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ABSTRACT

This paper uses a model with a continuum of equilibrium unemployment rates to explore the effectiveness of fiscal policy. The existence of multiple steady state unemployment rates is explained by the absence of markets for the inputs to a search technology for matching unemployed workers with vacant jobs. I explain the current financial crisis as a shift to a high unemployment equilibrium, induced by the self-fulfilling beliefs of market participants about asset prices. Using this model, I ask two questions. 1) Can fiscal policy help us out of the crisis? 2) Is there an alternative to fiscal policy that is less costly and more effective? The answer to both questions is yes.

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1 Introduction

As I write this paper, in the spring of 2009, the world is spiralling into what contemporary observers are calling the worst recession since 1930. Robert Reich (April 3rd 2009) has announced: "It's a Depression". The U.S. administration under president Barack Obama has announced a plan to run a budget deficit that could easily exceed 10% of gdp and many, but not all, world leaders are calling for coordinated government deficits across the globe to restore worldwide aggregate demand. These calls for fiscal profligacy have been attacked from both the left and the right.

On the left, Paul Krugman (January 6th 2009) has announced that a US deficit of 10% of gdp is not large enough to restore full employment. He thinks it should be bigger. On the right, Robert Barro (January 22nd 2009) and Eugene Fama (January 13th 2009) have announced that the policy will be ineffective and John Taylor (February 9th 2009) has argued that government is the problem, not the solution. Much of the debate is clouded by the lack of a coherent framework that explains why the free market appears to have failed and how government might possibly correct the problem.

The Obama plan is based on Keynesian economics. Many academic economists gave up on Keynes in the 1970s for two reasons. First, Keynes did not offer a theory of unemployment that is consistent with the established body of microeconomics codified in Walrasian general equilibrium theory. Second, Keynesian economics as laid out in the *General Theory,* is inconsistent with stagflation; the simultaneous occurrence of inflation and unemployment. When stagflation occurred in the 1970s, the response of macroeconomists was to retreat into classical economics and to treat the Great Depression as a special case that was unlikely to occur again. This analysis now seems premature.

In a companion paper, Farmer (2009), I develop a framework that integrates Keynesian and Walrasian economics and explains why the free market may fail to deliver full employment. I argue in that paper that there is a coordination failure in the labor market that arises from what George Akerlof (1970) has called a 'lemons problem'. The inability to distinguish honest from dishonest workers precludes the existence of markets for the inputs to the process of searching for a job. As a consequence, the labor market may get stuck in one of many equilibria each of which is consistent with optimizing behavior on the part of households and firms.

In his introductory textbook, Paul Samuelson (1955) introduced the neo-classical synthesis as a microfoundation to macroeconomics in which the economy is Keynesian in the short-run, because prices are slow to change, but classical in the long-run, once all price adjustments have run their course. In two forthcoming books Farmer (2010a,2010b) and in my (2009) paper, I provide an alternative microfoundation to macroeconomics that is not based on the assumption of sticky prices.

In my work, I attribute the current financial crisis to a loss of confidence in the value of assets that began in the US housing market and was quickly transmitted to worldwide stock markets. The value of worldwide assets has fallen by as much as 40% by some estimates since the inception of the crisis in the fall of 2007. Existing macroeconomic models cannot easily account for these events. The model developed in Farmer (2009,2010a,2010b) can.

In my explanation of the current financial crisis, a drop in confidence caused the economy to move from a low to a high unemployment equilibrium. This new equilibrium is sustainable as a steady state and, if the government does not actively intervene to correct the situation, there will be a permanent loss of output proportional to the size of the contraction that could easily amount to 20% of gdp in perpetuity. In this paper I ask two related questions. First: Can fiscal policy help us out of the crisis? Second: Is there an alternative to fiscal policy that is less costly and more effective? My answer to both questions is: Yes.

2 What's New in This Paper?

To analyze the questions posed in the introduction I construct a simple model that is rich enough to capture the essential features of the current financial crisis. The labor-market theory that underlies my argument is described in Farmer (2009). There, I drop the Walrasian assumption of perfect information and show that, as a consequence, any unemployment rate may be sustained as an equilibrium. The novel element in the current paper is a much richer theory of aggregate demand.

In Farmer (2009), I assumed the existence of a representative agent. As a consequence, fiscal policy is ineffective and cannot be used to restore full employment. In contrast, the population demographics in the current paper are based on work by Olivier Blanchard (1985) who developed a tractable model in which fiscal policy *is* effective.[1] I refer to this as the perpetual youth model since it makes the simplifying assumption that the probability of death is independent of age.

The perpetual youth model captures an important idea in a simple way. Government debt is net wealth to the community because a government transfer to the current population, financed by issuing debt, increases the wealth of current generations at the expense of future generations who incur higher taxes to pay the interest on the debt. This property is in contrast to that of the popular representative agent model that has become the standard vehicle for studying business cycles. In that model, government debt is not net wealth because the single representative agent fully discounts the future tax burden of current transfers.[2]

In the model I develop in this paper, the fact that government debt is net wealth has important consequences for the real interest rate and for employ-

[1] Blanchard's work was extended by Philippe Weil (1989). Their analysis is based on a paper by Menahem Yaari (1965).

[2] This property, dubbed Ricardian Equivalence by Robert Barro (1974), has become the benchmark for most recent macroeconomic models.

ment. If the government makes a transfer to the current population, consumers will spend more on goods and services because the transfer increases the net present value of their labor income. In contrast to Walrasian models, this increase in demand moves the economy to a new equilibrium with less unemployment. In the model I develop here, there are multiple steady state equilibria because of a labor market failure of the kind described in my earlier work.

3 The Details of the Model

In this section I describe the economic environment that underlies my theory of aggregate supply. Much of this is a repeat of the model described in Farmer (2009). Since I take an original and non-standard approach to the labor market I have repeated the main arguments here in some detail. In addition to describing the theory of aggregate supply, this section lays out the assumptions I make about the demographic structure. These assumptions are important and they lay the groundwork for my calculations of the potency of the short-run and long-run effects of fiscal policy.

3.1 Demographics

I begin with a description of the population structure. I assume that there are many generations alive at the same time. Each generation has a different consumption pattern which depends on its date of birth. But although there is heterogeneity at the individual level, two assumptions make aggregation possible. First, each generation has logarithmic preferences and hence their consumption is linear in wealth. Second, all agents have the same probability of death and hence there is a single concept of human wealth.[3]

[3] These two insights are drawn from Blanchard (1985), who studied a similar model in continuous time.

These two assumptions allow me to derive a set of equations in aggregate variables that describes the properties of an equilibrium. These equations are similar to those of the representative agent economy; but the representative agent's Euler equation is replaced by an aggregate consumption equation in which income and wealth affect steady-state consumption.

Each household discounts the future with discount factor β. It survives into the subsequent period with probability π. Every period a measure $(1-\pi)$ of households dies and a measure $(1-\pi)$ of new households is created. These assumptions imply that the population is fixed: I normalize its size to 1. There is no bequest motive, no population growth and no uncertainty although these features can be added at the cost of a little extra algebra.

3.2 Technology and the Planner

I will use a model of production that is explained fully in Farmer (2009). Here I provide a quick summary of the main ideas, beginning with the decisions that would be made by a social planner whose goal was to maximize consumer welfare.

There are two technologies, one for producing goods from labor and capital and one for moving workers from home to work. The manufacturing technology is represented by the constant-returns Cobb-Douglas function

$$\bar{z}_t = \bar{K}_t^{\alpha} \bar{X}_t^{1-\alpha}. \tag{1}$$

A bar over a variable denotes an economy-wide aggregate. Here, $\bar{z}_t$ is output in physical units of the produced commodity, $\bar{K}_t$ is the number of units of capital allocated to the production of commodities and $\bar{X}_t$ is the number of workers allocated to the task of producing goods.

I use the symbols $\bar{z}_t$, $\bar{c}_t$ and $\bar{g}_t$ to represent aggregate production, consumption and government purchases measured in physical units and $\bar{Z}_t$, $\bar{C}_t$

and $\bar{G}_t$ to represent their dollar values. Thus,

$$\bar{z}_t = \bar{c}_t + \bar{g}_t, \tag{2}$$

$$\bar{Z}_t = \bar{C}_t + \bar{G}_t, \tag{3}$$

and

$$\bar{Z}_t = p_t \bar{z}_t, \quad \bar{C}_t = p_t \bar{c}_t, \quad \bar{G}_t = p_t \bar{g}_t. \tag{4}$$

p_t is the dollar price of commodities. I use $\bar{L}_t$ to represent aggregate employment. $\bar{X}_t$ workers are assigned to producing goods and the remaining $\bar{V}_t$ are assigned to the task of searching for new workers. Hence,

$$\bar{L}_t = \bar{X}_t + \bar{V}_t. \tag{5}$$

The search technology is represented by the constant returns-to-scale Cobb-Douglas function

$$\bar{L}_t = \bar{H}_t^{1/2} \bar{V}_t^{1/2}. \tag{6}$$

Here, $\bar{H}_t$ is the measure of workers looking for a job in the economy as a whole.

The model is simplified by making the assumption that the entire labor force is fired and rehired every period. This strong assumption allows me to ignore the dynamics of labor adjustment whilst retaining the important idea that there is a labor market failure that leads to multiple labor market equilibria. I assume that households do not value leisure. This assumption implies

$$\bar{H}_t = 1. \tag{7}$$

This is true in both the social planning optimum and in the decentralized equilibrium concept that I define in Section 5. Putting together these equations, it follows that a social planner faces the technology

$$\bar{z}_t = \bar{K}_t^{\alpha} \bar{L}_t^{1-\alpha} \left(1 - \bar{L}_t\right)^{1-\alpha}. \tag{8}$$

Since the economy contains one unit of non-reproducible capital and one unit of labor, the social planner would choose

$$\bar{L}_t = 1/2, \tag{9}$$

to maximize consumer welfare. The natural rate of unemployment in this economy (defined as the solution to the social planning problem) is 50%.[4]

3.3 Production Firms

There are unit measures of each of two types of firms: production firms and financial services firms. Each production firm solves the following problem,

$$\max_{\{K_t, L_t, X_t, V_t\}} p_t K_t^{\alpha} X_t^{1-\alpha} - w_t L_t - r r_t K_t, \tag{10}$$

subject to,

$$L_t = X_t + V_t, \tag{11}$$

$$L_t = q_t V_t. \tag{12}$$

The firm chooses how much capital to rent, K_t, how many workers to hire, L_t, and how many of these workers to allocate to the production department, X_t, and the recruiting department, V_t. The absence of a bar over a variable denotes that it is associated with an individual firm. I consider symmetric equilibria for which $\bar{x}_t = x_t$ for any variable x_t by integrating over the measure of firms.

[4] This is not Friedman's (1968) definition which is ambiguous in a model of multiple equilibria. See the discussion in Farmer (2009, Page 7). The fact that the natural rate is so high follows from the assumption that the entire labor force is rehired in every period. I have retained this assumption since it simplifies my exposition.

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 $w_t = 1$.

The variable q_t which appears in Equation (12) is taken parametrically by each firm. It 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.[5] Substituting Equations (11) and (12) into (10) and defining

$$\Theta_t = (1 - 1/q_t), \tag{13}$$

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

$$\Pi_t = Z_t - L_t - rr_t K_t, \tag{14}$$

where

$$Z_t = p_t \Theta_t^{1-\alpha} K_t^{\alpha} L_t^{1-\alpha}. \tag{15}$$

is the dollar value of output.

Equation (13) is essential to understanding what is different about this model from a Walrasian model with a spot market for labor. It represents an externality to the firm but is determined, in equilibrium, by aggregate labor market conditions. In Section 5 I show that in a demand constrained equilibrium, Θ_t is determined by the equation

$$\Theta_t = \left(1 - \bar{L}_t\right), \tag{16}$$

where the bar denotes aggregate labor. The appearance of this term for aggregate employment in the production function of an individual firm explains

[5] Pissarides (2000).

the existence of Pareto inefficient equilibria. Individual firms do not take account of their influence on the aggregate labor market when they make their decision to allocate workers to the recruiting department. The presence of this externality invalidates the first welfare theorem of competitive equilibrium which provides the conditions under which competitive equilibria are socially optimal.

The profit maximizing firms will choose,

$$\alpha Z_t = rr_t K_t, \tag{17}$$

and

$$Z_t = \frac{1}{(1-\alpha)} L_t, \tag{18}$$

where Z_t is measured in wage units since I have normalized w_t to 1. Equations (17) and (18) are identical to the first order conditions that would hold in a competitive model with an auction market for labor. However, Equation (18) has a very different interpretation in this economy in which the labor market is cleared by search. I will use this equation to determine employment for any given value of aggregate demand.

3.4 Financial Service Firms

The second type of firm in this economy provides financial services. Financial services firms hold two types of assets: Capital and government debt. They finance their acquisition of these assets by issuing financial contracts to households. These contracts provide a claim to the assets of the firms and, in addition, they insure the households against mortality risk. They are described below.

There is free entry into the financial services industry. A financial services company may purchases assets and issue liabilities. Consider a company that purchases K_{t+1} units of capital and B_{t+1} pure discount bonds, issued by the government. Let capital sell for price $p_{k,t}$ and let Q_τ^t be the price at date τ

of a security that promises to pay one unit of account at date t. A special case is a pure discount bond that sells for price Q_t^{t+1}.

The financial services company sells a contract to the household for price $p_{H,t}$. It promises to pay the household one unit of account at date $t+1$ if and only if the household survives. How are the prices $p_{k,t}$, Q_t^{t+1} and $p_{H,t}$ related to each other?

The assumption of no riskless arbitrage opportunities implies the following two equations,

$$\left(\frac{p_{k,t+1} + rr_{t+1}}{p_{k,t}}\right) = \frac{1}{Q_t^{t+1}} \equiv R_t, \tag{19}$$

$$p_{H,t} = \pi Q_t^{t+1}. \tag{20}$$

The term R_t is the gross real interest rate on government debt. Equation (19) asserts that the return to capital must equal the return to government debt in an economy with no aggregate risk. Equation (20) asserts that the household will pay price πQ_t^{t+1} for a security that pays one dollar in period $t+1$ contingent on being alive. The factor π reflects an annuity discount that is offered by competitive financial service firms as a consequence of the no arbitrage assumption.

3.5 Government

The government faces the following sequence of constraints,

$$Q_t^{t+1} B_{t+1} = B_t + G_t - T_t, \quad t = \tau, ... \tag{21}$$

together with the no-Ponzi scheme condition

$$\lim_{T \to \infty} Q_\tau^T B_T \leq 0. \tag{22}$$

Equation (21) can also be written using the gross interest factor, R_t instead of the price of a discount bond;

$$B_{t+1} = R_t \left(B_t + G_t - T_t \right), \quad t = \tau, ...$$

These conditions can be combined to impose the following single infinite-horizon constraint on government choices,

$$\sum_{t=\tau}^{\infty} \left[Q_\tau^t G_t \right] + B_\tau \leq \sum_{t=\tau}^{\infty} Q_\tau^t T_t. \tag{23}$$

A feasible government policy is a sequence $\{B_{t+1}, T_t, G_t\}_{t=\tau}^{\infty}$ that satisfies (23). I assume that the government picks a feasible policy and I will study how that policy affects employment and the interest rate in equilibrium.

4 The Model Summarized

I am now ready to put together the pieces of a complete general equilibrium model of the economy. These pieces are represented by five equations that describe the behavior of five endogenous variables: Consumption, gdp, the interest rate, government debt and employment. This section summarizes each of them.

4.1 Equation 1: Consumption

The aggregate consumption equation (derived in Appendix A) has two compound parameters, $\tilde{\beta}$ and $\tilde{\alpha}$. They are functions of the discount factor β and the survival probability, π,

$$\tilde{\beta} = \frac{1 - \pi \left(1 - \beta\pi\right)}{\pi^2}, \quad \tilde{\alpha} = \frac{\left(1 - \beta\pi\right)\left(1 - \pi\right)}{1 - \pi\left(1 - \beta\pi\right)}. \tag{24}$$

Using: 1) the assumption that each household consumes a fixed fraction of wealth and 2) the fact that human wealth is independent of age; one can derive the following expression, in consumption, the interest factor, gdp, the price of capital, government debt, and the lump sum tax, T_t.

$$C_t = \frac{1}{R_t \tilde{\beta}} C_{t+1} + \tilde{\alpha} \left(Z_t + p_{k,t} + B_t - T_t \right). \tag{25}$$

In the special case when the population is fixed, ($\pi = 1$), the model collapses to a representative agent economy and Equation (25) reduces to the consumption Euler equation of the representative household. When $0 < \pi < 1$, aggregate consumption depends not only on expected future consumption but also on income and wealth with a coefficient $\tilde{\alpha}$.

4.2 Equation 2: The Interest Rate

The second equation of the model follows from combining Equation (17) with (19).

$$R_{t-1} = \left(\frac{p_{k,t} + \alpha Z_t}{p_{k,t-1}} \right). \tag{26}$$

The left side of this expression is the gross real return to debt held between periods $t-1$ and t. The right side is the gross return to buying a unit of capital for price $p_{k,t-1}$ at date $t-1$. Since capital does not depreciate in this model it can be sold for price $p_{k,t}$ and it earns a rental return of αZ_t where proportionality follows from the assumption of a Cobb-Douglas technology.

4.3 Equation 3: The Government Budget Constraint

The third equation is the government budget constraint;

$$B_{t+1} = R_t \left(B_t + G_t - T_t \right). \tag{27}$$

I will assume that government chooses a sequence $\{G_t, B_t\}_\tau^\infty$ and that taxes are chosen to ensure that

$$\sum_{t=\tau}^{\infty} \left[Q_\tau^t G_t\right] + B_\tau \leq \sum_{t=\tau}^{\infty} Q_\tau^t T_t.$$

4.4 Equation 4: The Gdp Accounting Identity

Equation four is the gdp accounting identity,

$$Z_t = C_t + G_t. \tag{28}$$

Z_t, C_t and G_t are all denominated in dollars. Since I have chosen labor to be the numeraire, this is equivalent to measuring all variables in wage units.

4.5 Equation 5: The Aggregate Supply Curve

The final equation is the first order condition for choice of labor,

$$Z_t = \frac{1}{1-\alpha} L_t. \tag{29}$$

Since the money wage is equal to 1, (labor is the numeraire), this equation describes the employment L_t needed to meet any level of demand Z_t when Z_t is measured in wage units. I refer to this equation as the Aggregate Supply Curve.

4.6 Comparison with the Walrasian Model

Equations (25) – (29) completely characterize the behavior of the aggregate variables of the model. How do they interact to determine the time paths of employment, gdp and prices? In the Walrasian model, prices and quantities are endogenous variables. They are completely determined by assumptions about preferences, technology and endowments.

The model of this paper is different because there are missing markets for the inputs to the search technology. Because these markets are missing, there are not enough relative prices to convey information to market participants about whether to fill vacant jobs with a large pool of unemployed workers and a few corporate recruiters or a large number of recruiters and a small pool of unemployed. The fact that there are missing markets implies that there are fewer equations than unknowns to determine the steady state unemployment rate. It is this fact that allows me to introduce self-fulfilling beliefs about the value of assets to close the model and determine the unemployment rate in a steady state equilibrium.

5 A Definition of Equilibrium

This section presents a formal definition of equilibrium and compares the model in this paper with the representative agent version described in my earlier work, Farmer (2009). To close the model I will assume, as did Keynes, that the state of long term expectations is an exogenous variable that determines beliefs about asset prices. I begin by providing a definition of beliefs that are consistent with equilibrium and by summarizing the set of possible fiscal policies.

5.1 Some Definitions

Consider first, the set of beliefs.

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

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

for all t*.*

In Farmer (2009,2010b) I derive an explicit value for the upper bound b as a function of the parameters of the model and I show that an equilibrium, of the kind I define below, exists for all bounded asset price sequences. That paper did not introduce government policy which I define below.

Definition 2 (Fiscal Policy) *A fiscal policy is a non-negative sequence* $\{G_t, B_t, T_t\}_{t=\tau}^{\infty}$ *and an initial debt level* B_τ. *If there exists a fiscal policy such that the inequality*

$$\sum_{t=\tau}^{\infty} Q_\tau^t G_t + B_\tau \leq \sum_{t=\tau}^{\infty} Q_\tau^t T_t \leq \sum_{t=\tau}^{\infty} Q_\tau^t Z_t, \tag{30}$$

is satisfied then the fiscal policy is said to be feasible for price sequence $\{Q_\tau^t\}_{t=\tau}^{\infty}$.

The right side of (30) is the net present value of gdp which puts an upper bound on the net present value of the government sector and bounds feasible taxation and expenditure plans. This upper bound would occur when the government is taking 100% of gdp in taxes to pay interest on the national debt. In practice, this bound is likely to be much more restrictive as high taxes have negative incentive effects on labor force participation that I have ignored.

Given these definitions, an equilibrium is a set of feasible values of the endogenous variables that is consistent with the behavioral assumptions of the model and with market clearing in every period. This can be summarized as follows.

Definition 3 (Demand Constrained Equilibrium) *A demand constrained equilibrium is a state of expectations,* $\{p_{k,t}\}_{t=\tau}^{\infty}$, *a feasible fiscal policy* $\{B_\tau, \{G_t, B_t, T_t\}_{t=\tau}^{\infty}\}$ *and a sequence of prices and quantities* $\{C_t, Z_t, R_t, L_t\}_{t=\tau}^{\infty}$ *such that Equations (25), (26), (27), (28) and (29) are satisfied.*

This definition deserves further explanation. With the exception of aggregate supply, Equation (29), these equations could equally well describe a

Walrasian economy. The other four equations determine sequences of consumption, government expenditure, government debt and taxes measured in dollars. If one were to assume a Walrasian labor market with inelastic labor supply, the model would be closed with two equations:

$$Z_t = \frac{1}{1-\alpha} w_t L_t. \tag{31}$$

$$L_t = 1. \tag{32}$$

Given that government policy is measured in dollars, these equations would determine employment and the money wage. The assumption of an exogenous sequence of asset prices, $\{p_{k,t}\}_{t=\tau}^{\infty}$ would define the value of the unit of the account.

In the model of this paper, Equations (31) and (32) are replaced by (33) and (34),

$$Z_t = \frac{1}{1-\alpha} L_t, \tag{33}$$

$$w_t = 1. \tag{34}$$

Now the unit of account is fixed by the assumption that the money wage equals 1 and the beliefs $\{p_{k,t}\}_{t=\tau}^{\infty}$ are beliefs about the real value of capital. Variations in the value of aggregate demand, measured now in wage units, pick out different values of employment and different demand constrained equilibria.

5.2 Steady State Equilibria

In later analysis I will focus on *steady state* equilibria by assuming that households form constant sequences of beliefs about the values of asset prices. Since there are no intrinsic dynamics in the model, the economy can jump from one steady state equilibrium to another. I will model the recent financial crisis as a drop in p_k from a high to a low value and I will assume that this fall was unanticipated.

Imposing the assumption that all variables are time independent leads to the following five equations that must hold in a steady state equilibrium

$$C\left(1-\frac{1}{R\tilde{\beta}}\right)=\tilde{\alpha}\left(p_k+B+Z-T\right), \tag{35}$$

$$Z=\frac{p_k}{\alpha}\left(R-1\right), \tag{36}$$

$$B-T=\frac{B}{R}-G, \tag{37}$$

$$Z=C+G, \tag{38}$$

$$Z=\frac{1}{1-\alpha}L. \tag{39}$$

The state of long term expectations is captured by the self-fulfilling belief that the stock market price will equal p_k. Taking p_k as given and given a feasible fiscal policy $\{B,G,T\}$, this system describes five equations in the five unknowns R, Z, C, L and T.

5.3 Comparison with the Representative Agent Model

Equation (35) is a relationship between the real interest factor, steady state consumption and wealth. In a representative agent model, the parameter $\tilde{\alpha}$ on the right side of this equation is equal to zero and the parameter $\tilde{\beta}$ is equal to β, the discount factor: For this special case, the equation states that the steady state real interest rate is equal to the discount factor of the representative agent.

One might expect that as π gets closer to 1, the model would behave more and more like the representative agent model. One might think that the influence of government debt on the steady state would become very small. But although $\tilde{a}$ may be tiny for realistic parameter values, fiscal policy may still have a non negligible effect.

How much will consumption increase for a given increase in government debt? The answer depends not on $\tilde{\alpha}$, but on the ratio

$$\frac{\tilde{\alpha}}{\left(1 - \frac{1}{R\tilde{\beta}}\right)}.$$

For values of R close to $\tilde{\beta}$, this ratio may be substantial even though $\tilde{\alpha}$ is very small. Even if π is close to one, the current generation can still gain at the expense of all future generations by increasing government debt. Debt raised by the current generation will generate a stream of interest payments that must be paid by all future generations. But since there is always a very large number of future households relative to those alive today, debt may represent substantial net wealth to the community even as lives become very long.

6 Analysis of the Crisis

In this section I will use the model I have constructed to study the effects of fiscal policy in an economy that has experienced a recession induced by what I refer to as a *self-fulfilling loss of confidence*. First, I develop a diagram that is similar to the IS-LM diagram used by generations of students to understand Keynesian economics. Second, I discuss the difference between short-run and long-run multipliers and provide a quantitative assessment of alternative fiscal policies in the short-run. Finally, I use the diagram developed in this section to analyze the long-run effects of fiscal policy in a calibrated model.

6.1 A Diagram to Study Equilibria

To facilitate the description and analysis of the steady state of the model, consider the function $g : \left(\frac{1}{\tilde{\beta}}, \infty\right) \rightarrow R^{+}$,

$$g\left(R\right) = \frac{1}{\left(1 - \frac{1}{R\tilde{\beta}}\right)}. \tag{40}$$

This function is decreasing on $\left(\frac{1}{\tilde{\beta}}, \infty\right)$ and has the property that $g \rightarrow 1$ as $R \rightarrow \infty$.

Using this definition, one can rearrange Equations (35) – (38) to give the following two expressions

$$\text{IS Curve:} \quad Z = \frac{\tilde{\alpha} g\left(R\right)}{1 - \tilde{\alpha} g\left(R\right)} \left(p_k + \frac{B}{R}\right) + G, \tag{41}$$

and,

$$\text{IR Curve:} \quad Z = \frac{p_k\left(R - 1\right)}{\alpha}. \tag{42}$$

The following discussion is phrased in the context of a diagram, similar to the IS-LM diagram that was used for decades to study Keynesian economics. But although this diagram is similar; it is original and different from the IS-LM diagram in several key respects. First, the model that I have built in this paper is purely real: There is no money other than as a unit of account. Second, it is a two-good model and the existence of a separate capital good with its own relative price is essential to my analysis of the current financial crisis. Third, the IS-IR diagram describes relationships between the interest rate and gdp in a perfect foresight steady state equilibrium. In contrast, the IS-LM diagram describes a monetary economy in temporary equilibrium and it can be derived from one-good model.

Figure 1 plots the IS curve and the IR curve, for different government policies and different values of the state of expectations. I have calibrated

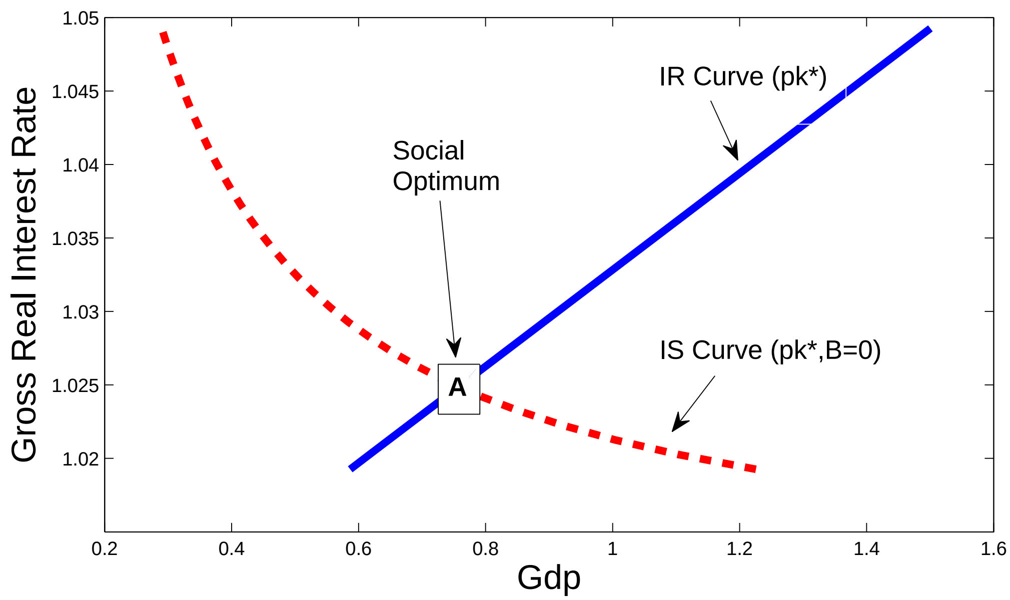

Figure 1: Steady State Equilibrium

the model to have a discount factor of 0.97, a survival probability of 0.98 and labor's share of gdp to equal 0.66. For these parameters the expected lifespan is fifty years. Because I assume that workers are fired every period, the social planner would choose $L^* = 0.5$. This implies $Z^* = 0.76$, a riskless interest rate of 2.5% and a value of p_k^* of 10.3. I have drawn the figure for zero government spending, zero debt and a state of expectations, p_k^*, that supports the social optimum.

The IS curve, Equation (41), is a relationship between the real interest factor (one plus the real interest rate) and the steady state value of gdp measured in wage units. It is the same curve that was first defined by John Hicks (1937) although the interpretation is slightly different.[6] The position

[6] In the original work of Hicks, the IS curve describes a temporary equilibrium: He did not impose perfect foresight. It slopes down because investment falls as the interest rate increases. My model has no investment and the IS curve slopes down because steady state consumption falls as the rate of interest increases.

of the IS curve on Figure 1 depends on the relative price of capital, p_k, and on government policy, G and B.

The IR curve, Equation (42), is new to this paper. It is an upward sloping relationship between gdp and the real interest factor that only makes sense in a model with more than one good. The IR curve slopes up because the return to government debt must equal the return to capital. If agents believe that the capital good is worth more, the steady state return to capital, given by the expression

$$1 + \alpha \frac{Z}{p_k}, \tag{43}$$

will fall for a given value of gdp. The IR curve plots values of Z and R for which the return to capital and the real return to government debt are the same.

In Section 6.3 I will report the results of a computational experiment in which I ask two questions. 1) What happens to gdp and employment if p_k falls by 50%? 2) Can fiscal policy restore full employment?

6.2 The Short Run and the Long Run

It is important to be clear about the nature of the experiment I will conduct. Suppose that market participants lose confidence in the value of assets and they revise downwards their valuations of the stock market by 50%. This experiment reflects the magnitude of the drop in the value of stocks that occurred during the early years of the Great Depression and it is 10% larger than the 40% fall in asset valuations that occurred in the fall of 2008. The assumption that the market does not recover is extreme. But it is an appropriate assumption to make since, in the model, there is no connection between self-fulfilling expectations and fiscal policy. Any recovery in expectations will help the situation but will not occur as a consequence of fiscal policy.

The experiment I will conduct asks if fiscal policy can help the economy to recover from the effects of a sustained drop in confidence that lasts forever. This is distinct from the question of whether there is a temporary fix to restore full employment either through borrowing or through a tax financed expenditure increase. The answer to this second question is yes and, although I will address the details of the answer in a separate paper, a few points are worth mentioning here.

Consider first, the effect of a balanced budget policy that pays for increased government expenditure through higher taxes. A policy of this kind can be sustained forever and, since the increased expenditure does not increase debt, the long-run and short-run effects are the same. In terms of Figure 1, a balanced budget fiscal expansion shifts the IS curve to the right by one dollar for every one dollar increase in government purchases. Since the IR curve slopes up, the short-run multiplier will be less than one and, in a model calibrated in the way that I describe below, it is equal to 0.62 at the full employment steady state.[7]

The short-run balanced budget multiplier in this model is less than one because a fiscal expansion drives up the real interest rate and every dollar of government expenditure crowds out 38 cents of private consumption expenditure. A multiplier of 0.62 is substantially larger than the long-run multipliers reported below for debt financed expenditure and a balanced budget fiscal expansion certainly increases employment. But does it increase welfare? That depends on whether the public goods provided by government more than offset the welfare loss from the reduced consumption crowded out by an increase in the interest rate. I personally find this unlikely although it is certainly possible to differ on the answer to this question depending on ones views as to the relative merits of public versus private provision of goods.[8]

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[7] I have computed this number by taking the baseline calibration from Section 6.3 and computing the linearized slopes of IS and IR curves around the full employment steady state.

[8] My analysis also assumes the possibility of non-distortionary taxation. Dropping this assumption would make a tax financed expenditure increase even less attractive.

Consider next the short-run effects of an expansion in government expenditure financed by borrowing. In this case one can show that the short-run multiplier is larger than one just as standard Keynesian models predict. Equation (45) can be used to calculate the multiplier in this case.[9]

$$Z_t = G_t + \frac{1}{(1-\tilde{\alpha}) R\beta} Z + \frac{\tilde{\alpha}}{1-\tilde{\alpha}} \left(p_k + \frac{B}{R} \right). \tag{45}$$

This expression assumes that government expenditure is positive in period t and that it falls back to zero in subsequent periods.

The fiscal expansion at date t has a direct effect on aggregate demand through G_t and an indirect wealth effect that enters through the term B/R. This term represents government debt, raised to pay for government purchases in period t. As I will argue in the next section, the indirect effect of a debt financed increase in government expenditure is likely to be very small and hence the debt-financed short run multiplier will be larger than 1; but not by much. It is considered to be net wealth by the current generation since they do not fully amortize the future taxes that must be raised to finance this debt. The multiplier is larger than one for a debt financed increase in government purchases because the government commits itself to make a permanent transfer of resources from the as yet unborn generations to the current generation by a permanent increase in taxes.

To summarize, the short-run balanced budget multiplier is equal to 0.62 when the economy is at full employment and the deficit financed multiplier is a littler larger than 1. It follows that a debt-financed increase in government expenditure will help to restore full employment and may even increase

[9] To arrive at this expression I have combined Equations (25), (27) and (28) and I have replaced Z_{t+1}, G_{t+1},R_t and B_{t+1} by their long-run values, Z, 0 and R. Although G_t, B_t and Z_t may be different in period t from their new long-run steady state, R_t moves immediately to its long-run value since it is determined from the IR curve which I represent as,

$$R_t = 1 + \frac{\alpha Z_{t+1}}{p_k} = 1 + \frac{\alpha Z}{p_k}. \tag{44}$$

welfare for the existing generations. But what is the cost? In the following section I move beyond the short-run question to ask if a debt financed increase in government purchases can help us out long-term. The answer I will give is that a policy of this kind can move the economy towards full employment but probably not get us all the way there given realistic assumptions about long-run (as opposed to short-run) multipliers. Further, I will argue that a debt financed fiscal expansion is very costly to future generations.

6.3 A Computational Experiment

Figure 2 illustrates the results of a computational experiment in which debt is used to finance a temporary increase in government purchases. All of the curves on this graph are drawn for government purchases of zero in the steady state.

Point A is at the intersection of IS and IR curves that are plotted for beliefs p_k^* that support the social optimum. Government debt is equal to 0. The model is calibrated to the same parameter values as Figure 1.[10]

Point B illustrates the effect on the interest rate and gdp of a drop in beliefs about the value of capital from p_k^* to $p_k^*/2$. I intend this to represent a drop of 50% in the value of the stock market that is expected to persist for ever. Its effect is to cause a 50% fall in equilibrium gdp and employment and to leave the real interest rate unchanged. Can fiscal policy move the economy back towards the social optimum?

Point C on this graph represents the long-run effect of a one time government purchase that increases government debt to 13 times full employment gdp. This is a huge fiscal expansion, far larger than anything currently contemplated. It is important to recognize that this experiment assumes that households remain pessimistic and that the value of the stock market stays at 50% of its full employment value. Under this assumption, this massive

[10] I have posted the matlab code used to generate these graphs on my website at http://farmer.sscnet.ucla.edu.

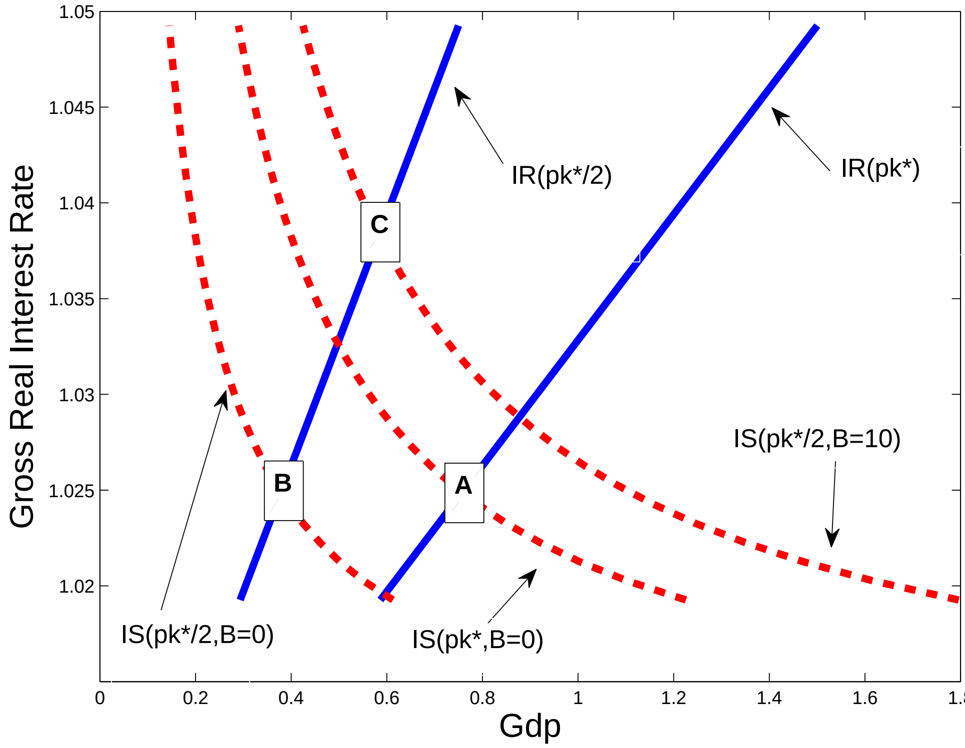

Figure 2: Fiscal Policy

stimulus moves the economy from 0.38 to 0.58, or 77% of full employment gdp. This is roughly half the way back towards full employment. The stimulus also raises the risk free interest rate from 2.5% to 3.8%. This leaves a tax burden on future generations of approximately $13 \times .038$ or 49% of full employment gdp. Is it worth doing? Is there a better policy? It turns out that, in this model, the answer to the first question depends on whether you are alive or yet to be born. The answer to the second question is yes.

Consider the welfare of an as yet unborn household. If this household could vote for the fiscal stimulus plan it would unequivocally reject it. Let x represent full employment gdp. Of this, 0.66 represents annual household pretax labor income at the social optimum. The net present value of this flow to a new-born household is $0.66x/.025$, where .025 is the interest rate at the social optimum. As a consequence of pessimistic expectations, in the absence of a fiscal stimulus, the household receives only half of this amount.

Its wealth, without a stimulus, call this W^{NS} is given by,

$$W^{NS} = \frac{(0.5 \times 0.66)\, x}{.025}. \tag{46}$$

If the proposed stimulus plan is enacted, the interest rate will increase to 3.8%, and gdp will increase from $0.5x$ to $0.77x$, reflecting the fact the stimulus moved the economy approximately half of the way back towards the social optimum of x. But the additional income generated by the stimulus will be discounted by 3.8% instead of 2.5% and half of it will go to pay taxes on the debt that is owned by the existing generations. The wealth of a new-born household under the stimulus plan, call this W^S is

$$W^S = \frac{(0.77 \times 0.66)\, x}{.038} - 13x. \tag{47}$$

The first term in Equation (47) is the net present value of the income flow of a new-born household if the plan is enacted. The second term is the present value of a tax flow to finance a stimulus plan equal to 13 times full employment gdp. Since, W^{NS} and the first term of W^S are approximately equal,

$$W^{NS} - W^S \simeq 13x, \tag{48}$$

and it follows that the unborn households in this economy would be better off by a factor of approximately 13 times full employment gdp without the stimulus. This is half the value of their human wealth at the social optimum which is equal, under these assumptions, to $0.66x/.025$ or approximately 26 times full employment gdp.

The calculation for existing generations is different. Assuming that the debt is used to buy perishable commodities that are valued by current generations, the increased tax burden on the current population is offset by the benefit of the government purchases paid for by the expansion in debt. Their wealth moves from a flow of $0.5x$ discounted at 2.5% without the stimulus to $0.77x$ discounted by 3.8% with the stimulus. This represents a net gain from the stimulus of roughly 1/2 of 1% of full employment gdp. To the extent that the goods purchased by the government are durable, the new-born individuals will also benefit from these public goods and the cost to them of the stimulus package will be lower than these calculations suggest.

To summarize, under the assumptions of my calibration, a fiscal stimulus of 13 times gdp would be needed to sustain a move of the economy half way towards full employment. This plan would increase the welfare of current generations by approximately half of 1% of full employment gdp and it would impose a cost on all generations of 13 times full employment gdp. To the extent that different generations share in the utility provided by the goods purchased by government, this tax burden will generate an offsetting benefit. All of my calculations assume that the public remains pessimistic about the likely effect of the plan and that the stock market valuation stays at 50% of its efficient value.

6.4 Robustness to Different Assumptions

Suppose that the survival probability, π is 0.9 rather than $0, 98$. Under this assumption the average life span falls to 10 years. Since this assumption reduces the degree of overlap of generations it works to increase the effect of fiscal multipliers.

When $\pi = 0.9$, the steady state interest rate at the social optimum is 4.4% and the value of the capital stock, p_k^*, is equal to 5.8. In this world, if there is a 50% drop in the value of the stock market, an increases in steady state debt from 0 to 6.6 times full employment gdp, will move the economy to 100% of full employment at the cost of increasing the interest rate to 9%. Under this scenario, the cost to future generations is less dramatic but is still of the order of 6.6 times full employment gdp.

7 Is There a More Effective Solution?

It is clear from the analysis of my model that the effectiveness of fiscal policy depends, in an important way, on how well the economy is approximated by the representative agent assumption. Those commentators who support a large fiscal stimulus, like Paul Krugman or Robert Reich, believe that the representative agent assumption is a poor approximation to reality. Those commentators like Robert Barro or Eugene Fama, who argue that fiscal policy will be ineffective, are proponents of the Ricardian position. They believe that, for the most part, households fully discount the future tax consequences of an increase in government purchases.

There is a second split between these groups. Those who favor a fiscal stimulus are, on the whole, believers in the proposition that the free market can sometimes deliver grossly inefficient outcomes. Opponents of a fiscal stimulus plan are believers in laissez-faire.

My position is different from both of these groups. Like Reich and Krugman I believe that sometimes the free market may break down. Like Barro and Fama, I believe that a large fiscal stimulus will be less effective at restoring full employment than its proponents suggest. If the extreme Ricardian position is close to reality and consumers *fully* discount the cost of future tax increases, we will find ourselves in the nightmare situation where aggregate supply is Keynesian but aggregate demand is Ricardian.

But even if the economy is not Ricardian in this sense, my work strongly suggests that fiscal policy will still be ineffective in the long-run if it fails to restore confidence in the asset markets. My analysis is different from both classical and new-Keynesian explanations and unlike orthodox accounts of Keynesian economics, it does not rely on the assumption that prices are sticky. I have articulated a market failure that follows from an informational asymmetry. Unlike models based on the new-classical synthesis, this failure cannot be corrected simply by restoring aggregate demand. It matters where this demand comes from.

My analysis suggests that replacing private expenditure by government expenditure, without restoring confidence in the stock market, will not lead to a permanent reduction in unemployment. There is, however, an alternative sustainable approach that will work and that does not impose costs on future generations. It is to intervene in the asset markets directly by offering to exchange government debt for private equity.

Many observers believe that the stock market and housing prices, in the last decade, were overvalued. But even though the market has fallen considerably since its 2008 peak, households and firms are holding liquid assets because they are afraid that asset prices may fall even further. One way to restore confidence is to place a floor and a ceiling on the value of the stock market. In the model, this would be sustained by an announcement that the price of capital will be supported at p_k^*. The predicted effect is to increase the value of private wealth and, since debt and capital are perfect substitutes, the price will move immediately to the price announced by the government. In terms of Figure 2, the effect will be to shift the IR and IS curves to the right without changing either government expenditure or government debt.

Suppose that the government must buy private assets to force the price to change. In this case, the purchase of private assets at price p_k^* would be paid for by issuing debt without changing taxes or government expenditure. It would be much like a monetary operation in which the Fed exchanges debt for money. Since government debt and the value of capital will continue to pay the same return, the budget of the government will remain balanced with the revenue from dividends offset by the interest payments on debt.

The changes to Fed operating procedures, based on the new paradigm for macroeconomics proposed here, have the potential to stabilize business cycles and increase welfare in a way that standard monetary and fiscal policy cannot.

8 Conclusion

We are at a time in history when established assumptions about macroeconomics are being questioned. There are many voices in the debate. Most arguments are informed either by a classical model in which free markets are assumed to be optimal or by the neoclassical synthesis that was discredited in the 1970s. It is more important than ever, if economists are to play the role of social engineers, that the rationale behind their recommendations is understood by the experts and explained clearly to the public. In my view, much of the current debate does not meet these criteria.

It is difficult to argue credibly that free markets always produce efficient outcomes in the face of recent evidence. Stock market and housing market bubbles and the subsequent crashes in these markets are widely blamed for the current crisis by economists on both sides of the debate. But what are bubbles, how are they connected to the assumption of rational choice by households, and how do bubbles and crashes cause an inefficient allocation of labor?

The main theme of all of my recent work is that bubbles and crashes are caused by self-fulfilling crises of confidence that move the economy between equilibria. In this paper I have argued that fiscal policy is less effective than its proponents claim. An alternative might be for the Fed to intervene in the asset markets through purchases and sales of a broad index fund of stocks.

The way forward is to take the best ideas from Keynes and to combine them with existing economic theory in a way that explains which markets have failed and why. That is what I have done in the current paper, in Farmer (2009), and in two forthcoming books.[11] My argument is that informational asymmetries cause missing markets, missing markets lead to the existence of multiple equilibria, and psychology, in the form of self-fulfilling prophecies, becomes an additional fundamental that selects an equilibrium.

[11] *Expectations Employment and Prices*, Farmer (2010b) is written for the academic audience. *Confidence Crashes and Self-Fulfilling Prophecies* (2010a) is aimed at the layperson.

In this paper I have provided a model in which these ideas can be discussed and compared with the alternatives. This model articulates the market failure and provides a framework in which alternative solutions can be checked for internal consistency. The model I propose can be estimated or calibrated to provide quantitative assessments of the likely success of alternative strategies and it allows one to assess the costs and benefits of a fiscal stimulus against the alternatives.

A Appendix: Aggregate Consumption

This appendix derives Equation (25).

Household h solves the problem,

$$\max J_t^h = \sum_{t=\tau}^{\infty} \left[(\pi\beta)^{s-t} \log (c_t) \right], \quad t \geq h \tag{49}$$

subject to

$$\pi Q_t^{t+1} A_{t+1}^h = A_t^h + L_t - T_t - p_t c_t^h, \quad t = h, ...\infty. \tag{50}$$

Since agents have logarithmic preferences, their utility maximizing decision is to consume a fraction $(1 - \beta\pi)$ of wealth in every period. That is

$$C_t^h = (1 - \beta\pi) \left[A_t^h + h_t^h \right], \tag{51}$$

where

$$h_t^h = L_t + -T_t + \pi Q_t^{t+1} h_{t+1}^h. \tag{52}$$

Let $\mathcal{A}_t$ be the set of agents alive at date t and $\mathcal{A}_{t+1}$ be all agents alive at date $t + 1$. Define aggregate human wealth as

$$h_t = \sum_{h \in \mathcal{A}_t} h_t^h, \tag{53}$$

This gives the expression,

$$\sum_{h\in\mathcal{A}_t} h_t^h = \sum_{h\in\mathcal{A}_t} [L_t - T_t] + \pi Q_t^{t+1} \sum_{h\in\mathcal{A}_t} h_{t+1}^h, \tag{54}$$

where

$$\sum_{h\in\mathcal{A}_t} [L_t - T_t] = [L_t - T_t]\,. \tag{55}$$

To interpret the term $\sum_{h\in\mathcal{A}_t} h_{t+1}^h$ notice that there are $(1-\pi)$ newborn agents at date $t+1$ and hence this sum is less than aggregate human wealth at date $t+1$ by the factor π,

$$\sum_{h\in\mathcal{A}_t} h_{t+1}^h = \pi \sum_{h\in\mathcal{A}_{t+1}} h_{t+1}^h = \pi h_{t+1}. \tag{56}$$

Combining these expressions gives the equation,

$$h_t = L_t - T_t + \pi^2 Q_t^{t+1} h_{t+1}. \tag{57}$$

Adding up Equation (51) over all agents $h \in \mathcal{A}_t$ gives the expression,

$$C_t = (1-\beta\pi)\,[A_t + h_t]\,. \tag{58}$$

Next consider the budget constraint, Equation (50), which may be aggregated over all agents alive at date t to give the expression,

$$A_{t+1} = \frac{1}{Q_t^{t+1}\pi}\,[A_t + L_t - T_t - C_t]\,. \tag{59}$$

Aggregating the policy function, Equation (51) across agents gives,

$$C_t = (1-\beta\pi)\,[h_t + A_t]\,. \tag{60}$$

Rearranging Equation (60), substituting it into (57) and making use of (59) gives the following expression,

$$\frac{C_t}{(1-\beta\pi)} - A_t = L_t - T_t$$
$$+\pi^2 Q_t^{t+1}\left[\frac{C_{t+1}}{1-\beta\pi} - \frac{1}{Q_t^{t+1}\pi}\left(A_t + L_t - T_t - C_t\right)\right], \tag{61}$$

which can be rearranged to give

$$C_t\left(\frac{1-\pi\left(1-\beta\pi\right)}{1-\beta\pi}\right) = \left(L_t - T_t + A_t\right)\left(1-\pi\right) + \frac{\pi^2 Q_t^{t+1} C_{t+1}}{(1-\beta\pi)}. \tag{62}$$

Define the following constants:

$$\tilde{\beta} = \frac{1-\pi\left(1-\beta\pi\right)}{\pi^2}, \quad \tilde{\alpha} = \frac{\left(1-\beta\pi\right)\left(1-\pi\right)}{1-\pi\left(1-\beta\pi\right)}, \tag{63}$$

and notice that

$$A_t = B_t + \left(p_{k,t} + rr_t\right).$$

Using the facts that $L_t + rr_t = Z_t$ from the national income accounting identity, we have the following intermediate expression,

$$L_t + A_t = p_{k,t} + B_t + Z_t. \tag{64}$$

Substituting this into Equation (62) and making use of definition (63) and of the interest factor

$$R_t \equiv \frac{1}{Q_t^{t+1}}, \tag{65}$$

yields the result,

$$C_t = \frac{C_{t+1}}{R_t\tilde{\beta}} + \tilde{\alpha}\left(Z_t + p_{k,t} + B_t - T_t\right). \tag{66}$$

which is the equation we seek.

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