NBER WORKING PAPER SERIES

THE IMPORTANCE OF BELIEFS IN SHAPING MACROECONOMIC OUTCOMES

Roger Farmer

Working Paper 26557
http://www.nber.org/papers/w26557

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2019

I would like to thank David Vines for encouraging me to write this paper and C. Roxanne Farmer for helpful comments. The views expressed herein are those of the author and do not necessarily reflect the views of the National Bureau of Economic Research.

The Importance of Beliefs in Shaping Macroeconomic Outcomes
Roger Farmer
NBER Working Paper No. 26557
December 2019
JEL No. D50,E12,E24,E32

ABSTRACT

For the past thirty years of the history of macroeconomic thought, the Indeterminacy School of Macroeconomics has used general equilibrium models with indeterminate equilibria to understand the independent role of beliefs in shaping macroeconomic outcomes. In this paper I describe the most recent advances in the indeterminacy agenda, Keynesian Search Theory, in which the steady-state unemployment rate is indeterminate as a consequence of labour-market frictions. In Keynesian Search Theory, the belief of market participants is an independent exogenous variable that selects a steady-state equilibrium. I study two assumptions about beliefs, one where investment is exogenous and one where the belief about the stock market is exogenous and I examine their implications for fiscal policy.

Roger Farmer
UCLA
Department of Economics
Box 951477
Los Angeles, CA 90095-1477
and CEPR
and also NBER
rfarmer@econ.ucla.edu

The importance of beliefs in shaping macroeconomic outcomes[1]

Roger E. A. Farmer

Abstract

For the past thirty years of the history of macroeconomic thought, the *Indeterminacy School of Macroeconomics* has used general equilibrium models with indeterminate equilibria to understand the independent role of beliefs in shaping macroeconomic outcomes. In this paper I describe the most recent advances in the indeterminacy agenda, *Keynesian Search Theory,* in which the steady-state unemployment rate is indeterminate as a consequence of labour-market frictions. In Keynesian Search Theory, the belief of market participants is an independent exogenous variable that selects a steady-state equilibrium. I study two assumptions about beliefs, one where investment is exogenous and one where the belief about the stock market is exogenous and I examine their implications for fiscal policy.

JEL D50, E12, E24, E32

I. Introduction

The work I describe in this paper is part of the *Indeterminacy School*, a research agenda in macroeconomics that exploits the indeterminacy of general equilibrium models to explain macroeconomic phenomena. The early papers in this school used models of dynamic indeterminacy to explain how beliefs independently influence outcomes.[2] Here I describe advances from the past ten years which use general equilibrium models with steady-state indeterminacy to model what Keynes referred to as *involuntary unemployment.*[3] I call these advances, *Keynesian Search Theory* (Farmer, 2016, p. 77).

---

[1] I would like to thank David Vines for encouraging me to write this paper and C. Roxanne Farmer for helpful comments.

[2] Farmer (1993) and Benhabib and Farmer (1999) (Cherrier & Saïdi, 2018).

[3] The Keynesian search model is summarized in De Vroey's book on the history macroeconomic thought (De Vroey, 2016). Some of the papers that use the Keynesian search approach are framed in a model without capital where beliefs are formed over the current value of an asset in fixed supply. These include (Farmer, 2008b) (2012a) (2013) and (Guerrazzi, 2011). (Heathcote & Perri, 2018) (Kocherlakota, 2011) (2012) and (Michaillet & Saez, 2015) construct related models that display multiple steady state equilibria. Empirical work that seeks to substantiate the empirical link from asset values to unemployment include (Farmer, 2012b) (2015), (Arabaci, 2017) (Miao, Wang, & Xu, 2015) and (Pan, 2018). Papers that build models with capital and steady-state indeterminacy include (Beningno & Fornaro, 2018), (Farmer, 2010b) (Gelain & Guerrazzi, 2010), (Guerrazzi, 2012), (Plotnikov, 2019) and (Shea, 2013). One theme raised in (Farmer & Plotnikov, 2012) and (Farmer, 2012b) is that traditional fiscal policy may not be the best way to restore full employment. The implications of steady-state indeterminacy have been explored in models with money (Farmer & Platonov, 2019), and the empirical content of models with indeterminate steady-states for the Phillips curve has been explored in Farmer and Nicolò (2018), (2019). Farmer (2014) contains a survey of the literature on steady-state indeterminacy.

Keynesian Search Theory provides a way of reconciling Keynes' theory with the microeconomics of general equilibrium theory. Keynesian Search Theory is distinct from New-Keynesian economics and it does not suffer from the significant empirical and theoretical failures of New Keynesian economics. New Keynesian economics fails empirically because it is unable to explain salient features of the Great Depression, the largest recession in the last two hundred years. New Keynesian economics fails theoretically, because it is unable to capture what I consider to be the three most important contributions of Keynes' *General Theory* (Keynes, 1936).

The empirical facts from the Great Depression that New Keynesian economics fails to capture are that nominal wages and nominal prices fell by 25% between 1929 and 1933 and that employment and consumption both fell substantially at the same time that the real wage increased.

The theoretical contributions from *The General Theory* that New Keynesian economics fails to capture are: First, there is a continuum of steady-state equilibrium unemployment rates: Second, the steady-state equilibrium unemployment rate that prevails is selected by the self-fulfilling beliefs of market participants, and: Third, government policies can substantially increase welfare by eliminating involuntary unemployment.

Keynesian Search Theory provides a credible and internally coherent alternative paradigm that is distinct from New-Keynesian economics. It is consistent with the empirical facts from the Great Depression that I summarized above, and it captures the three main contributions to economic thought from *The General Theory* that I have drawn attention to.[4]

Although Keynesian Search Theory draws its inspiration from *The General Theory*, it is not a simple rehash of the interpretations of Keynesian economics offered by Hicks and Hansen, the architects of the IS-LM model.[5] By providing a dynamic theory of aggregate demand and a logically consistent explanation for involuntary unemployment, Keynesian Search Theory provides a framework to assess the likely benefits of fiscal policy as a means of restoring and maintaining full employment. An important conclusion of the theory is that asset market intervention through the active control of the stock market is a more effective tool than traditional fiscal policy to increase welfare.

In Section II, I provide a brief introduction to the intellectual history of New Keynesian economics. I trace the interaction of the history of thought with economic events and I describe the facts that emerged in the Great Depression that influenced Keynes' decision to jettison classical ideas. In Section III, I present two charts which show that money prices and money wages fell by 25% in the early 1930s at the same time that unemployment increased by a factor of 12. These facts are inconsistent with New Keynesian theory which relies on the assumption of nominal price or wage rigidity.

In Section IV I discuss the classical and new Keynesian theories of the labour market and in Section V I show that consumption and employment both fell substantially in the first three

---

[4] In my book *Prosperity for All*, I coined the term Keynesian Search Theory to clearly differentiate this from the IS-LM model and from what I call *Classical Search Theory,* an approach for which Diamond, Mortensen and Pissarides were awarded the Nobel prize in 2010 (Farmer, 2016, p. 77). In previously published works, I referred to the Keynesian Search Model as Old-Keynesian economics (Farmer, 2008a) (Farmer, 2008b).

[5] The IS-LM model is a textbook interpretation of *The General Theory* that has been taught to several generations of undergraduates following the attempts by (Hansen, 1936) and (Hicks, 1937) to reconcile Keynesian economics with general equilibrium theory. For a contemporary version of the IS-LM approach that uses Keynesian Search theory, see (Farmer & Platonov, 2019).

years of the Great Depression. These facts are inconsistent with both classical and New Keynesian theories of the labour market which imply that consumption and employment should move in opposite directions in response to a shock to aggregate demand.

In Section VI I distinguish between what I call Classical and Keynesian Search Theory (Farmer, 2016, p. 77) and in Section VII I explain why, when firms and workers are price-takers, search theory leads to the indeterminacy of steady-state equilibrium. In Section VIII, I explain how the Keynesian Search Model of the labour market resolves this indeterminacy and I situate that theory in an analogue of a real business cycle model in which beliefs are modelled as separate exogenous state variables.

In Sections IX and X, I present two complete macroeconomic models, each closed with a different assumption about what determines beliefs. In Version 1, described in Section IX, I assume that investment is an exogenous driving variable. In Version 2, described in Section X, I assume that the belief about the future value of the stock market is an exogenous driving variable. For both versions of the model, I show that temporary and permanent shocks have very different effects on employment, GDP, consumption and investment. Finally, in Section XI, I present a brief discussion of the implications of this research for economic policy.

II. The Intellectual History of Keynesian Economics

At the risk of oversimplification, the history of macroeconomics began with the publication of *The General Theory of Employment and Money* (Keynes, 1936). Before that date, economics was separated into price theory, which dealt with the determination of relative prices, and monetary theory, which dealt with the determination of the absolute level of prices in terms of money (Patinkin, 1956). The state of business cycle theory was captured by Pigou's book, *Industrial Fluctuations* (Pigou, 1923).

In *Industrial Fluctuations*, Pigou discusses multiple possible sources of, what today we would call, 'shocks' to the aggregate economy. Following a shock, the economy returns to a unique steady-state equilibrium in which the demands and supplies of all commodities are equal. In the language of modern general equilibrium theory, the steady-state equilibrium would be described as the solution to the problem of a social planner whose task is to maximize social welfare. In Pigou's conception of the aggregate economy, although markets are subject to shocks and to frictions that cause temporary deviations from market equilibrium, on balance, they work well.

Between 1929 and 1933, the stock market lost 80% of its value and the U.S. unemployment rate increased from 2% to 24%. In the following decade, the unemployment rate never fell below 15% of the labour force. It is hard to envisage that period as one in which markets work well and, motivated by the immense social misery that was experienced by the unemployed, Keynes changed economics and politics forever with the publication of his persuasive narrative, *The General Theory of Employment Interest and Money* (Keynes, 1936).

In my book *How the Economy Wor*ks, (Farmer, 2010a) I identified three important ideas that were introduced in *The General Theory*. The first is that steady-state equilibrium is not unique. Instead, the economy may become stuck with a situation of high *involuntary unemployment*, a concept that Keynes associated with a lack of sufficient aggregate demand. The second is that the equilibrium unemployment rate is selected by the *animal spirits* of entrepreneurs, a concept that I use interchangeably with the idea that the state of *beliefs* is an independent driving variable of the macroeconomy. The third is that governments have a

responsibility to intervene in markets to remove involuntary unemployment by *active fiscal and monetary policy*. If investors refuse to spend, the treasury must spend for them.

The General Theory is a static verbal representation of an economy that does not contain a theory of inflation. In the three decades following its publication, macroeconomists sought to mathematize *The General Theory* and to equip it with a way of understanding the inflation that had arisen in the decades following the end of WWII. The apogee of Keynesian dominance of macroeconomics came in 1955 when Samuelson wrote the third edition of his textbook, *Economics: An Introductory Analysis* (Samuelson, 1955).

In the third edition of *Economics*, Samuelson introduced a new theory that he called the Neo-Classical Synthesis. He meant by this, that the economy is Keynesian in the short run and classical in the long run (Pearce & Hoover, 1995). Writing in Cambridge Massachusetts, Samuelson identified the short run as a period in which not all prices and wages have adjusted to their market-clearing levels. He identified the long run as the period in which prices and wages have adjusted to their market-clearing levels and employment has returned to its social planning optimum. Writing in Cambridge England, Joan Robinson referred to this development as 'bastard Keynesianism.[6]

III. Some Evidence from the Great Depression

Keynes' disciples in Cambridge England, Joan Robinson among them, resisted the Cambridge Massachusetts interpretation of *The General Theory*. This was due, in part, to the fact that evidence from the 1930s in the United States was hard to square with the assumption that the increase in unemployment was caused by wage or price stickiness. And although Keynes himself introduced money wage rigidity in Chapter 3, he did not believe that his theory rested on the assumption that money wages are rigid downwards. Here is what Keynes had to say:

> In this summary we shall assume that the money-wage and other factor costs are constant per unit of labour employed. But this simplification, *with which we shall dispense later*, is introduced solely to facilitate the exposition. (Keynes, 1936) Chapter 3 Part II (my italics).

To understand why Keynes might not have been prepared to rest his theory on the assumption of downwards wage rigidity, in Figure 1 I have presented some data for the decade from 1929 through 1939 in the United States. Writing in 1936, Keynes would have been aware of the fact that prices, wages and employment fell substantially in the United States between 1929 and 1933.

Figure 1 has two panels. In both panels the upper line, measured on the right axis on an inverted scale, is the unemployment rate. This scale runs from 0 to 30%. On the left panel, the lower line, measured on the left axis, is the logarithm of a money wage index. On the right panel, the lower line, also measured on the left axis, is the logarithm of a price index.

The left panel of Figure 1 shows that the logarithm of the money wage index fell from 0.4 to 0.1in the space of four years. The right panel shows that the logarithm of the GDP deflator fell from 1.9 to 1.59 over the same period. These changes mean that the money wage and the

[6] (Robinson, 1978, p. 256).

money price level in 1933 were each approximately 75% of their 1929 magnitudes.[7] While it is possible that prices and wages did not fall *enough*, this figure shows that there is little support for the proposition that money wages or money prices were rigid downwards in the largest recession in the United States in the last two hundred years.

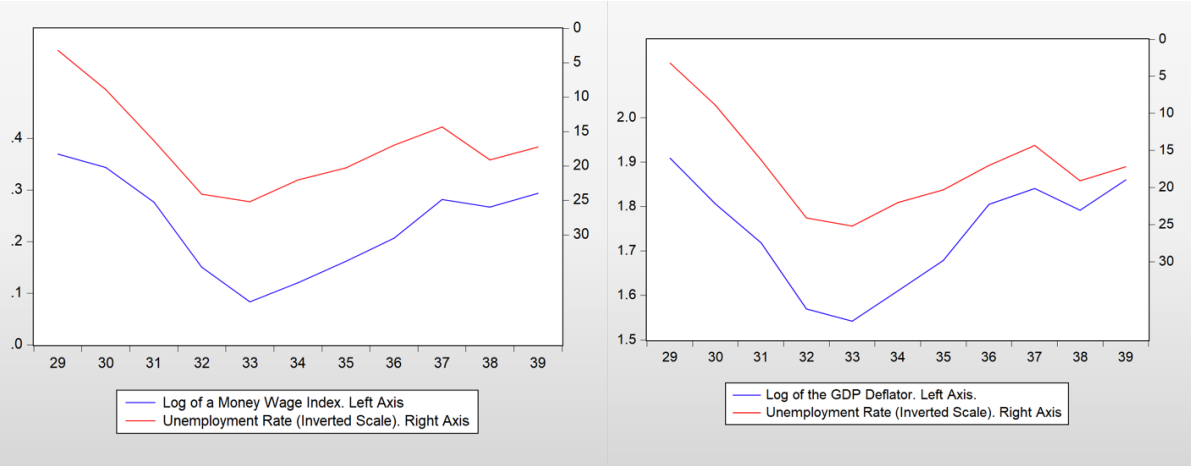


Figure 1: Wages, Prices and Unemployment During the Great Depression

To understand this evidence, Keynes introduced the concepts of aggregate demand and aggregate supply. Those concepts were later modified by Samuelson in *Economics: An Introductory Analysis* and to contemporary readers, they have come to mean an interpretation of *The General Theory* in which an aggregate price index is plotted on the vertical axis and a measure of the difference of real GDP from potential GDP is plotted on the horizontal axis.[8] This measure moves inversely with the unemployment rate and it is referred to as *the output gap*. Figure 2 presents two panels in which I plot a nominal price index on the vertical axis and the output gap on the horizontal axis. These panels illustrate why Keynesian economists attribute the cause of the Great Depression to a shock to aggregate demand.

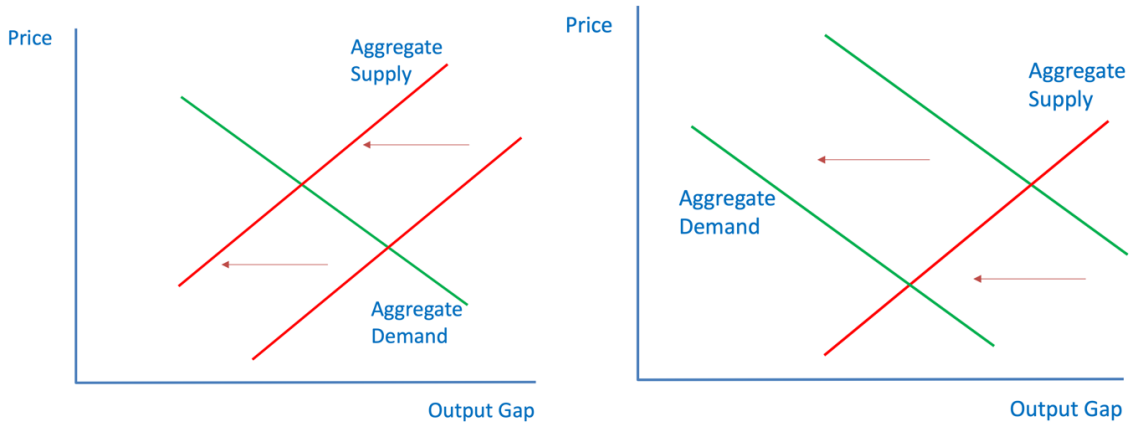


Figure 2: Understanding the Great Depression

The left panel of Figure 2 plots a downwards sloping aggregate demand curve and a pair of upward sloping aggregate supply curves. This panel shows that if the Great Depression had

[7] Expressing the change in levels leads to the following calculations. For the money wage exp(0.1)/exp(0.4) = 0.74 and for the money price level, exp(1.59)/exp(1.9) = 0.73.

[8] In (Farmer, 2008b), I discuss the original meaning of those terms.

been caused by a leftwards shift in the aggregate supply curve, it would have been associated with an increase in the price level.

But we see in Figure 1 that the price level did not increase in the 1930s; it fell by 25%. The right panel of Figure 2 plots an upward sloping aggregate supply curve and a pair of downward sloping aggregate demand curves. This panel shows that a leftward shift in the aggregate demand curve is consistent with the facts illustrated in Figure 1 and a fall in aggregate demand is, therefore, a good candidate explanation for the cause of the Great Depression.

IV. The Classical Representation of the Labour Market

If a simple aggregate demand and supply diagram can explain the Great Depression; why did Keynes claim in T*he General Theory* that he had overturned all of classical economics and replaced it with a new *general* theory? To understand his argument, we must look at the microfoundations of the labour market.

Classical economic models are characterized by a pair of equations representing the demand and supply of labour. The first of these two equations is represented by Equation (1). This equation arises from the profit maximization condition of a representative firm. The left side of Equation (1) represents the marginal product of labour. The right side of Equation (1) represents the real wage.

$$(1-\alpha)S_t\left(\frac{K_t}{L_t}\right)^{\alpha} = \frac{w_t}{p_t}. \tag{1}$$

When plotted on a graph with the real wage on the vertical axis and employment on the horizontal axis, Equation (1) traces a downwards sloping labour-demand curve whose position is determined by capital, K_t and productivity, S_t. The term w_t is the money wage, p_t is the money price of goods and S_t is a random variable that represents shocks to labour productivity. The subscript t represents calendar time.

An equation of this form is an important component of simple equilibrium business cycle models in which a single aggregate commodity, Y_t, is produced from capital using a Cobb-Douglas technology,

$$Y_t = S_t K_t^{\alpha} L_t^{1-\alpha},$$

and where the parameter α represents the elasticity of production with respect to capital. Writing in *The General Theory*, Keynes referred to a variant of Equation (1) as the first postulate of classical economics (Keynes, 1936) (Chapter 2).

The second of the two labour market equations is represented by Equation (2). This equation arises from the utility maximization problem of a representative household. The left side of Equation (2) represents the disutility of work, measured relative to the marginal utility of consumption. The right side of Equation (2) represents the real wage.

$$\frac{\gamma C_t}{1-L_t} = \frac{w_t}{p_t}. \tag{2}$$

When plotted on a graph with the real wage on the vertical axis and employment on the horizontal axis, Equation (2) traces an upward sloping labour-supply curve whose position is determined by aggregate consumption, C_t. An equation of this form is a second component of the formulation of labour market equilibrium in equilibrium business cycle models. In these models, a representative household maximizes the present discounted value of a sequence of

period utility functions. In writing Equation (2) I have assumed that the period utility function has the functional form,

$$U_t = \log(C_t) + \gamma \log(1 - L_t),$$

and that the household has one unit of time to allocate every period between employment and leisure. The parameter γ represents the household's preference for leisure and the term, $\gamma C_t/(1 - L_t)$ is the slope of an indifference curve in consumption-leisure space for this functional form for utility.

Writing in *The General Theory*, Keynes referred to Equation (2) as the second postulate of classical economics (Keynes, 1936) (Chapter 2). It is this equation that he sought to replace with an alternative theory in which employment is determined by aggregate demand.

By throwing out the second postulate, Keynes was left with an incomplete theory. In neoclassical models the real wage and the equilibrium quantity of employment are determined by equating the quantity of labour demanded to the quantity of labour supplied. Without a labour supply curve, the model cannot simultaneously determine the volume of employment and the real wage. To correct this deficiency, Keynes added a new independent equation. He closed his system by assuming that investment expenditure is determined by the 'state of long-term expectations' a new independent variable that I refer to as 'beliefs'.

V. A Problem with the Classical Representation of the Labour Market

To understand why Keynes rejected the second postulate of classical economics, it helps to fast forward forty years to the 1980s when the classical theory of business cycles was first formalized using the language of mathematics (Kydland & Prescott, 1982; Long & Plosser, 1983). This formulation, known as Real Business Cycle (RBC) theory, provides a complete dynamic theory of the determination of capital, employment, consumption and the real wage.

In the RBC formulation of the classical model, expenditure on consumption and expenditure on leisure are described by the equations,

$$C_t = \frac{(1-\beta)}{1+\gamma} W_t, \qquad \text{and} \qquad \frac{w_t}{p_t}(1 - L_t) = \frac{\gamma(1-\beta)}{1+\gamma} W_t,$$

where W_t is aggregate wealth and all variables are measured in units of date t consumption goods. The wealth measure, W_t, is equal to the current stock of capital plus the discounted present value of the agent's endowment of time. The parameter β is the rate at which the representative agent discounts expected future utility.

Are these equations consistent with the behaviour of consumption and unemployment during the Great Depression? I answer this question in Figure 3 by graphing consumption, unemployment and the real wage in the United States in the period from 1929 through 1939. On both panels of Figure 3, the upper line is the unemployment rate measured on the right axis. On the left panel, the lower line is real private consumption measured on the left axis in billions of 1987 dollars. On the right panel the lower line is the logarithm of the real wage.

The left panel of Figure 3 shows that consumption fell from 560 in 1929 to 440 in 1933, a drop of approximately 20%. At the same time, unemployment, which is the classical analogue of leisure, increased by a factor of 12 from 2% of the labour force in 1929 to 24% of the labour force in 1939.

A negative co-movement between leisure and consumption of this magnitude is not easy to square with classical economics. Examining Equation (3), we see that if the real wage had remained constant, the classical theory predicts that consumption and leisure should both have fallen in proportion and both movements would have been associated with a fall in wealth. In the data, consumption and leisure moved in opposite directions.

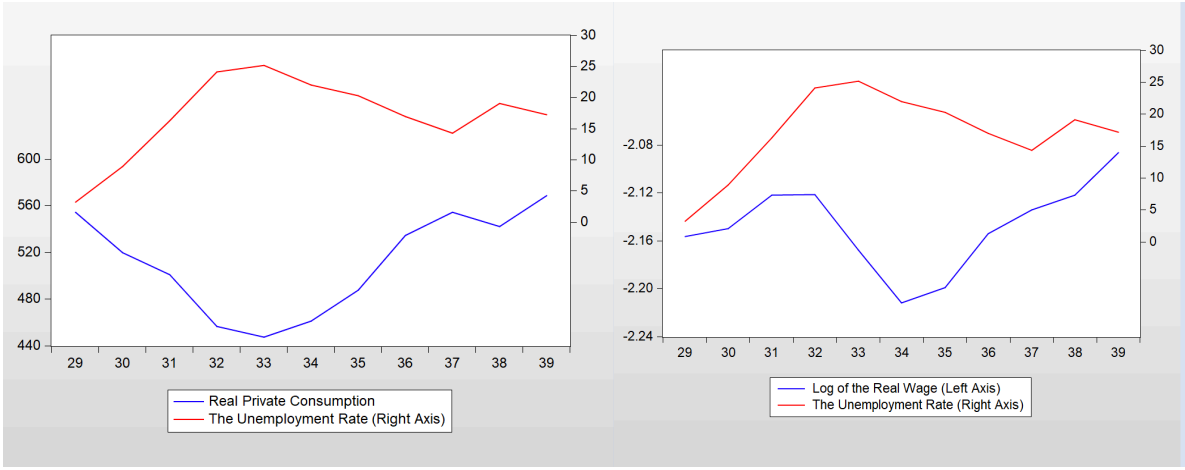


Figure 3: Consumption, Unemployment and the Real Wage During the Great Depression

One possibility, if the classical theory is correct, is that the real wage fell even more than employment rose. If this was the case, expenditure on leisure could have fallen even when time devoted to leisure increased. This possibility can be evaluated by examining the right panel of Figure 3. In the right panel of this figure I show that the real wage increased in the first three years of the Depression and it only began to fall in 1932 at about the time when leisure *also began to fall*. These facts are hard to interpret through the lens of the classical model.

VI. Search Theory, Unemployment and Vacancies

In the three decades following the publication of *The General Theory* economists attempted to reconcile Keynesian economics with a classical theory of the labour market. Those attempts were abandoned in 1972 when Robert Lucas (1972) persuaded the profession to jettison the concept of involuntary unemployment. In Lucas' new formulation of 'rational expectations macroeconomics', economists were entreated to return to the two classical postulates of classical economics and to abandon the idea that beliefs are independent factors that determine outcomes.

Lucas' appeal to abandon Keynesian economics was spectacularly successful and almost every macroeconomics paper written in the last forty years has adopted some version of the labour market that embodies a theory in which the real wage and the volume of employment are determined by equating the quantity of labour demanded to the quantity of labour supplied. Unemployment was no longer a component of macroeconomic models; instead, economists turned their attention to understanding why hours spent by households in paid employment fluctuates over the business cycle.

But although macroeconomists stopped modelling unemployment; microeconomists did not. In 1970, Edmund Phelps edited an influential collection of papers (Phelps, 1970) that presented theoretical interpretations of the microeconomics of inflation and unemployment. The eponymous *Phelps volume* created the field of *search theory* that was recognized in 2010 with three Nobel prizes; awarded to Peter Diamond, Dale Mortensen and Christopher

Pissarides. Some of that research found its way into macroeconomics, (Merz, 1995; Andolfatto, 1996). Much of it did not.

Search theory proposes that the process of moving unemployed workers into paid employment uses resources. This process is modelled by a *search technology*, $m(\cdot)$,

$$m_t = m(\bar{V}_t, \bar{U}_{t-1}),$$

where m_t is the number of newly employed people in period t, $\bar{U}_{t-1}$ is the time spent by unemployed workers searching for a job at the beginning of period t and $\bar{V}_t$ represents aggregate resources employed by the corporate sector in filling vacancies.[9] The search technology is a simple way of modelling the fact that the faster an economy fills vacant jobs, the more resources it must devote to the task of efficiently matching the right worker to the right vacancy.

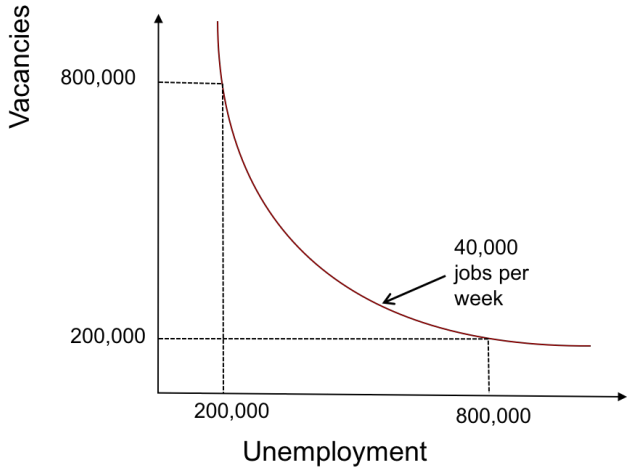


Figure 4: The Beveridge Curve[10]

In neoclassical economics we conceive of the harvesting of a field of wheat as a technology that uses two inputs, labour and capital. To describe the alternative ways that a farmer might choose to harvest his field, we draw a graph in which we plot the input of capital on one axis and the input of labour on the other. Alternative methods for harvesting 40 bushels of wheat are represented by downward sloping curves that we call *isoquants*.

As I have argued elsewhere (Farmer, 2016, pp. 76-78), the search technology is similar to a neo-classical production technology. We can describe alternative ways in which a social planner might choose to move unemployed people into vacant jobs by drawing a graph with unemployment on one axis and vacancies on the other. Alternative methods for filling 40,000 vacant jobs per week can be represented by downward sloping curves that represent the isoquants of the search technology.

This idea is illustrated in Figure 4, which plots the theoretical relationship between vacancies and unemployment implied by search theory. A relationship, similar to this, exists between

[9] In my published research in this area (Farmer, 2008b) (2012a) (2013) I assume that the firm employs L_t workers that may be allocated to production or recruiting. This leads to a modified production function $Y_t = S_t K_t^{\alpha} X_t^{1-\alpha}$, where the firms total labour force L_t is allocated to production X_t and recruiting, V_t.

[10] Source: (Farmer, Prosperity for All: How to Prevent Financial Crises, 2016) page 80.

unemployment and vacancies in empirical data in the UK and in the US. This relationship, called the Beveridge curve, is named after the UK politician William Beveridge.

VII. The Steady-State Indeterminacy of Search Theory

In my book *Prosperity for All* (Farmer, 2016, pp. 76-78) I distinguished the research recognized by the Nobel committee, which I call *Classical Search Theory*, from my own research and that of my students and collaborators, which I call *Keynesian Search Theory*. Both theories must face the issue that search theory does not contain enough relative prices to efficiently allocate resources to competing ends. As a consequence of missing factor markets, search theories are necessarily incomplete.

This section explains *why* search theories are incomplete and it compares the two alternative methods that classical and Keynesian search theories use to resolve the implied indeterminacy of steady-state equilibrium.

Consider first, how a social planner would solve the problem of allocating resources in an economy with search frictions. By allocating employed workers to the activities of production and recruiting, the social planner would pick the point on the Beveridge curve that maximizes the utility of the representative household. When the search technology satisfies the assumption of constant returns-to-scale, we know from the second welfare theorem of economics that it would be possible to decentralize the social planning problem using markets. What would that decentralization look like?

In a decentralized competitive equilibrium, a large number of competitive recruiting firms would purchase, from production firms, the exclusive right to fill their vacancies. They would purchase, from unemployed workers, the exclusive right to find them a job. Both of these inputs to the search technology would have a price. Competitive recruiting firms would match suitable workers to suitable firms and sell the best match to the worker-firm pair. In a competitive equilibrium, the prices of the two inputs and the price of the matched pair, would adjust to implement a socially optimal unemployment rate.

In the real world, we do not see markets for the inputs to the search technology. If these markets did exist, they would be subject to significant moral hazard problems. Why would an unemployed worker accept a job when she is paid to be unemployed? How could she be prevented from selling the exclusive right to match her skills to multiple recruiting firms? Because of the substantial informational asymmetries that characterize the search process, the markets for the inputs to the search technology do not, in practice, exist.

Search theory recognizes that the factor markets for the search technology are missing. It assumes instead that firms randomly meet workers. Because there is no market for the time of a searching worker, the price that should record the marginal cost of that time does not exist. And because there is no market for the cost of the resources that a firm must devote to filling a vacancy, the price that should record the marginal cost of that activity does not exist either. The absence of these price signals causes search theory, except in exceptional circumstances, to generate suboptimal outcomes.

In competitive equilibrium theory we assume that firms and workers take prices and wages as given and we model the process by which prices are set through the adjustment of demand and supply as firms seek higher profits and workers seek higher utility. In search theory, the assumption that firms and workers take wages as given breaks down because there are not enough price signals to direct market participants to the optimal point on the Beveridge

curve. When firms and workers are price takers in a search market, there are fewer equations than unknowns and the resulting competitive equilibrium outcome is indeterminate.

Classical and Keynesian search theories solve the indeterminacy problem in different ways.

Classical Search Theory assumes that firms and workers are not price takers. Instead, when a firm meets a worker, the firm and the worker bargain over the wage. The theory introduces a new parameter, the *bargaining weight*, that splits the surplus of a match between the firm and the worker. It is the bargaining weight that determines *which* point on the Beveridge curve is chosen in a classical search-market equilibrium.

Keynesian Search Theory uses the same conceptual apparatus as Classical Search Theory, but it closes the model by making *beliefs* an independent exogenous determinant of aggregate demand. In Keynesian Search Theory, workers and firms are price takers in the labour market as they are in classical theory. Firms hire enough workers to meet their share of aggregate demand and the real wage and the effective recruiting cost of an extra worker adjust independently to ensure that enough workers are employed to meet the aggregate demand for goods. The effective recruiting cost of an extra worker depends on a variable referred to in the search literature as labour-market tightness. It is labour-market tightness that adjusts in a Keynesian search equilibrium to ensure that each firm makes zero profit in equilibrium.

VIII. The Keynesian Search Model

In Section VIII I situate the Keynesian Search Model in the context of a simple RBC economy and in Sections IX and X, I use this model to answer the following question: If macroeconomists were to adopt the Keynesian Search Model as a micro-foundation to the general theory instead of Samuelson's neo-classical synthesis, what difference would it make?

Recall that the labour-demand equation of the RBC model is represented by Equation (1),

$$(1-\alpha)S_t\left(\frac{K_t}{L_t}\right)^{\alpha} = \frac{w_t}{p_t}, \tag{1}$$

and the labour-supply equation is represented by Equation (2).

$$\frac{\gamma C_t}{1-L_t} = \frac{w_t}{p_t}. \tag{2}$$

In its simplest incarnation, RBC theory combines equations (1) and (2) with an equation that explains how capital evolves through time

$$K_{t+1} = K_t(1-\delta) + S_t K_t^{\alpha} L_t^{1-\alpha} - C_t, \tag{3}$$

and an equation that directs the household on the best way to allocate consumption through time,

$$\frac{1}{C_t} = \beta \mathbb{E}_t\left[\frac{1}{C_{t+1}}\left\{1-\delta+\frac{Y_{t+1}}{K_{t+1}}\right\}\right]. \tag{4}$$

Equation (4), the Euler equation, is named after Leonhard Euler who was an early contributor to the mathematical theory of intertemporal optimization theory.

The parameter δ in equation (3) represents capital depreciation and the symbol $\mathbb{E}_t(\cdot)$ in Equation (4) is the expectations operator with respect to the known probability measure of

the random variables $Y_{t+1}$and C_{t+1}; an interpretation that is implied by the assumption that agents have rational expectations. Equations (1) – (4) determine the evolution of consumption, capital, employment and the real wage as functions of shocks to technology, represented by the variable S_t.

A *solution* to the RBC model is a set of functions, $h(\cdot)$, $g_C(\cdot)$, $g_L(\cdot)$ and $g_\omega(\cdot)$, that determine the evolution of capital, consumption, employment and the real wage as functions of the underlying shock to productivity, S_t.

$$K_{t+1} = h(K_t, S_{t+1}), \qquad C_t = g_C(K_t, S_t), \qquad L_t = g_L(K_t, S_t), \qquad \frac{w_t}{p_t} = g_\omega(K_t, S_t).$$

The solution has the property that, when the variables K_t, S_t, C_t, L_t and w_t/p_t are described by these functions, equations (1) – (4) are satisfied simultaneously.

The variables K_t and S_t are called *state variables* and given a time series process for S_t, the evolutions of these variables are independent of the other variables of the system. The variables, C_t, L_t and w_t/p_t are called *costate variables.* Once the behaviour of capital and productivity are known, the costate variables are fully determined as known functions of the state variables.

According to the textbook interpretation of Keynesian economics, the Great Depression was caused by a fall in aggregate demand that was triggered by a collapse in confidence of investors. The Keynesian remedy for the fall in investment expenditure that followed was for the government to replace private investment expenditure by government purchases.

To assess the plausibility of the Keynesian explanation of the Great Depression consider the following representation of the Keynesian Search Model.

$$Y_t = C_t + I_t + G_t, \tag{K1}$$

$$Y_t = S_t K_t^{\alpha} X_t^{1-\alpha}, \tag{K2}$$

$$K_{t+1} = K_t(1-\delta) + I_t, \tag{K3}$$

$$\frac{1}{C_t} = \beta \mathbb{E}_t \left[\frac{1}{C_{t+1}} \left\{ 1 - \delta + \frac{Y_{t+1}}{K_{t+1}} \right\} \right]. \tag{K4}$$

Equations (K1) – (K4) are four equations in five endogenous variables, Y_t, I_t, K_t, C_t and X_t; the "K" stands for Keynesian. If this was a classical model, it would be closed with the assumption that labour employed to produce commodities, X_t, is equal to aggregate employment, L_t. The model would be completed first, by adding the assumption that the quantity of labour demanded is equal to the quantity of labour supplied, Equations (1) and (2),

$$(1-\alpha) S_t \left(\frac{K_t}{L_t} \right)^{\alpha} = \frac{w_t}{p_t} = \frac{\gamma C_t}{1 - L_t}, \tag{1), (2}$$

and second, by specifying time series processes for the exogenous productivity shock S_t and for the exogenous government expenditure variable, G_t.

My specification of the Keynesian Search Model is similar to the RBC model but I dispense with the labour supply curve and replace it with the assumption that aggregate demand is determined by the self-fulfilling beliefs of market participants. I will explore two ways to do that.

The first way to close the Keynesian Search Model is by assuming that investment is driven by an exogenous process. This assumption is modelled by Equation (K5),

$$I_{t+1} = \rho_I I_t + (1 - \rho_I)\bar{I} + \varepsilon^I_{t+1}. \tag{K5}$$

Here, ε^I_{t+1} a belief shock that has zero mean and persistence ρ_I. $\bar{I}$ is the unconditional mean of investment.

The second way to close the Keynesian Search Model is by assuming that beliefs about the stock market, I call this variable Z^B_t, follows an exogenous stochastic process

$$Z^B_{t+1} = \rho_B Z_t + (1 - \rho_B)\bar{Z}^B + \varepsilon^B_{t+1}. \tag{K6}$$

The stock market is modelled as the discounted present value of future GDP

$$Z_t = Y_t + \mathbb{E}_t\left[\frac{Z_{t+1}}{R_{t+1}}\right], \tag{K7}$$

where, $R_{t+1} = 1 - \delta + Y_{t+1}/K_{t+1}$ is the real interest rate and expectations are assumed to be rational,

$$Z^B_{t+1} = \mathbb{E}_t[Z_{t+1}]. \tag{K8}$$

The variable ε^B_{t+1} in Equation (K6) is a belief shock that has zero mean and persistence ρ_B and $\bar{Z}^B$ is the unconditional mean of the belief about the real value of the stock market.

The two representations of the Keynesian Search Model both contain Equations (K1) – (K4). Version 1 of the model is closed by Equation (K5). In this version, investment is an exogenous state variable. Version 2 of the model is closed by equations (K6) – (K8). In this version, the belief about the future value of the stock market is an exogenous state variable.

IX. Four Experiments in the Keynesian Search Model (Version 1).

In this section I present the results of four experiments in which I study the impact of temporary and permanent shocks to investment and government purchases. In these experiments, I use Version 1 of the Keynesian Search Model as a computational laboratory. The experiments are designed to illustrate the strengths of the model as an explanation of the Great Depression and of the recovery from the Depression that occurred when the US engaged in a massive fiscal expansion at the onset of WWII.

Figure 5 contains two panels. The left panel reports the impulse response functions for a shock to investment. In this panel I set the autocorrelation of investment expenditure to 0.9 and I shocked investment by 5% in period 1. The right panel reports the impulse response functions for a shock to government purchases. In this panel I assumed that government purchases are given by Equation (K9),

$$G_{t+1} = \rho_G G_t + (1 - \rho_G)\bar{G} + \varepsilon^G_{t+1}. \tag{K9}$$

I set the autocorrelation of government expenditure, $\rho_G = 0.9$, and I shocked government consumption purchases by 5% in period 1.

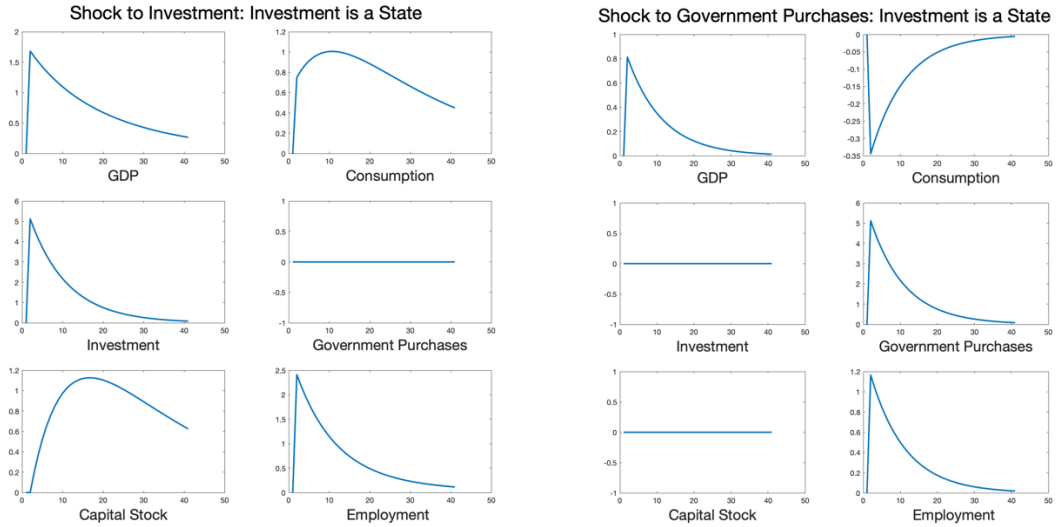


Figure 5: Temporary Shocks to Investment and Government Purchases[11]

Consider the impulse responses to a temporary shock to investment, displayed in the left panel of Figure 5. When $\rho_I = 0.9$, the half-life of a shock to investment is ten quarters. The panel shows that consumption, employment and GDP are all positively correlated with investment.[12] Consumption and capital display a hump-shaped pattern which is characteristic of impulse response functions estimated in U.S. data.[13] Government consumption does not move because it is determined by Equation (9) and I have assumed that there is no feedback from the economy to government consumption.

Next, consider the impulse responses to a temporary shock to government consumption, displayed in the right panel of Figure 5. When $\rho_G = 0.9$, the half-life of a shock to government consumption is ten quarters. The panel shows that employment and GDP are positively correlated with government purchases, but the magnitude of the government purchases multiplier is smaller than the investment multiplier. A 5% shock to investment causes a 2.5% increase in employment. The government consumption purchases multiplier is roughly one half of this and, unlike the investment effect, consumption falls, rather than rises, in response to a government consumption shock. Investment and the capital stock are unaffected by an increase in government purchases.

The responses to a temporary shock to investment are consistent with the US data, some of which I presented in Figures 1 – 3. And the responses to a government purchases shock are consistent with the evidence from WWII where consumption fell even as employment and

[11] The panel reports the returns of GDP, consumption, investment, government purchases, the capital stock and employment in productive activity for forty quarter after the shock. The parameters were calibrated to $\beta = 0.992$, $\delta = 0.04$ and $\alpha = 0.3$.

[12] I have been somewhat cursory in my description of the labour market and in the figures presented in Sections VIII and IX. I have treated employment used in production interchangeably with aggregate employment. In theoretical models of Keynesian search (Farmer, 2012a) (2013) these variables are distinct. For calibrations in which labour turnover is high, as it is in US data, the approximation $L_t = X_t$ is not a bad one. Approximately 12% of US workers change jobs every quarter (Bureau of Labor Statistics , 2019).

[13] (Sims, 1989).

GDP increased.[14] It is perhaps unsurprising that a temporary increase in government consumption expenditure cannot mimic the effects of a temporary increase in private investment expenditure. An investment shock adds to productive capital. A government consumption shock does not.

The experiment I have conducted in Figure 5 highlights an important difference of Keynesian Search Theory from more traditional interpretations of Keynesian economics in which consumption is a function of income. Keynes famously claimed that digging holes and filling them in would be capable of restoring full employment.[15] In the model that he set out in *The General Theory*, the associated stimulus from government consumption was predicted to lead not only to an increase in employment and GDP, but also to an increase in consumption. Because the Keynesian Search Model is closed with a theory in which consumption is a function of wealth rather than income, the prediction that consumption will increase in response to an increase in government purchases fails to hold.

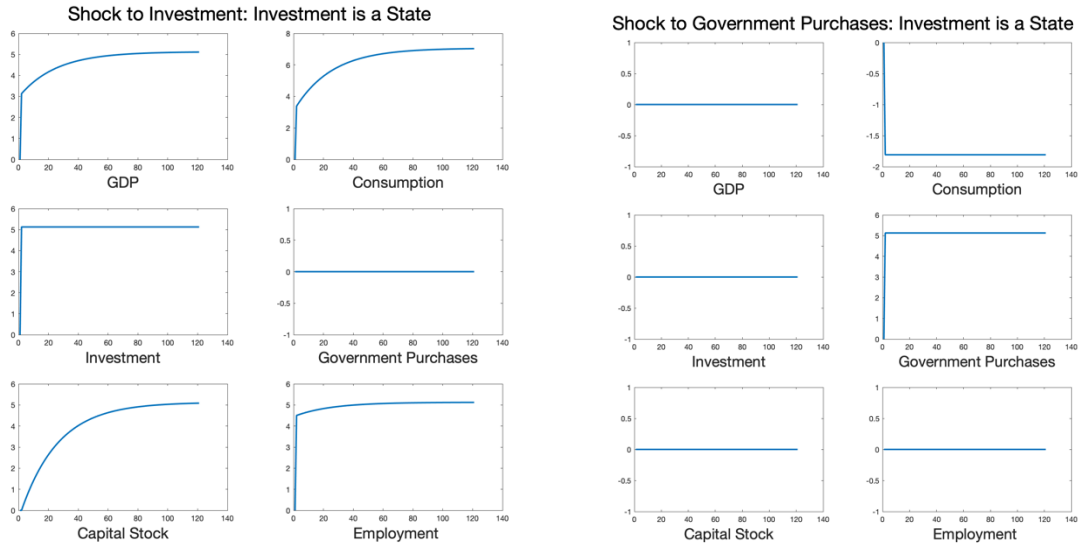


Figure 6: Permanent Shocks to Investment and Government Purchases

How do these predictions change when the shocks generating investment and government purchases are permanent? To answer that question, Figure 6 contains two panels that plot the impulse response functions of GDP, consumption, investment, government consumption, and employment for the cases when ρ_I and ρ_G are equal to 1. For these parameter values, shocks to investment and shocks to government consumption are permanent. Consider first, the impact of a permanent investment shock plotted on the left panel of Figure 6.

This panel shows that, in the Keynesian Search Model, a permanent 5% increase in investment expenditure leads to a 5% permanent increase in GDP, capital and employment that builds up slowly and still has not achieved its full effect after 80 quarters. Employment quickly achieves a new equilibrium, 5% higher than its initial level. Consumption and capital increase more gradually, eventually attaining new steady states where consumption is 7% higher than its initial level and capital is 5% higher.

[14] (Farmer, 2012b, p. 705).

[15] Keynes (1936) Chapter 10, Section VI.

These impulse responses are very different from those that occur in the New Keynesian model and they reflect the fact that the Keynesian Search Theory contains a continuum of steady state equilibria. As long as the economy is operating below full employment, a permanent change in investment will induce a permanent increase in economic activity. If investment is non-stationary, this behaviour will be reflected in the other variables in the model.

On the right panel of Figure 6 I have depicted the impulse response functions for GDP, consumption, investment, capital and employment following a permanent 5% increase in government purchases. This panel shows that a permanent 5% increase in government purchases leads to a permanent reduction in consumption of a little over 1.5% and no change in investment, capital, employment or GDP.[16]

The result that government purchases crowd out consumption may seem counter-intuitive in a Keynesian model. We have come to expect that there is a substantial government expenditure multiplier when the economy is operating at less than full employment. The crowding out result follows from two assumptions. First, in Version 1 of the Keynesian model, investment is exogenous. Second, the assumption of a representative agent implies that the household and the government budget constraints are two sides of the same coin. A permanent increase in government consumption imposes an implicit tax liability on households and, recognizing this liability, households reduce consumption permanently and immediately in the face of a government consumption increase in order to maintain solvency.

It is important to stress that, in the Keynesian Search Model, belief shocks have permanent effects. This feature is very different from the New-Keynesian model in which the economy is characterized by small fluctuations around a social planning optimum. In the Keynesian Search Model, permanent deviations from the optimal unemployment rate can cause large permanent losses to GDP.

X. Two Experiments in the Keynesian Search Model (Version 2).

In this section I explore Version 2 of the Keynesian Search Model which I close by assuming that beliefs about the future value of the stock market are fundamental. I capture that assumption with equations (K6), (K7) and (K8), reproduced below

$$Z^B_{t+1} = \rho_B Z_t + (1-\rho_B)\bar{Z} + \varepsilon^B_{t+1}, \tag{K6}$$

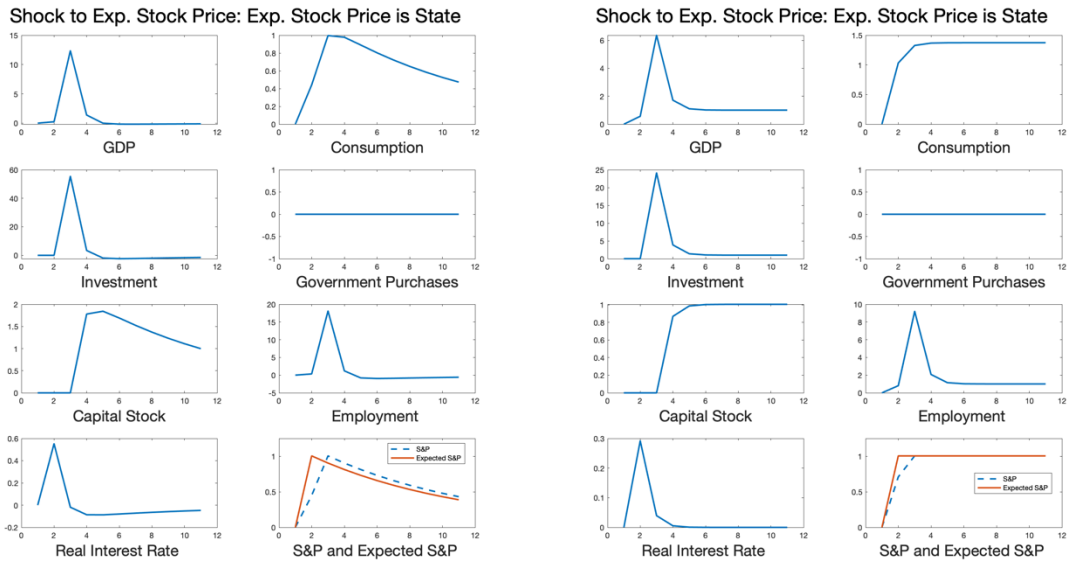
$$Z_t = Y_t + \mathbb{E}_t\left[\frac{Z_{t+1}}{R_{t+1}}\right], \tag{K7}$$

$$Z^B_{t+1} = \mathbb{E}_t[Z_{t+1}]. \tag{K8}$$

Equation (K6) describes the evolution of the belief shock. Equation (K7) defines Z_t to be the expected discounted present value of a claim to future GDP and Equation (K8) imposes the assumption that expectations are rational. I refer to Z_t interchangeably as *the stock market* or as the *S&P* and I refer to Z^B as the *stock-market belief* or the *Expected S&P*.

[16] The relative magnitudes of the permanent percentage changes in consumption and government consumption reflect the fact that private consumption is a larger fraction of GDP than government consumption. The absolute magnitudes of these changes are equal and opposite.

The top three rows of Figure 7 plot the impulse responses of GDP, consumption, investment, government purchases, capital and employment to a stock-market belief shock when the stock-market belief is a state variable. These are the variables we studied in Figure 6 for the model where investment was a state variable. The bottom row of Figure 7 plots the impulse responses of the real interest rate, the stock market and the stock-market belief.



.

Figure 7: Temporary and Permanent Shocks to Beliefs

The left panel of Figure 7 depicts the impulse responses of GDP, consumption, investment, government purchases, the capital stock and employment to a temporary 1% increase in the stock-market belief when $\rho_B = 0.9$. The right panel depicts the impulse responses of these variables to a permanent 1% increase in the stock-market belief.

Consider first, the impact of a temporary belief-shock. The left-panel of Figure 7 shows that GDP, employment and investment spike up and the magnitudes of the effects are substantial and are driven largely, by investment which undergoes a 50% increase. GDP and employment undergo temporary increases of 12% and 16% which subside almost immediately but consumption and the capital stock undergo sustained increases that display substantial persistence as a consequence of the accumulation of capital that arises from the investment boom.

Consider next, the impact of a permanent belief-shock. The right-panel shows that the investment effect of a permanent belief shock is roughly one third of the magnitude of a temporary shock. The impact effects of a permanent belief shock on GDP and employment are also more muted than the impact effect of a temporary shock. Importantly, however, a permanent belief shock has a permanent effect on GDP, employment, investment and the capital stock.

The bottom row of Figure 7 illustrates the impact of a belief shock on the interest rate and the stock market. An observer of these economies would see an investment boom accompanied by an increase in employment consumption and GDP. Using the IS-LM model to interpret these facts, our observer would attribute the increase in employment to a rightward shift of the IS curve, driving up the interest rate and reflected in an increase in asset values.

In Section VIII, I posed the question: If macroeconomists were to adopt the Keynesian Search Model as an alternative micro-foundation to the general theory instead of Samuelson's neo-classical synthesis, what difference would it make?

The first big difference is in the way that econometricians should analyse time-series data. The New-Keynesian model is well described by a stationary vector autoregression in which economic shocks disturb a self-correcting system that returns quickly to a steady state. The Keynesian Search Model is instead described by a Vector Error Correction Model in which permanent shocks to beliefs cause permanent shocks to the paths of consumption, GDP and investment and to the level of the unemployment rate.[17]

The second big difference is in the way policy makers should view their role. The steady state of the New Keynesian model is at or close to a social planning optimum. If that is the case, it is not clear why treasuries or central banks should be concerned with stabilizing recessions. As Friedman argued in his 1968 presidential address (Friedman, 1968), when markets work well, active policy is counterproductive. It does little more than add additional noise. New Keynesian economists have effectively formalized Friedman's theory and by so doing, they have written themselves out of the picture.

If Keynesian Search Theory is a better description of the economy we inhabit, active policy has an important role, not just to stabilize temporary shocks, but to steer the economy to a safe harbour. In response to shocks to beliefs, the Keynesian Search Model displays no tendency for the unemployment rate to return to a social planning optimum. If this is the world we live in, economic stabilization policy has a central role to play in preventing depressions and in maintaining full employment.

XI. Conclusion

What should the reader take away from the analysis in this paper? I have presented an alternative micro-foundation to Keynes' *General Theory* that has very different policy implications for standard interpretations of Keynesian economics than the policy implications implied by New Keynesian economics. These alternative implications stem from two sources.

First, I have argued that a market economy, if left to itself, does not display a self-stabilizing mechanism to restore full employment. This is in contrast to the New-Keynesian interpretation of macroeconomics in which active policy may perhaps speed up the return to full employment, but where business cycles are just minor wrinkles around a social planning optimum.

Second, I have shown how beliefs may be self-fulfilling prophecies and I have provided two mechanisms by which they may operate. It is an important question, as to which of these mechanisms is a more accurate description of the world we inhabit.

If investment is exogenous, the only way to restore the optimal capital stock is through public investment. If stock-market beliefs are exogenous, treasury or central bank intervention in the asset markets, is a more effective means of restoring full employment than fiscal policy. In either scenario, fiscal intervention through increased government consumption will not be effective at maintaining full employment in the face of permanently depressed beliefs about the value of private assets.

[17]This is precisely the behaviour we see in data. King et. al (1991), Beyer and Farmer (2007).

Over the past forty years, macroeconomists have formalized the elegant verbal theory of business cycles described by (Pigou, 1923). While this is a considerable intellectual achievement, it does not bear much relationship to Keynesian economics. The Indeterminacy School has a history that stretches back for more than thirty years. It is my hope that macroeconomists will continue to build upon the ideas developed in this school by recognizing that indeterminacy is not a problem to be sidestepped, but an inherent property of general equilibrium models. Models with indeterminacy provide an elegant and consistent way of providing a foundation to the central ideas of Keynes' General Theory.

References

Andolfatto, D. (1996). Business Cycles and Labor-Market Search. *American Economic Review, 86*(1), 112-132.

Arabaci, O. (2017). Testing for cointegration with threshold effect between unemployment and stock prices. *Appied Economics Letters, 25*(9), 643-647.

Benhabib, J., & Farmer, R. E. (1999). Indeterminacy and sunspots in macroeconomics. In J. T. Woodford, *The Handbook of Macroeconomics* (pp. 387--448). New York: North Holland.

Beningno, G., & Fornaro, L. (2018). Stagnation Traps. *The Review of Economic Dynamics, 85*(3), 1427-1470.

Beyer, A., & Farmer, R. E. (2007). Natural Rate Doubts. *Journal of Economic Dynamics and Control, 31*(121), 797-825.

Bureau of Labor Statistics . (2019, October 9th). *News Release*. Retrieved from BLS: https://www.bls.gov/news.release/pdf/jolts.pdf

Cherrier, B., & Saïdi, A. (2018). The Indeterminate Fate of Sunspots in Economics. *History of Political Economy, 50*(3), 425--481.

De Vroey, M. (2016). *A History of Macroeconomics.* Cambridge: Cambridge University Press.

Farmer, R. E. (1993). *The Macroeconomics of Self-Fulfilling Prophecies.* Cambridge, MA: MIT Press.

Farmer, R. E. (2008a). Old Keynesian Economics. In R. E. Farmer (Ed.), *Macroeconomics in the Small and the Large* (pp. 23-43). Cheltenham, UK: Edward Elgar.

Farmer, R. E. (2008b, March). Aggregate Demand and Supply. *International Journal of Economic Theory, 4*(1), 77-94.

Farmer, R. E. (2010a, April). *How the Economy Works: Confidence, Crashes and Self-fulfilling Prophecies.* New York: Oxford University Press.

Farmer, R. E. (2010b). How to reduce unemployment: A new policy proposal. *Journal of Monetary Economics, 57*, 557-572.

Farmer, R. E. (2012a). Confidence Crashes and Animal Spirits. *Economic Journal, 122*, 155--172.

Farmer, R. E. (2012b). The Stock Market Crash of 2008 Caused the Great Recession: Theory and Evidence. *Journal of Economic Dynamics and Control, 36*, 696--707.

Farmer, R. E. (2013). Animal Spirits, Financial Crises and Persistent Unemployment. *Economic Journal, 123*(568), 317--340.

Farmer, R. E. (2014). The Evolution of Endogenous Business Cycles. *Macroeconomic Dynamics*.

Farmer, R. E. (2015). The Stock Market Crash Really Did Cause the Great Recession. *Oxford Bulletin of Economics and Statistics, 77*(5), 617-633.

Farmer, R. E. (2016). *Prosperity for All: How to Prevent Financial Crises.* New York: Oxford Univesity Press.

Farmer, R. E., & Nicolò, G. (2018). Keynesian Economics without the Phillips Curve. *Journal of Economic Dynamics and Control, 89*, 137--150.

Farmer, R. E., & Nicolò, G. (2019). Some International Evidence for Keyesian Economics without the Philips Curve. *Journal of Economic Dynamics and Control*, In Press.

Farmer, R. E., & Platonov, K. (2019). Animal Spirits in a Monetary Economy. *European Economic Review, 115*, 60--77.

Farmer, R. E., & Plotnikov, D. (2012, April). Does Fiscal Policy Matter? Blinder and Solow Revisited. *Macroeconomic Dynamics, 16*(Supplement 1), 149-166.

Friedman, M. (1968). The Role of Monetary Policy. *American Economic Review, 58*(March), 1-17.

Gelain, P., & Guerrazzi, M. (2010). A DSGE Model from the Old Keynesian Economics: An Empirical Investigation. *Centre for Dynamic Macroeconomic Analysis: WP Series*.

Guerrazzi, M. (2011). Search and stochastic dynamics in the old keynesian economics: A rationale for the Shimer puzzle. *Metroeconomica, 62*(4), 561-586.

Guerrazzi, M. (2012). The "Farmerian" approach to ending finance-induced recession: Notes on stability and dynamics. *Economic Notes, 41*, 81-89.

Hansen, A. (1936). Mr. Keynes on Underemployment Equilibrium. *Journal of Political Economy, 44*(5), 667-686.

Heathcote, J., & Perri, F. (2018). Wealth and Volatility. *The Review of Economic Studies, 85*(4), 2173-2213.

Hicks, J. R. (1937, April). Mr. Keynes and the Classics: A Suggested Interpretation. *Econometrica, 5*(2), 147-159.

Keynes, J. M. (1936). *The General Theory of Employment, Interest and Money.* London and Basingstoke: MacMillan and Co.

King, R. G., Stock, J. C., & Watson, M. (1991). Stochastic trends and economic fluctuations. *American Economic Review, 81*(4), 819-840.

Kocherlakota, N. (2011). Bubbles and Unemployment. *Mimeo: Federal Reserve Bank of Minneapolis*.

Kocherlakota, N. (2012). Incomplete Labor Markets. *Federal Reserve Bank of Minneapolis, mimeo*.

Kydland, F. E., & Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations. *Econometrica, 50*, 1345-1370.

Long, J. B., & Plosser, C. I. (1983). Real Business Cycles. *Journal of Political Economy, 91*(1), 39-69.

Lucas Jr., R. E. (1972). Expectations and the Neutrality of Money. *Journal of Economic Theory, 4*, 103-124.

Merz, M. (1995). Search in the Labor Market and the Real Business Cycle. *Journal of Monetary Economics, 36*, 269-300.

Miao, J., Wang, P., & Xu, L. (2015). Stock market bubbles and unemployment. *Economic Theory, 61*(2), 273-307.

Michaillet, P., & Saez, E. (2015). Aggregate Demand, Idle Time, and Unemployment. *Quarterly Journal of Economics, 130*(2), 507--569.

Pan, W.-F. (2018). Does the stock market really cause unemployment? A cross-country analysis. *The North American Journal of Economics and Finance, 44*, 34-43.

Patinkin, D. (1956). *Money, Interest and Prices: An Integration of Monetary and Value Theory.* Evanston Ill.: Row, Peterson and Co.

Pearce, K. A., & Hoover, K. D. (1995). After the Revolution: Paul Samuelson and the Textbook Keynesian Model. *History of Political Economy, 27*(5), 183-216.

Phelps, E. S. (1970). *Microeconomic Foundations of Employment and Inflation Theory.* (E. S. Phelps, Ed.) New York: Norton.

Pigou, A. C. (1923). *Industrial Fluctuations.* London: McMillan.

Plotnikov, D. (2019). Hysteresis in Unemployment: A Confidence Channel. *International Journal of Economic Theory, 15*(1), 109--127.

Robinson, J. (1978). *Contributions to Modern Economics.* Oxford: Academic Press.

Samuelson, P. A. (1955). *Economics: An Introductory Analysis (3rd Ed.).* McGraw Hill.

Shea, P. (2013). Learning by Doing, Short-sightedness and Indeterminacy. *Economic Journal, 569*(1), 738-763.

Sims, C. A. (1989, May). Models and Their Uses. *American Journal of Agricultural Economics, 71*, 489-494.