Confidence, Crashes and Animal Spirits

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Abstract

This paper argues that the equilibrium business cycle theory which has guided macroeconomics for the past thirty five years is flawed. I introduce an alternative paradigm that retains the main message of Keynes' General Theory and which reconciles that message with Walrasian economics. I argue that there are two market failures in the labor market: A lemons problem and an externality. I show how those two problems lead to inefficient equilibria in which the unemployment rate is determined by the self-fulfilling beliefs of stock market participants.

1 Introduction

In the winter of 2009, as the world economy spirals into a deep recession, Keynesian economics has once more become fashionable. Some, but not all of this resurgence in Keynesian ideas is positive. The positive part of the Keynesian revival is the recognition that sometimes markets fail and that, when this occurs, there is a potential for government policy to improve human welfare. The negative part of the revival is the rush for policy economists throughout the world to dust off their copy of Samuelson's introductory textbook[1] and blindly apply fiscal policies that do not have a distinguished history of success. As economists, we need to get the economics right before we rush in as saviors.

The *General Theory*[2] had two important messages for economists. First, the labor market is different from most other markets and, as a consequence, there may be may different labor market equilibria and many different equilibrium unemployment rates. Second, the unemployment rate we end up with is selected by the confidence of market participants. Keynes did not try to reconcile these ideas with Walrasian economics and the attempt to do so by post-war economists was, in my view, a failure. It led to the bastard Keynesianism of the neoclassical synthesis which castrated the main message of the *General Theory*: Persistent high unemployment is an equilibrium phenomenon.[3] This paper makes this idea precise, in a way that the *General Theory* did not, by explaining the market failure that leads to multiple steady state equilibria.

[1] Samuelson (1948).
[2] Keynes (1936).
[3] The term 'bastard Keynesianism' is from Joan Robinson 1965, Pages 100-101.

2 The Market Failure

According to the first theorem of welfare economics, every competitive equilibrium is Pareto efficient. It is difficult to overemphasize the power of this idea and the importance it has had in guiding the questions that economists ask and the explanations we seek for economic misfortune.

If the first welfare theorem applies to the real world, then high unemployment must be a result of changes in the fundamentals of the economy. A social planner would have chosen a high unemployment rate because technological constraints have temporarily changed in a way that makes high unemployment the right way to satisfy human wants. Even those who hold a strong faith in free markets find it difficult to make this argument about the current recession. There is similar reluctance to attribute social efficiency to unemployment during the Great Depression. Some economists have claimed instead that the problem at that time was one of government intervention in markets in ways that distorted efficient outcomes: According to this view, government is not the solution, it is the problem.[4]

Although there is much to be said for the argument that government sometimes does more harm than good, there is also much to be said for the argument that free markets do not always deliver efficient outcomes. There is a long history in economics of recognizing specific market failures and recommending policies to correct them. In this paper I will identify two such failures, an *externalities problem* and a *lemons problem*.[5] I will argue that

[4] Milton Friedman and Anna Schwartz made the argument in *A Monetary History of the United States* (1963) that the Great Depression was made a great deal worse than it should have been by incompetent monetary policy. For a recent example of a similar argument see the paper by Harold Cole and Lee Ohanian in the *Journal of Political Economy* (2004). For a criticism of the classical approach to understanding depressions see Peter Temin's review article in the *Journal of Economic Literature* (2008).

[5] By a lemons problem I mean the market failure identified by Akerlof (1970) in his classic paper, "The Market for Lemons". Akerlof discussed informational asymmetries in the used car market. I will apply a similar argument to the markets for inputs to the process of search in the labor market.

the process of finding a job can be represented by a search technology and that a lemons problem leads to the nonexistence of input markets to the search technology. The non existence of these markets leads to the existence of multiple equilibria that are supported not by prices but by an externality in the search market that plays the role of a missing relative price.

3 Overview of the Model

In the following pages I will construct the simplest possible model that captures my main theme. It is a variant of a 'Lucas Tree Economy', populated by a representative agent, endowed with a single unit of non-reproducible capital.[6] Output is produced by competitive firms that rent capital from households and employ workers each period. The main difference from a standard model is in the way I model the labor market by adopting a variant of search theory.

In an approach that has become standard in search theory, one assumes that firms and workers are randomly matched. Once matched, the wage is set by a Nash bargain. In this paper I drop the Nash bargaining assumption and assume instead that all firms offer the same wage in advance. This leads to a model in which there is a continuum of steady state equilibria.[7] In each equilibrium there is a different real wage, a different unemployment rate and a different value for assets. Every equilibrium is associated with zero profits for firms but not all equilibria have the same welfare properties. The main idea of this paper is to exploit the fact that there are multiple labor market equilibria to introduce business confidence (Keynes called this animal spirits) as an independent determinant of economic activity.

[6] Lucas Jr. (1978).

[7] I refer repeatedly in this paper to standard search theory. By this I mean the work discussed in Pissarides (2000) and the more recent developments of that literature surveyed in Rogerson, Shimer, and Wright (2005). In almost all of this work there is a locally unique equilibrium unemployment rate that depends only on fundamentals. A rare exception to models with this property is Hall (2005).

In the following sections, I begin by describing preferences, technologies and endowments and I show how a social planner would choose employment in each period. I then argue that an informational asymmetry precludes markets from decentralizing this equilibrium in the usual way and that the problem is so severe that it precludes the existence of markets for the inputs to the search technology. Because of these missing markets there is a continuum of decentralized equilibria.

4 Endowments, Preferences and Technology

There is an infinite sequence of periods and a representative household with a continuum of members. The economy is endowed with one unit of non reproducible capital and, in each period, with one unit of time. The endowments place constraints on the resources available for production that are represented by inequalities (1) and (2):

$$H_t \leq 1, \tag{1}$$

$$K_t \leq 1. \tag{2}$$

I use the symbol K_t to represent capital allocated to production and H_t to represent time allocated to labor market search. I explain this idea further below.

Household utility is defined over sequences of a unique consumption good, $\{c_t\}$. It is represented by the expression

$$J = \sum_{t=1}^{\infty} \log(c_t). \tag{3}$$

Households suffer no disutility from work.

There are two technologies, one for producing output from labor and one for moving workers from home to work. I use the symbol L_t to refer to

the measure of workers employed in any given period and U_t to refer to the measure of unemployed. They are related by the expression:

$$L_t + U_t = H_t, \tag{4}$$

which states that if H_t workers search for a job, L_t will be successful and the remaining U_t workers will be unemployed.

Employed labor may be allocated to one of two tasks: Recruiting or production. I refer to labor allocated to recruiting with the symbol V_t and I use X_t for labor allocated to production. The sum of V_t and X_t is total employment, L_t,

$$V_t + X_t = L_t. \tag{5}$$

The manufactured commodity is produced from labor and capital using the constant-returns Cobb-Douglas technology

$$c_t = K_t^a X_t^b, \tag{6}$$

where, by the constant returns-to-scale assumption,

$$a + b = 1. \tag{7}$$

Each period labor must be moved from home to work using a search technology. To keep the model as simple as possible I make the unrealistic assumption that all workers are fired and must be rehired every period. Given this assumption, the search technology takes the form,

$$L_t = H_t^{1/2} V_t^{1/2}. \tag{8}$$

The assumption that all labor is rehired every period is a strong one. If I did not make this assumption then employment would become a state variable and the description of the dynamics of equilibria would become more

complicated. It is not too difficult to work out what happens in this case but since it complicates the algebra without adding insight, I have dispensed with that complication here.

The cost to the firm of hiring new workers is measured in labor units, rather than output, in contrast to most search models. This innovation to the standard search model is not important and is made for expositional simplicity. The timing of the employment decision deserves some discussion, however, since it is somewhat non-standard. Effectively, I am allowing the firm to use workers to recruit themselves.

Since the firm begins the period with no workers, and since workers are an essential input to recruiting, it might be argued that the firm can never successfully hire a worker. Since I will be thinking of the time period of the model as a quarter or a year, this assumption should be seen as a convenient way of representing the equilibrium of a dynamic process. The planner chooses a feasible 4−tuple $\{V, c, L, X\}$ and Equations (5) – (8) describes the set of feasible plans.

5 The Social Planning Problem

The planner maximizes (3) subject to the constraints (5) – (8). Since there is no way of accumulating new capital, this problem reduces to the simpler one of maximizing consumption in every period. By combining the constraints into a single inequality the problem of the social planner can be restated as follows:

$$\max_{\{L_t\}} \; c_t \tag{9}$$

$$c_t \leq \left[L_t \left(1 - L_t\right)\right]^b . \tag{10}$$

This problem has the following solution

$$L_t = \frac{1}{2}, \qquad t = 1, ... \tag{11}$$

The social planner will chose to find jobs for only half of the labor force in every period; the remaining half remain unemployed.

This economy possesses an optimal unemployment rate of 50%.[8] This is an obvious candidate to represent 'the natural rate of unemployment' and I shall define it as such in this paper. This is a somewhat different definition from that of Milton Friedman who, in his 1968 presidential address to the American Economic Association defined the natural rate as follows:

> The "natural rate of unemployment," ... is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility, and so on. [Friedman (1968), page 8.]

These two definitions are equivalent only in an economy in which the first welfare theorem holds. I will argue that, as a consequence of missing markets, the first welfare theorem does not hold. As a consequence, there is a continuum of unemployment rates that "would be ground out by the Walrasian system of general equilibrium equations". If one is looking for benchmark of efficiency, and a benchmark like this is certainly useful, Friedman's definition is not much help. It is for this reason that I have chosen to define the natural rate of unemployment to be equivalent to the unemployment rate that would be chosen by a social planner.

Why *is* there an optimal unemployment rate in this economy? Since search gives no disutility one might expect that everyone looking for a job

[8] The fact that it is 50% rather 2% or 90% is a property of the parametrization of the search technology. I have retained this rather unrealistic parametrization since it simpifies the algebra.

should be employed. The social planner would not choose to expand employment beyond 50% since adding additional workers to the firm requires taking workers away from the production of commodities and putting them to work in the recruiting department. Although an employment rate of 100% is feasible as a limiting case, it would be counterproductive to push employment to this level since everyone would be so busy recruiting each other there would be nobody left to produce commodities.

6 Why the Standard Decentralization Fails

In general equilibrium theory, every commodity is produced by a group of profit maximizing firms. Just as Microsoft produces computer software and Apple produces computers so general equilibrium theory predicts we should see headhunting firms that operate the search technology to match workers with firms. The inputs to the search technology are the search effort of unemployed workers and the search effort of firms with vacant jobs. These inputs should be purchased from households and firms by competitive headhunters.

The output of the search technology is a successful match between a vacancy and a worker who is qualified to fill it. This output should be sold to a worker-firm pair once a match has been established. Although we do see some headhunting firms, they are a small fraction of the employment market and they do not operate in the way that general equilibrium theory predicts.

In practice, those headhunting firms that do exist operate as personnel departments for firms that are too small or too specialized to run their own operations. They charge firms for their services but they do not pay them for their vacancies nor do they pay unemployed workers for the exclusive right to match them with firms. The markets for the input time of searching workers and the market for the input time of searching firms do not exist. It is not hard to see why this is the case since, if they did exist, workers and firms would have incentives to cheat that are hard to monitor. The markets for

the inputs to the search process are missing because of a lemons problem.

Suppose that there are two types of workers; honest workers who always tell the truth and dishonest workers who will lie if it is in their best interests to do so. How would the markets for search inputs operate if these markets did exist? For the market to work properly, the searching worker would be required to sell his input to only one headhunting firm. But a dishonest unemployed worker could sell his search time to multiple headhunting firms but tell each one that his relationship with that firm was unique. If one of the headhunters were to find the worker a job, he could turn it down on spurious grounds and continue to receive payments from other headhunting firms while remaining unemployed. Since there will often be good reasons to refuse a job, it would be impossible to write a contract in which the worker must take any job that he is offered.

In some countries there are organized employment exchanges, run by the government, that pay benefits to unemployed workers. The UK is an example. These institutions are often subject to fraud in which individuals sign up for benefits under multiple names and turn down every job offered. This behavior is the kind that we would expect to see in a market with a lemons problem. When there are honest workers and dishonest workers (lemons) the inability of headhunting firms to sort between them may lead to the breakdown of the private market.

7 Decentralization Through Search Equilibrium

Because of the informational problems I have described, most labor markets are not auction markets. They are better described by random matching. In this paper I will assume that competitive firms take prices, wages and meeting probabilities as given and choose employment to maximize profit. This approach is similar to standard search theory with one exception. I do

not allow firms and workers to bargain over the wage. Instead, I assume that all firms offer the same wage and that this wage is chosen by market forces to implement a zero profit equilibrium. The fact that there is a missing market leads to a model with fewer equations than unknowns in which there is a continuum of steady state equilibrium unemployment rates. This, I argue, is a perfect way of modeling Keynes' idea that there is something different about the labor market and it allows me to close the model in different way from that of standard general equilibrium theory. I close the model with 'animal spirits' by assuming that 'confidence' is an independent fundamental determinant of economic activity.

When a theorist writes down a model in which a market is missing, his immediate instinct is that the model is incomplete. We are trained that way in graduate school. The theorist assumes that he must add an equation to show how the unemployment rate is, after all, determined by preferences, endowments and technology. Some theorists complete their model by adding a new equation to determine the wage through bargaining. The papers of Dale Mortensen (1970) and Christopher Pissarides (1976) are examples. Others, Espen Moen (1997) for example, introduce fictional 'market makers' who compete with each other to match workers with jobs. The standard search literature typically seeks an extra equation to replace the price signals that are missing in the labor market because of the twin market failures of externalities and the lemons problem.

I believe that theorists who follow this route have asked the wrong question. We should not be looking for hidden mechanisms that make the labor market work well. We should instead recognize that these mechanisms are absent. As a consequence, there may be many equilibrium unemployment rates, most of which have very bad welfare consequences.

8 A Competitive Model

In this section I will describe the behavior of households and firms in a decentralized search equilibrium. Later in the paper, I will formalize this idea by defining a new concept: a demand constrained equilibrium. Roughly speaking – this is a competitive equilibrium in which all agents optimize, taking prices and matching probabilities in the search market as given.

The preferences of the representative household are logarithmic with discount rate β. The household supplies a measure 1 of workers to the search process and, in equilibrium, a fraction $\tilde{q}_t$ of them find jobs. The variable $\tilde{q}_t$ is determined by how many other firms are searching for workers. I will return to this idea below.

There is a large number of competitive firms each of which solves the following problem,

$$\max_{\{K_t, V_t, X_t, L_t\}} p_t K_t^a X_t^b - w_t L_t - rr_t K_t, \tag{12}$$

subject to,

$$L_t = X_t + V_t, \tag{13}$$

$$L_t = q_t V_t. \tag{14}$$

The money price p_t, the money wage w_t and the money rental rate rr_t are taken as given. In one-commodity general equilibrium models it is typical to choose the consumption good as the numeraire and to set the money price of goods at 1. Here, I choose instead to take labor to be the numeraire and I set $w_t = 1$. I made this choice because it generalizes easily to multicommodity versions of the model.[9]

I define the value of aggregate expenditure to be

$$C_t \equiv p_t c_t. \tag{15}$$

[9] My (2008) paper in the *International Journal of Economic Theory* explores this idea.

In Keynesian economics, the value of expenditure is determined by assumptions about the spending habits of consumers and the beliefs of stock market participants about the value of their wealth. Since I choose labor as numeraire, these expenditures are measured in effective units of labor.

The variable q_t which appears in Equation (14) is taken parametrically by each firm. This variable represents the number of additional workers that can be hired by a single worker allocated to the recruiting department and it is analogous to the labor market tightness variable in a standard search model.

Substituting Equations (13) and (14) into (12) and defining

$$\Theta_t = (1 - 1/q_t)\,, \tag{16}$$

one obtains a reduced form expression for the profit of a typical firm,

$$\Theta_t^b p_t K_t^a L_t^b - L_t - rr_t K_t. \tag{17}$$

This expression is maximized when

$$aC_t = rr_t K_t, \tag{18}$$

and

$$bC_t = L_t. \tag{19}$$

Equations (18) and (19) are identical to those that would hold in a competitive model with an auction market for labor. They represent the two first order conditions for profit maximization. The model I have constructed differs from a competitive model since the recruiting efficiency parameter Θ_t is endogenously determined by aggregate economic activity but is taken parametrically by the firm. I will show below that this externality allows the model to display a continuum of search equilibria each of which is consistent with profit maximization by individual firms and optimizing behavior

by forward looking households with perfect foresight.

9 Search Market Equilibrium

The variables Θ_t, $\tilde{q}_t$ and q_t, taken parametrically by households and firms, are determined in equilibrium by market clearing in the markets for search inputs. To see how this works, it helps if we place a bar over a variable to represent its aggregate value. For example, $\bar{L}_t$ is the measure of aggregate employment and L_t is the measure of workers hired by the average firm. These variables are conceptually distinct although they turn out to be equal in equilibrium.

Using this notation and recognizing that everybody will look for a job, that is, $\bar{H}_t = 1$, Equation (8) implies that in aggregate,

$$\bar{V}_t = \bar{L}_t^2. \tag{20}$$

This equation represents the relationship between recruiters and the number of workers hired in the economy as a whole. Each individual firm assumes instead that the following relationship holds between its own recruiting effort V_t and the number of workers that it can hire,

$$q_t V_t = L_t. \tag{21}$$

If we impose the symmetric equilibrium assumption, $L_t = \bar{L}_t$ and $V_t = \bar{V}_t$, it follows that q_t is related to aggregate employment by the expression

$$q_t = \frac{1}{\bar{L}_t}, \tag{22}$$

and Θ_t is determined by the expression,

$$\Theta_t = \left(1 - \bar{L}_t\right). \tag{23}$$

Equation (23) defines a term, Θ_t, which looks like a productivity shock but is in fact a recruiting externality. I will define equilibrium more carefully below but some intuition may be helpful at this point.

I will show that there exists a continuum of labor market equilibria. In a high unemployment equilibrium, firms allocate a small fraction of their workforce to recruiting. The productivity of a recruiter is high because all other firms also allocate a small fraction of employed workers to recruiting. It's like fishing in a pond full of fish (searching workers) when there are very few other fishermen (recruiters from other firms). In a high unemployment equilibrium, Θ_t is high and the real wage is high but employment is low.

In a low unemployment equilibrium, firms allocate a large fraction of their workforce to recruiting. The productivity of a recruiter is low because all other firms also allocate a large fraction of their workforce to recruiting. In a low unemployment equilibrium, Θ_t is low and the real wage is low but employment is high.

10 Asset Pricing

I have described how the labor market works. This section explains how it is connected to the asset markets.

I begin by describing equilibrium choices by the household. Since the household has logarithmic preferences, it will choose to consume a fixed fraction of its wealth. Wealth consists of the value of the household's capital, its income from current dividends, and the net present value of human capital.

If we define $p_{k,t}$ to be the price of a unit of capital and h_t to be the present value of labor income then, in equilibrium, the value of consumption in wage units is given by the expression,

$$C_t = (1 - \beta)\left(p_{k,t} + rr_t + h_t\right). \tag{24}$$

I now turn to relationship between consumption expenditure and the

stock price.[10] It follows from the assumption of no riskless arbitrage opportunities that the asset price $p_{k,t}$ solves the pricing equation

$$p_{k,t} = Q_{t+1}\left(p_{k,t+1} + rr_{t+1}\right), \tag{25}$$

where Q_{t+1} is the nominal pricing kernel and rr_{t+1} is the dividend (equal to the rental rate) paid on a unit of capital.

Since the firm is competitive and there is a single unit of capital it follows from Equation (18) that the rental rate is proportional to consumption,

$$rr_{t+1} = aC_{t+1}, \tag{26}$$

and, since preferences are logarithmic, the pricing Kernel Q_{t+1} is given by the expression

$$Q_{t+1} = \frac{\beta C_t}{C_{t+1}}. \tag{27}$$

Combining Equations (25), (26) and (27) it follows that expenditure on consumption goods (equal to gdp in this economy) is proportional to the asset price,

$$C_t = \lambda p_{k,t}, \tag{28}$$

where the constant of proportionality, λ is given by the expression,

$$\lambda = \frac{1-\beta}{\beta a}. \tag{29}$$

There are two ways of interpreting Equation (28). The traditional way is to treat it as an equation that determines the asset price $p_{k,t}$ in terms of fundamentals. In Keynesian economics, the view that I will take in this paper, this equation works the other way around. Beliefs about the value of the stock market, represented here by $p_{k,t}$, determine wealth and wealth

[10] My argument is identical to that which holds in a standard asset pricing model and for details the reader is referred to Lucas Jr. (1978).

determines aggregate expenditure. Given the value of aggregate expenditure, there is a self-fulfilling equilibrium which consists of a price level an unemployment rate and a physical quantity of real output that makes the belief about the value of the asset self-fulfilling.

In classical economics, all movements in stock prices are driven by fundamentals. If Microsoft shares drop in value it is because rational investors anticipate that Microsoft's profits will fall. Perhaps there is a new competitor in the market. Perhaps there is a new invention that makes the personal computer obsolete. But there is no room for what Alan Greenspan called irrational exuberance and Keynes called animal spirits.

If fundamentals are strong, there will be low unemployment. Profits and dividends will be high and firms will be able to invest in new factories and machines to fund future growth. Rational forward looking households will make an unbiased forecast of the future strength of the economy and they will bid up the value of stocks to keep pace with the forecast rate of economic growth.

If the fundamentals are weak, there will be high unemployment. Profits and dividends will be low and firms will not have the inclination or the resources to invest in new factories and machines. Rational forward looking households will correctly forecast that future profits will be low and they will bid down the value of stocks in line with their forecast of a period of contraction in real economic activity. This is the classical view of the role of the stock market in the real economy.

In Keynesian economics, individuals do not buy and sell shares because they believe that their fundamental values have changed. They buy and sell shares because they think that other people will value them more or less in the future. When households remain pessimistic for a long period of time, they undervalue the stock market. If this pessimism persists, it will cause some households to reduce their purchases of consumption goods. Those households that are beginning their retirement will find that they are unable

to fund the same standard of living that they had expected and they will live in smaller houses, reduce spending on new cars and purchase fewer restaurant meals. Younger households who are saving for college or to buy a home will choose a cheaper vacation in order to replenish their savings. Firms will be unable to sell all of the goods they produce and will lay off workers. As profits fall, the makers of consumer goods will be unable to pay for new factories and machines and orders for investment goods and raw materials will drop. Dividends, profits and investment will all fall and the initial pessimistic view of the future will become self-fulfilling. This is the Keynesian view of the importance of the stock market to the real economy.

11 Demand Constrained Equilibrium

This section provides a formal definition of equilibrium based on the ideas sketched out above. I will appropriate a term, *demand constrained equilibrium*, that was used by Jean Pascal Benassy (1975), Jacques Dreze (1975) and Edmond Malinvaud (1977) in a literature on fixed-price economics that was developed in the 1970's. 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 the equilibrium of a particular kind of competitive search model. The common heritage of both usages of demand constrained equilibrium is the idea of effective demand from Keynes' *General Theory*.

In this paper I am going to mean something very specific by 'confidence'. I will use the term interchangeably with 'animal spirits' and I will assume that confidence determines what Keynes called the 'state of long term expectations'. The state of long-term expectations is a self-fulfilling sequence of beliefs about asset prices. Before defining equilibrium I will need to be clear about which beliefs are permissible and which are not. I will allow agents to form any non-stationary sequence of beliefs about the price of the asset

provided these beliefs are bounded above in a way that is consistent with the existence of equilibrium.

Definition 1 *A (bounded) state of (long-term) expectations is a non-negative sequence* $\{p_{k,t}\}_{t=1}^{\infty}$ *with a bound* B *such that*

$$p_{k,t} < B$$

for all t*.*

According to this definition, the state of expectations is a sequence of beliefs about the value of capital in all future periods. In a more general model, there will be a different sequence of beliefs for every type of reproducible capital and discrepancies between expectations and the interest rate will cause changes in investment expenditures. In this model I am abstracting from investment spending by assuming that there is a unique non-reproducible capital good. Even in this simple environment changes in beliefs about the value of capital will have an effect on expenditure since long-term expectations influence wealth which, in turn, influences consumption.

The following definition is of a demand constrained equilibrium. Following this definition, I derive expressions for aggregate variables.

Definition 2 *(Demand Constrained Equilibrium) For any bounded state of expectations* $\{p_{k,t}\}_{t=1}^{\infty}$ *a demand constrained equilibrium (DCE) is a sequence of rental rates* $\{rr_t\}_{t=1}^{\infty}$ *a sequence of prices* $\{p_t\}_{t=1}^{\infty}$ *set of quantity sequences* $\{c_t, X_t, V_t, L_t\}_{s=t}^{\infty}$ *and a pair of sequences of numbers* $\{\tilde{q}_t, q_t\}_{t=1}^{\infty}$*, such that the following equations hold for all* $t = 1, \ldots \infty$*:*
1) Feasibility and Market Clearing. ,

$$c_t = X_t^b, \tag{30}$$

$$X_t + V_t = L_t, \tag{31}$$

$$L_t = V_t^{\frac{1}{2}}, \tag{32}$$

2) Consistency with optimal choices by firms and households.

$$1 = b\frac{C_t}{L_t}, \qquad rr_t = aC_t, \tag{33}$$

$$C_t = \frac{1-\beta}{\beta a} p_{k,t}. \tag{34}$$

3) Search market equilibrium:

$$\tilde{q}_t = L_t, \tag{35}$$

$$q_t = \frac{1}{L_t}. \tag{36}$$

Equations (30)-(32) define technologies, adding up constraints and market clearing conditions. Equations (33) and (34) are first order conditions that define solutions to individual optimizing problems and (35) and (36) represent the conditions for consistency of the social and private search technology in a search market equilibrium.

Proposition 3 (DCE) *There exists a unique Demand Constrained Equilibrium for every state of expectations with bound*

$$B \leq \frac{\beta a}{b\left(1-\beta\right)}.$$

In a DCE, for $t = 1, \ldots,$ aggregate consumption expenditure, aggregate employment and the rental rate are described by Equations (37)-(39),

$$C_t = \frac{(1-\beta)}{\beta a} p_{k,t}, \tag{37}$$

$$L_t = bC_t, \tag{38}$$

$$rr_t = \frac{p_{k,t}\,(1-\beta)}{\beta}. \tag{39}$$

The physical quantity of the consumption good produced is given by the equation

$$c_t = (bC_t)^b\,(1-bC_t)^b\,. \tag{40}$$

and the price in wage units by the expression

$$p_t = (C_t)^a \left(\frac{1}{b}\right)^b \left(\frac{1}{1-bC_t}\right)^b. \tag{41}$$

Proof. See Appendix A. ■

What should one make of this proposition? I am advancing the concept of a demand constrained equilibrium as an alternative paradigm to the real business cycle model. It provides a way of understanding the relationship between the asset markets and the labor market that gives an internally coherent explanation of the current crisis. It is distinct from both classical economics and new-Keynesian economics. It explains what caused the crisis – a drop in confidence – and why we should be actively try to end it.

If the economy remains arbitrarily far from the planning optimum for a long period of time, the welfare cost of a deep recession is potentially huge. In contrast, both classical and new-Keynesian theories describe business cycles as small deviations from a social optimum and, in both accounts, the welfare costs of a recession are second order.[11]

12 My Argument Summarized

In modern market economies it is costly to match unemployed workers with vacant jobs. Because there are no markets for the search time of unemployed

[11] The case that business cycle fluctuations have small welfare costs was made in the context of the classical model by Lucas Jr. (1987) and in the context of the new-Keynesian model by Galí, Gertler, and Salido (2007, Page 56).

workers or the search time of corporate recruiters, free market economies do not provide the necessary price signals to ensure that a given number of jobs is filled in the right way. Because the relevant price signals are missing, a market economy can become stuck in an equilibrium with a high unemployment rate. There are many such equilibria and almost all of them are socially inefficient.

Firms decide how many workers to hire based on the demand for the goods that they produce. The demand for goods depends on wealth. Every different equilibrium unemployment rate is associated with a different set of prices for factories and machines and the value of these physical assets depends on what market participants think they will be worth in the future.

The world economy is currently headed rapidly towards a high unemployment, low wealth equilibrium which was triggered by a loss of confidence in the value of assets, backed by mortgages in the US subprime mortgage market. The inability to value these assets has since led to an amplification of the crisis as panic hit the global financial markets. Even though the US stock market is appropriately valued based on historical price earnings ratios – investors are worried that the value of stocks could fall further. If the Dow does fall further, the drop may prove to be self-fulfilling and the consequences for human welfare are troubling to contemplate.

13 Conclusion

Recognizing the nature of a problem is a first, and necessary step, towards finding its solution. I hope, in this paper, to have made a contribution to this first step.

What of the likely success of the $800b Obama stimulus plan, enacted in the winter of 2009. I am skeptical that it will do much good. Post-war research on the consumption function found that consumption expenditure depends on wealth, not on income. This suggests there is a good chance that forward looking agents will undo the effects of a fiscal stimulus by increasing

private saving. This is the Ricardian case made by Robert Barro (1974) and it is a property not only of classical models but also of the model described in this paper. The evidence from past data that the multiplier is positive is slim and we should be concerned that the current spending package passed by Congress will lead to inflation without appreciably solving the unemployment problem.

I do not want to close this paper on an entirely gloomy note. For the reader that wants more than a description of the cause of the crisis I would direct attention to two books that will be coming out later this year.[12] I suggest there that the Fed should support the stock market directly by trading index funds and I explain why a policy of that kind makes sense.

[12] Farmer (2009 forthcoming), Farmer (2009 Forthcoming).

A Proof of Proposition 3

Proof. The proof of existence is constructive. Since labor supply is bounded above by 1, and since, in a DCE, $L_t = bC_t$, from Equation (19), C_t is bounded above by b^{-1}. The asset pricing equations, (25)–(27) can be combined to give

$$\frac{1}{C_t} = \frac{\beta}{C_{t+1}} \left(\frac{p_{k,t+1} + rr_{t+1}}{p_{k,t}} \right). \tag{42}$$

Using Equation (26) and rearranging terms,

$$\frac{1}{C_t} = \frac{\beta}{C_{t+1}} \left(\frac{p_{k,t+1}}{p_{k,t}} \right) + \frac{\beta a}{p_{k,t}}, \tag{43}$$

which can be iterated forward to obtain the expression

$$\frac{1}{C_t} = \frac{\beta a}{p_{k,t}} \left(1 + \beta + \beta^2 ... \right). \tag{44}$$

Since $\beta \in (0, 1)$ and

$$\lim_{T \to \infty} \frac{\beta^T p_{k,t+T}}{p_{k,st}} \frac{1}{C_{t+T}} = 0, \tag{45}$$

the infinite sum on the RHS of (44) converges to $(1 - \beta)^{-1}$. Rearranging this expression then leads to Equation (28). Since C_t is bounded above by b^{-1}, it follows that a valid equilibrium requires

$$p_{k,t} \leq \frac{a\beta}{b\,(1 - \beta)}. \tag{46}$$

Equation (38) follows from (19) and (39) follows from combining (26) with (37). To obtain Equation (40), note that the production function can be written, in reduced form, as

$$c_t = \Theta_t^b L_t^b, \tag{47}$$

and it follows from (23) and (19) that

$$\Theta_s = (1 - bC_t)\,. \tag{48}$$

Combining these expressions gives

$$c_t = (1 - bC_t)^b\,(bC_t) \tag{49}$$

which is (40). To obtain (41) note that

$$p_t = \frac{C_t}{c_t} = \frac{C_t}{(1 - bC_t)^b\,(bC_t)^b} \tag{50}$$

which can be rearranged to give (41). ■

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