac{1}{1-\theta}} \equiv f(\tau). \tag{33}$$

Comparing Eq (33) with (31) it follows that for any positive tax rate, social utility, given L, will be lower in any demand constrained equilibrium with positive taxes, reflecting the fact that government purchases are assumed to yield no utility. The set of possible demand constrained equilibria is depicted in Figure 3. The curves $f(0)$ and $f(\tau)$ represent attainable levels of adjusted social utility (the right side of Eq. (33)) for different tax rates.

For a given tax rate, employment increases as government purchases increase. In the figure this would correspond to shifting the line L^K to the right. As G increases, social utility will increase up until a maximum that depends on τ. At that point further increases in government purchases will increase employment but decrease welfare. It follows that the optimal policy is approached (but never achieved) by lowering the tax rate towards zero and choosing G to pick $L^K = L^*$.

3 An Intertemporal Model

My purpose in this section is to provide a brief sketch of how one might develop the static model, described above, into a full blown dynamic stochastic general equilibrium model. The work I will describe is in progress and will be reported in more detail elsewhere. There are nevertheless several important details of the generalization that are worth describing and also some preliminary results that may be of interest.

The equilibrium I will use is a generalization of the static concept of demand constrained equilibrium. Since the factor markets are incomplete, I will close the model by assuming that investment expenditure depends on the self-fulfilling beliefs of entrepreneurs. The result is a model with multiple stationary equilibria, indexed by beliefs.

3.1 Recursive utility and the real interest rate

The conventional approach to dynamic general equilibrium posits the existence of a representative agent with time additively separable preferences. This approach restricts the long-run real interest rate to equal a parametrically determined rate of time preference and it is too restrictive for my purposes. Since I will be concerned with the role of fiscal policy I will need to describe a model in which aggregate expenditure is a function of the real interest rate. If this is fixed by the time preference rate, government purchases will "crowd out" private consumption and have no effect on equilibrium employment in the long run. For this reason, I chose to model preferences with a recursive utility function of the kind studied by Uzawa (1968), Lucas and Stokey (1984) and Epstein and Hynes (1983) and adapted by Farmer-Lahiri (2005) to allow for balanced growth.

Recursive utility functions allow the long-run real rate of interest to depend on consumption sequences. An alternative model with this property is a version of the overlapping generations model with long lived agents. I will not follow this approach here since empirically plausible versions of the overlapping generations model are more complicated than the recursive representative agent approach.

Utility is defined by the equation,

$$J_t = A_t \sum_{t=1}^{\infty} E_1 \left[-\rho_1^t \left(\frac{A_t}{C_t} \right)^{\lambda} \right] \tag{34}$$

where

$$p_1^1 = 1 \tag{35}$$

$$\rho_1^t = \beta^{t-1} \prod_{s=2}^{t} \left(\frac{A_s}{A_{s-1}} \right) \left(\frac{A_{s-1}}{C_{s-1}} \right)^{\lambda}, \quad t > 1. \tag{36}$$

The term A_t is an exogenous trend that grows at the rate of growth of the economy and β and λ are parameters. These preferences allow the representative agent's discount rate to depend on consumption relative to a growing trend. The inclusion of a trend in preferences is necessary for this representation to be consistent with balanced growth and it could potentially arise from a more fundamental assumption in which one assumes a home production sector (as in Benhabib, Rogerson and Wright (1991)) where home productivity grows at the same rate as productivity in the market sector.

3.2 Some details of the model

The representative agent is situated in a relatively standard one-sector growth model with the additional twist that there is a matching technology for moving labor from households to firms. This technology implies that labor in place at firms in period t is given by the expression

$$L_t = L_{t-1} (1 - s) + B (1 - L_t)^{\theta} V_t^{1-\theta} \tag{37}$$

where s represents exogenous separations, the second expression on the right hand side of Eq (37) represents matches at date t and $1 - L_t$ is the fraction of the labor force unemployed. The timing of the matching function is chosen to enable demand shocks to influence output contemporaneously – that is, workers can produce in the period in which they are employed.

Output is produced with the technology

$$Y_t = K_t^{\alpha} (A_t X_t)^{1-\alpha} \tag{38}$$

where X_t is labor used in productive activity and it is related to L_t (total labor in place at the firm) and V_t (labor used in recruiting) by the expression,

$$V_t + X_t = L_t. \tag{39}$$

Other elements of the model are standard. The representative agent inelastically supplies a unit measure of labor to the market and at any given date U_t units of labor are unemployed and L_t are employed where $U_t = 1 - L_t$.

I will assume that agents are able to trade a complete set of contingent claims and that fundamental uncertainty is indexed by histories of events that I will denote σ^t. Thus, σ^t is a list of everything relevant to the economy that occurred up to and including date t. The agent faces a sequence of real wages and interest rates and chooses consumption sequences to maximize expected utility subject to a sequence of budget constraints

$$K_{t+1} = K_t (1 - \delta) + \omega_t L_t + \Pi_t - C_t \tag{40}$$

$$\lim_{T \to \infty} Q_1^T \left(\sigma^T\right) K_{T+1} \left(\sigma^T\right) \geq 0 \tag{41}$$

where Π_t is profit, ω_t is the real wage and $Q_1^T \left(\sigma^T\right)$ is the present value price of capital at date T in event history σ^T.

3.3 A definition of equilibrium

The following definition is a sketch of how the DCE concept can be extended to a DSGE model.

Definition 2 *For a given sequence $\{I_t\}$ a Demand Constrained Equilibrium (DCE) is a 4-tuple of quantity sequences $\left\{C_t\left(\sigma^t\right), V_t\left(\sigma^t\right), L_t\left(\sigma_t\right), K_{t+1}\left(\sigma^t\right)\right\}$ (as functions of event histories), a sequence of matching probabilities $\left\{p^v\left(\sigma^t\right)\right\}$, a sequence of rental rates and wage rates$\left\{q_t\left(\sigma^t\right), \omega\left(\sigma^t\right)\right\}$, and a sequence of utility levels and profits $\left\{J\left(\sigma^t\right), \Pi\left(\sigma^t\right)\right\}$, with the following properties:*

1) Taking as given the sequences of rental rates, wage rates and matching probabilities the quantity sequences maximize the expected net present value of the firm.

2) Taking as given the sequences of rental rates and wage rates and the profit sequence the quantity sequences maximize the expected utility of the households.

3) The matching probabilities are determined in equilibrium by equality of average and agent specific unemployment and vacancy rates and the demands and supplies for all commodities are equal.

3.4 Comparing an equilibrium with a planning optimum

Given the model outline sketched above one can show that, given certain bounds on investment sequences, there exists a different demand constrained equilibrium for every stationary investment sequence. One can also establish the existence of a unique balanced growth path that characterizes a stationary planning optimum. Both concepts are characterized by the following set of seven equations in the eight variables j_t,c_t,k_t,y_t,i_t,L_t,X_t and V_t. Lower case letters represent the ratio of variables to the trend growth path and $\gamma = \frac{A_t}{A_{t-1}}$ is the trend growth factor.

$$j_t = E_t \left\{ \left(-1 + \beta \gamma j_{t+1}\right) \frac{1}{c_t^{\lambda}} \right\} \tag{42}$$

$$k_{t+1} = \frac{1-\delta}{\gamma} k_t + \frac{1}{\gamma} y_t - \frac{1}{\gamma} c_t \tag{43}$$

$$y_t = k_t^{\alpha} \left(X_t\right)^{1-\alpha} \tag{44}$$

$$y_t = i_t + c_t \tag{45}$$

$$X_t = L_t - V_t \tag{46}$$

$$L_t = (1-s) L_{t-1} + B \left(1 - L_t\right)^{\theta} V_t^{1-\theta} \tag{47}$$

$$\frac{1}{c_t} = E_t \left\{ \left(\frac{1}{c_t}\right)^{\lambda} \left(\frac{j_{t+1}}{j_t}\right) \frac{\beta}{c_{t+1}} \left(1 - \delta + \frac{y_{t+1}}{k_{t+1}}\right) \right\}. \tag{48}$$

A social planning optimum is defined by the previous seven equations and the additional condition

$$\frac{1}{c_t} \left[\frac{(1-\alpha) y_t}{X_t} g_1 \left(L_t, L_{t-1}\right) + E_t \left\{ \left(\frac{1}{c_t}\right)^{\lambda} \left(\frac{j_{t+1}}{j_t}\right) \frac{\gamma\beta}{c_{t+1}} \frac{(1-\alpha) y_{t+1}}{X_{t+1}} g_2 \left(L_{t+1}, L_t\right) \right\} \right] = 0. \tag{49}$$

where $g\left(L_t, L_{t-1}\right)$ is a function that describes the relationship between X_t (labor used to produce output) and the stocks of labor at the firm at dates t and $t-1$. One can show that a demand constrained equilibrium is determined by the same seven equations (42) – (48) but the system is closed by the assumption that investment follows the following exogenous stochastic process

$$i_t = i_t^{\chi} e_t \tag{50}$$

where χ is parameter that measures persistence of the exogenous investment sequence and e_t is a stochastic innovation to beliefs.

It is worth pausing at this point to draw attention to Equation (50) since it is the main feature that makes this a model of old-Keynesian economics. The term i_t is defined as the ratio of investment to a growing trend and this equation states that investment evolves exogenously with no regard for expected future profits. It is precisely this idea which I take to be central to the *General Theory* and which has disappeared from much of modern macroeconomics. Although my own previous work with Jess Benhabib (1994) and Jang-Ting Guo (1994) went part way to rehabilitating animal spirits; in that work we only considered a model with a unique steady state. The current proposal goes far beyond the previous literature since I am proposing to allow the steady state of the economy itself to be influenced by beliefs. As in my previous work, all of these belief driven equilibria are fully rational and leave no room for arbitrage opportunities or for mistaken expectations.

To explain the behavior of prices and matching probabilities in a belief driven equilibrium one can derive a separate set of equations that describes how the rental rate q_t, the real wage rate ω_t and the match probability p_t^v depend on the state. The real wage, for example, follows the process

$$\omega_t = (1-\alpha)\frac{y_t}{X_t}\left(1-\frac{1}{p_t^v}\right) + E_t\left\{\gamma Q_t^{t+1}(1-\alpha)\frac{y_{t+1}}{X_{t+1}}\frac{(1-s)}{p_{t+1}^v}\right\} = 0 \quad (51)$$

where

$$p_t^v = \frac{L_t - (1-s)L_{t-1}}{L_t - X_t}. \quad (52)$$

3.5 Some preliminary results

As a preliminary check on the chances of this model to fit data I simulated a demand constrained equilibrium for an investment sequence calibrated fit to the properties of time series data; for this purpose I chose the shock to have a standard deviation of 0.04 and the autocorrelation parameter to equal 0.5. Figure 4 compares the properties of a single simulated data series (left panel) with the US data (right panel) for GDP and unemployment and Figure 5 does the same for GDP, investment and consumption. In all cases the data was detrended in the manner described in Section 4.

The exercise that I carried out to simulate these data series was similar to that which characterizes many real business cycle papers. But the shock that is driving the model is entirely driven by demand. Of course there are many

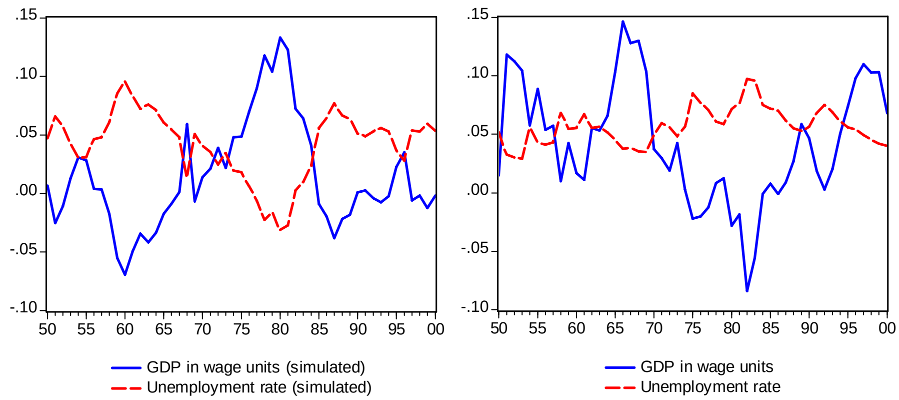

Figure 4: Gdp and Unemployment

features of this explanation still to be ironed out. I have not provided data on productivity or real wages although my preliminary investigations suggest that these series too will have approximately the right properties. Although the model does not have a TFP shock, an econometrician who estimates a standard Cobb-Douglas production function has a mis-specified model since the variable X_t that enters the production function differs from total employment L_t by the labor V_t used in recruiting. Since V_t is procyclical, it will appear in this data that output is driven by TFP.

An important question to which this model provides a very different answer from standard models concerns the welfare cost of business cycles. Figure 6 plots the consumption series against the social planning optimum. Since all uncertainty (in this simulation) arises from the animal spirits of investors, the social planner can, and will, choose a constant (detrended) consumption sequence. The figure illustrates that consumption in the simulation is always below the optimum and deviations from the first best can be as high as 2.5% of steady state consumption. Overemployment is as bad in this model as underemployment since it results from diverting too many resources to recruiting and away from productive activity.

With an investment sequence similar to that which occurred during the 1930's the welfare loss from this model could be substantially higher than that which I have reported. This simulation no doubt overstates the importance of belief driven cycles since it is unlikely that all business cycle fluctuations arise as a consequence of belief shocks. It does make the point

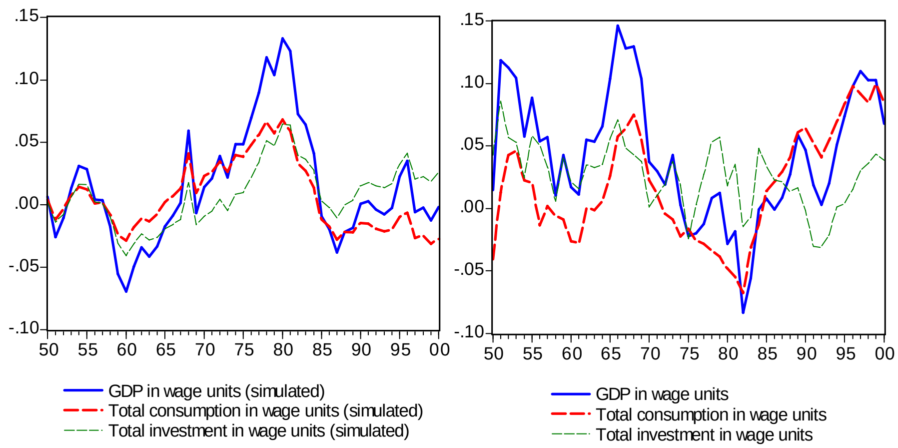

Figure 5: Gdp Consumption and Investment

however; that models in this class are likely to lead to much larger welfare costs of business cycles than the fraction of a percentage point described in Robert Lucas's (1987) work. One should consider this example to be the opposite extreme to the real business cycle assumption that all shocks arise as a consequence of aggregate disturbances to TFP.

4 A Note on Measurement

I want to raise one further issue in this essay that relates to the way that macroeconomists report data. Since the work of Hodrick and Prescott (1997), macroeconomic data has typically been detrended with a two-sided filter. Since the models I am interested in may contain important low frequency relationships between series; detrending each individual series by a separate low frequency component is not very sensible since it removes relevant information from the data that could potentially discriminate between theories. I will be concerned with the question: Is the long-run rate of unemployment is a function of fiscal policy? To answer a question of this kind I need a way of detrending data that does not remove a different low frequency component from each series.

The data reported in this paper was detrended by a method suggested by Keynes in the *General Theory.* This involves deflating nominal series by

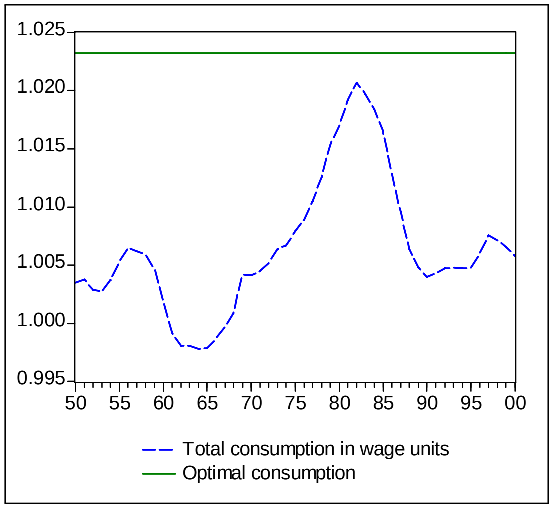

Figure 6: Equilibrium and Optimal Consumption Compared

a measure of the nominal wage to arrive at series measured in “wage units”. Figure 6 compares unemployment with gdp detrended using the HP filter (left panel) with this alternative method. Notice that when GDP is measured this way, it moves much more closely with unemployment (measured on the left axis using an inverse scale).

5 Conclusion

It is a dangerous business to claim to have uncovered the meaning of Keynes and although it has become fashionable recently to assert that the *General Theory* was a misstep in the history of thought, I do not take that view. I am old enough (just) to have learned Keynesian economics at graduate school, as well as as an undergraduate, and foolish enough to have believed at least part of what I was taught.

In distilling a complex book like the *General Theory* into a logically coherent argument one necessarily makes compromises since the pieces of the jigsaw come from different puzzles. The task is infinitely more complicated when one is required fit them together with modern ideas that adopt the fiction of the representative agent, the aggregate production function, complete contingent claims markets and so on. But it is equally distressing when the accepted interpretation of the Keynesian heritage in the form of new-

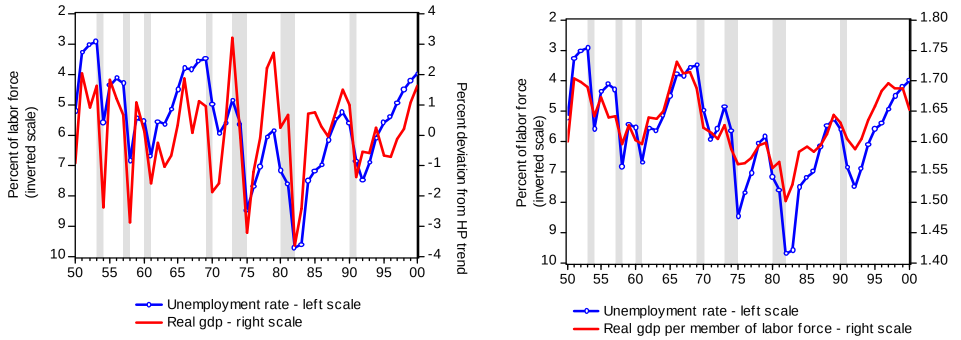

Figure 7: Two Ways of Detrending Data

Keynesian economics distorts the central message of the *General Theory* into a form in which the message is so diluted that it becomes unrecognizable. That message, is that unregulated capitalist economies sometimes go very wrong and the cure, when this happens, is deficit spending. I hope, in this essay, to have provided a framework in which this Keynesian theory of public finance, at least conceptually, makes sense. Whether this is a good description of the world is a different question but surely it is one worth asking.

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