Keynes in Nutshell: A New Monetarist Approach (Incomplete)

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Abstract

A Farmer-type Keynesian model is constructed to explore and exposit Keynesian ideas. The modeling innovation is to integrate Farmer's approach with monetary exchange and to derive optimal monetary and fiscal policies. Two approaches are taken to optimal policy - an approach in the spirit of New Keynesian sticky-wage-and-price models, and an a "sophisticated policy" approach. Optimal policies typically do not appear to resemble Keynesian-type policies, though the model is undoubtedly Keynesian.

1 Introduction

The set of economists that claim to be Keynesians is large, but since Keynes wrote the *General Theory* (Keynes 1936), no one has been quite sure what Keynes had in mind, and there have been many interpretations of Keynesian ideas. Hicks's IS-LM model (Hicks 1937) is probably the first and most well-known of these interpretations, having found its way into many post-World War II undergraduate economics textbooks. In modern macroeconomics, the menu cost models of the 1980s (Mankiw 1985, Blanchard and Kiyotaki 1987), coordination failure models (Bryant 1983, Diamond 1982, Cooper and John 1988), dynamic models with multiple equilibria (e.g. Farmer and Guo 1994), and New Keynesian models (Clarida, Gali, and Gertler 1999, Woodford 2003) all have some claim to the moniker "Keynesian." These are quite different models, however, with different policy implications. In policy discussions, when Keynes is invoked, we can never be sure what people have in mind. Is this the Keynes of the general theory, or Keynes as interpreted by Diamond, Kiyotaki, Mankiw, Woodford, or someone else?

The goal of this paper is to use a single framework to exposit and evaluate Keynesian ideas, using Farmer (2011) as a base. All Keynesian models share the idea that it is difficult for economic agents to agree on the terms of exchange in decentralized trading. Either it is costly or difficult to change prices or wages (Hicks 1937, Mankiw 1985, Blanchard and Kiyotaki 1987, Clarida, Gali and Gertler 1999, Woodford 2003), or there are Pareto-improving trades that are feasible, yet aggregate outcomes can have the property that economic agents do not choose to make those trades. Farmer (2011) provides a simple approach to capturing this general idea in a search framework.

In order to clarify the basic ideas, we start here with a simplified static version of Farmer (2011). Economic agents choose between two activities, work and production, but must search for a trading partner. In a successful match, output results, and the worker and producer split the output between them and consume. Not all would-be workers and producers are matched in equilibrium, so there are unemployed workers and unfilled vacancies. In typical labor search models, e.g. Mortensen and Pissarides (1994), workers and firms split the surplus from a match according to some bargaining rule, e.g. Nash bargaining. However, we can imagine a world - Farmer's Keynesian world - where a matched worker and producer in our model have difficulty splitting the surplus from production. Then, there exists a continuum of equilibria, indexed by wages and labor market tightness. In general, an equilibrium with a high (low) wage is associated with low (high) labor market tightness. In equilibrium, economic agents are indifferent at the outset between seeking a match as a worker or a producer. If the wage is high, then work is attractive relative to production, so the labor market is not tight and it is relatively more difficult to find a match as a worker than as a producer.

In this static model, the equilibrium can be suboptimal, in that labor market tightness is too high or too low. Indeed, the unemployment rate could be too high or too low.

The modeling innovation in this paper is to integrate monetary arrangements in a Farmer-type model in the spirit of Lagos and Wright (2005). In the dynamic model constructed here, successful matches involve a worker, a producer, and a consumer, with the worker and producer producing output which they do not wish to consume, but which they can exchange with the consumer for money. Just as in the static model, we can use a conventional bargaining approach to determine an equilibrium in this model. Such an equilibrium exhibits some (but not all) of the features of the model of Berentsen, Menzio, and Wright (2011), for example there is a long-run positive relationship between the inflation rate and the unemployment rate. Higher money growth increases the inflation rate, thus reducing the consumer's surplus from exchange. In equilibrium the unemployment and vacancy rates rise.

In the dynamic model, we also include fiscal policy, in the form of a subsidy paid to producers who match successfully. Effectively this gives the government a second policy tool that will affect the relative surpluses from production, work, and consumption. In an equilibrium with conventional bargaining, a higher subsidy increases the surplus of producers in a productive match, and this acts to reduce the unemployment rate and increase the vacancy rate.

In the spirit of Farmer's approach, we go on to analyze the case where there is nothing to determine how a matched worker, producer, and consumer split the surplus. In the dynamic model, this implies a two-dimensional indeterminacy. In the set of equilibria, a high wage is associated with high worker surplus, with high labor market tightness, and with low goods market tightness. Also, a high product price is associated with high labor market tightness and low goods market tightness. By high (low) labor market tightness, we mean a large (small) quantity of producers searching relative to workers, and high (low) goods market tightness is characterized by a large (small) quantity of consumers searching relative to workers.

Following the Keynesian spirit, the model is used to determine optimal monetary and fiscal policies. What can the government do in the face of indeterminacy and the possibility that the economy could settle in a suboptimal equilibrium? We take two approaches to this problem. The first is in line with New Keynesian economics (e.g. Woodford 2003), in that nominal wages and prices in decentralized markets are treated as exogenous. In this context, we are able to determine optimal monetary and fiscal policies. While optimal monetary policy in this context is recognizably Keynesian - the money stock moves proportionally to nominal wages - fiscal policy is not, in that the optimal producer subsidy depends in a complicated fashion on wages and prices.

An alternative approach is to consider "sophisticated policies" of the type studied by Atkeson, Chari, and Kehoe (2008). In the context of multiplicities, these policies can work not only to eliminate multiplicity, but to pick out an equilibrium that supports an optimal allocation. Sophisticated optimal monetary and fiscal policies are derived, and these policies are quite different from those determined using the New Keynesian fixed-price and fixed-wage approach. Further, though these optimal policies are derived in a model with Keynesian features, they are not recognizably Keynesian policies. For example, an optimal monetary policy does not appear to be a Taylor rule, and an optimal fiscal policy does not appear to be countercyclical in any sense.

The paper proceeds as follows. In the second section, a simplified static version of Farmer (2011) is presented, and this model is expanded in the third section to include dynamics, monetary exchange, monetary policy, and fiscal policy. The fourth section is a discussion, followed by a conclusion.

2 The Static Model

This is a simplified version of the model in Farmer (2011). There is a continuum of agents with unit mass, each of whom maximizes consumption during the period. An individual agent can choose one of two different activities, i.e. he or can be a worker or a producer. The production of output requires a match between a worker and a producer. If a match occurs, then $y > 0$ units of the consumption good are produced. Letting x and z denote the masses of workers and producers, respectively, searching for a match, the quantity of successful matches is given by

$$l = \psi(x, z),$$

where $\psi(\cdot, \cdot)$ is the matching function. Assume that $\psi(\cdot, \cdot)$ is strictly increasing in both arguments, twice continuously differentiable, homogenous of degree 1, and has the properties $\psi(0, z) = 0$ for $z \geq 0$ and $\psi(x, 0) = 0$ for $x \geq 0$.

In a match, let w denote the wage, i.e. the payment received by the worker, which implies that the producer receives surplus $y - w$. The probabilities of achieving a match, for a worker and a firm, respectively, are $\frac{\psi(x,z)}{x}$ and $\frac{\psi(x,z)}{z}$. In equilibrium, each agent must face the same expected payoff to becoming a worker or a producer, which gives

$$\frac{\psi(x, z)w}{x} = \frac{\psi(x, z)(y - w)}{z},$$

or, defining labor market tightness by $\theta \equiv \frac{z}{x}$,

$$w = \frac{y}{1 + \theta}. \tag{1}$$

2.1 Conventional Solution

If we follow the typical approach in search models, for example Mortensen and Pissarides (1994), we would argue that a matched worker and producer must bargain over w. There are several alternative bargaining solutions, including Nash bargaining, which is a common approach. Here, we will use Kalai bargaining (Kalai 1977). Letting α denote the worker's share of the surplus in a match, with $0 \leq \alpha \leq 1$, Kalai bargaining gives

$$w = \alpha y, \tag{2}$$

and then from (1) and (2), we obtain

$$\theta = \frac{1 - \alpha}{\alpha}. \tag{3}$$

We can then calculate the unemployment rate u as the number of workers who search but fail to achieve a match, divided by the number who search, or

$$u = \frac{x - \psi(x, z)}{x} = 1 - \psi(1, \theta), \tag{4}$$

which is decreasing in θ. Similarly, the vacancy rate v is

$$v = \frac{z - \psi(x, z)}{z} = 1 - \psi(\frac{1}{\theta}, 1),$$

so v is increasing in θ. Therefore the vacancy/unemployment ratio $\frac{v}{u}$ is increasing in θ.

Aggregate welfare is increasing in the quantity of aggregate output in equilibrium, as the expected utilities of all agents are identical in equilibrium, so expected utility for each agent is expected consumption for an individual, which is equal to aggregate output. Then, letting W denote aggregate welfare, we have

$$W = y\psi(x, z) = yx\psi(1, \theta),$$

since the matching function is homogeneous of degree 1. But, since $x + z = 1$, we then have

$$W = \frac{y\psi(1,\theta)}{1+\theta}. \tag{5}$$

Therefore, optimal labor market tightness, θ^*, solves the first-order condition

$$\psi_2(1,\theta^*) - \psi_1(1,\theta^*) = 0, \tag{6}$$

where (6) uses the homogeneity-of-degree-one property of the matching function.

In general, equilibrium labor market tightness will be suboptimal, unless bargaining proceeds according to a "Hosios rule" whereby, from (3),

$$\alpha = \alpha^* \equiv \frac{1}{1+\theta^*}$$

2.2 Farmer Keynesian Indeterminacy

In Farmer (2011), matched workers and producers somehow have difficulty determining how to split the surplus in the match, in which case equation (1) yields a continuum of equilibrium solutions for w and θ. Note that the right-hand side of (1) is a strictly decreasing function of θ, so an equilibrium with high wages is associated with low labor market tightness. In equilibrium, economic agents are indifferent between searching for a match as a worker and searching as a producer. If the wage is high, then the surplus received by workers is high and the surplus received by producers is low. Thus, if agents are to be indifferent between searching as a worker or searching as a producer, it must be more difficult to find a match as a worker than as a producer, so labor market tightness must be low.

Further, from (5), if we differentiate the expression on the right-hand side of (5) with respect to θ, we get

$$\frac{\partial W}{\partial \theta} = \frac{y}{(1+\theta)^2}\left[\psi_2(1+\theta) - \psi(1,\theta)\right] = \frac{y}{(1+\theta)^2}\left[\psi_2(1,\theta) - \psi_1(1,\theta)\right],$$

and, since $\psi(\cdot,\cdot)$ is homogeneous of degree 1, $\frac{\partial W}{\partial \theta} > 0$ for $\theta < \theta^*$, and $\frac{\partial W}{\partial \theta} < 0$ for $\theta > \theta^*$. Therefore, welfare and output are maximized in the equlibrium where $\theta = \theta^*$. Further, if we compare alternative equilibria, the unemployment rate is monotonically decreasing in θ, but as we increase θ output increases and then decreases. Thus, the relationship between the unemployment rate and aggregate output across equilibria is non-monotonic.

3 A Dynamic New Monetarist Model

This model, in the spirit of Berentsen, Menzio, and Wright (2011), includes search frictions in matching workers, producers, and consumers. Time is indexed by $t = 0, 1, 2, ...$, and each period is divided into two subperiods, denoted the centralized market (CM) and decentralized market (DM). There is a continuum of infinite-lived agents with unit mass, each of whom has preferences given by

$$E_0 \sum_{t=0}^{\infty} \beta^t (C_t - H_t + c_t),$$

where $0 < \beta < 1$, C_t denotes consumption in the CM, H_t labor supply in the CM, and c_t is consumption in the DM. In the CM, each agent has available a technology that permits one unit of perishable CM consumption goods to be produced for each unit of labor input. In the CM, all agents are together in one location and can trade money for goods on a Walrasian market where the price of money in terms of goods is ϕ_t. Agents observe ϕ_t in the Walrasian market, but cannot observe the actions of other agents. In the CM, each agent pays a lump-sum tax τ_t to the government. Let M_t denote the quantity of money when the Walrasian market opens in the CM, and assume that each agent is endowed with M_0 units of money in period 0, and that $\tau_0 = 0$. The sequence of government budget constraints is given by

$$\phi_t(M_t - M_{t-1}) + \tau_t = 0, \;\; t = 1, 2, ...$$

Before he or she enters the DM, an agent must decide whether to be a worker, a producer, or a consumer. Then, in the DM, a successful match occurs when a worker, a producer, and a consumer all meet so that the worker and producer can supply output y to the consumer. Any worker and producer who match cannot consume their own output, and the output is perishable. Letting x_t, z_t, and k_t denote the fractions of the population who choose to be workers, producers, and consumers, respectively, the number of matches l_t is determined by the matching function

$$l_t = \chi(x_t, z_t, k_t),$$

where the function $\chi(\cdot,\cdot,\cdot)$ has properties identical to $\psi(\cdot,\cdot)$, except with three arguments instead of two.

In a match among a worker, a producer, and a consumer, credit is not feasible as there is no memory, i.e. an agent does not have access to the histories of other agents. Exchange is possible using money however, and the consumer exchanges m_t units of money (in units of the $t+1$ CM consumption good) for y units of goods. The worker receives $w_t \leq m_t$ units of real balances, and the producer receives the residual, $m_t - w_t$.

Assume that, in the CM when production and consumption take place, that an agent does not know whether he or she will have a successful match in the subsequent DM, but that each consumer learns this at the end of the period, and that the information also becomes public knowledge at that time. In the model, the government engages in a simple fiscal policy, which is a subsidy to matched producers, of s_t in units of $t+1$ goods. The subsidy is given to the producer as a money transfer, which can then be spent by the producer in the next CM. If $s_t < 0$, then the producer pays a tax in money, where the money is acquired in the current CM. Producers are able to write insurance contracts in the CM which allow them to share money balances. Consumers are also able to share money, i.e. they can write insurance contracts prior to learning whether they achieve a successful match or not, and so only consumers in successful matches need to carry money with them into the DM. All agents learn before leaving the CM whether their match is successful or not. Matched producers leave the CM with s_t units of money (in units of the $t+1$ CM consumption good), in the case where $s_t > 0$. If $s_t < 0$, then each would-be producer acquires $-\frac{\chi(x_t,z_t,k_t)s_t}{z_t}$ units of money (again in units of the $t+1$ consumption good) in the CM, and then each matched producer pays the tax $-s_t$ to the government in money. Matched consumers leave the CM with m_t units of money (in units of the $t+1$ CM consumption good) and unmatched consumers hold no money.

Then, in equilibrium in the CM, each agent must be indifferent among the three alternative activities in the succeeding DM, i.e. similar to (1),

$$\frac{\chi(x_t,z_t,k_t)}{x_t}\beta w_t = \frac{\chi(x_t,z_t,k_t)}{z_t}\beta(m_t - w_t + s_t) = \frac{\chi(x_t,z_t,k_t)}{z_t}\left(y - \frac{m_t\phi_t}{\phi_{t+1}}\right),$$

or

$$\theta_t w_t = m_t - w_t + s_t, \tag{7}$$

$$\sigma_t \beta w_t = y - \frac{m_t\phi_t}{\phi_{t+1}}, \tag{8}$$

where $\theta_t \equiv \frac{z_t}{x_t}$ or labor market tightness, and $\sigma_t \equiv \frac{k_t}{x_t}$ or goods market tightness.

3.1 Conventional Solution

Just as in the static model, one approach is to use Kalai bargaining. In the DM, the worker's surplus is βw_t, the producer's surplus is $\beta(m_t - w_t)$, and the consumer's surplus is $y - \beta m_t$, so if the worker's share of total surplus is α and the producer's share is δ, with $\theta + \delta \leq 1$, then

$$w_t = \frac{\alpha y}{\beta} \tag{9}$$

and

$$m_t = \frac{(\alpha+\delta)y}{\beta}. \tag{10}$$

Then, (7), (8), (9), and (10) give

$$\theta_t = \frac{\delta y + \beta s_t}{\alpha y} \tag{11}$$

$$\sigma_t = \frac{1 - \frac{(\alpha+\delta)\phi_t}{\beta\phi_{t+1}}}{\alpha}, \tag{12}$$

Further, money demand equals money supply in the CM, so from (10),

$$\frac{[(\alpha+\delta)y + \beta s_t]\,\chi(1,\theta_t,\sigma_t)}{\beta(1+\theta_t+\sigma_t)} = \phi_{t+1}M_t \tag{13}$$

and then (11), (12), and (13) solve for $\{\theta_t, \sigma_t, \phi_t\}_{t=0}^{\infty}$.

Suppose that the money stock grows at a constant rate, i.e. $M_{t+1} = \mu M_t$, for $t = 1, 2, 3, ...$, that $s_t = s$ for all t, and confine attention to stationary equilibria where $\theta_t = \theta$, $\sigma_t = \sigma$ for all t, and ϕ_t grows at a constant rate. Then, from (10)-(13), we have $\frac{\phi_{t+1}}{\phi_t} = \frac{1}{\mu}$ and the following two equations solve for θ and σ :

$$\theta = \frac{\delta}{\alpha} + \frac{\beta s}{\alpha y} \tag{14}$$

$$\sigma = \frac{1 - \frac{(\alpha+\delta)\mu}{\beta}}{\alpha} \tag{15}$$

Then, using (13), (**??**), and (**??**), we can solve for prices

$$\phi_{t+1} = \frac{\left[(\alpha + \delta)y + \beta s\right] \chi(1, \theta, \sigma)}{\beta(1 + \theta + \sigma)M_t}, \tag{16}$$

and output in the DM is given by

$$Y^{DM} = \frac{y\chi\left(1, \theta, \sigma\right)}{(1 + \theta + \sigma)} \tag{17}$$

Then, from (14), note that labor market tightness θ is invariant to money growth, as money growth does not affect the relative payoffs to workers and producers. However, from (15), higher money growth causes a decrease in σ, which represents goods market tightness, i.e. higher inflation reduces the ex ante surplus of consumers, and so reduces the mass of consumers searching relative to producers and workers.

As in the static model, we calculate the unemployment rate given the probability for a worker of achieving a match. The unemployment rate is given by

$$u = \frac{x - \chi\left(x, z, k\right)}{x} = 1 - \chi\left(1, \theta, \sigma\right) = 1 - \frac{\chi\left(\alpha, \delta + \frac{\beta s}{y}, 1 - (\alpha + \delta)\frac{\mu}{\beta}\right)}{\alpha},$$

which is increasing in the money growth rate, in line with results in Berentsen, Menzio, and Wright (2011). Higher inflation results in an increase in the mass of economic agents who choose to search for work, and to an increase in the mass of producers searching, but there are fewer consumers with whom to match. The result is that a larger fraction of workers goes unmatched, or unemployed. Note also that a higher subsidy for producers reduces unemployment, as this increases the fraction of producers searching relative to workers and consumers.

Similarly, the vacancy rate is given by

$$v = \frac{z - \chi\left(x, z, k\right)}{z} = 1 - \chi\left(\frac{1}{\theta}, 1, \frac{\sigma}{\theta}\right) = 1 - \chi\left(\frac{\alpha y}{\delta y + \beta s}, 1, \frac{y - y(\alpha + \delta)\frac{\mu}{\beta}}{\delta y + \beta s}\right).$$

Therefore v is increasing in the money growth factor, and increasing in the subsidy s. An increase in the money growth factor reduces the ex ante surplus for consumers, so that fewer consumers search relative to producers and workers, the result being a higher vacancy rate - more producers are ultimately not matched. An increase in the subsidy to producers increases producer's surplus, more producers search relative to workers and consumers, and this also increases the vacancy rate.

What is output in the CM each period? From (16), this is the quantity

$$Y^{CM} = \frac{[(\alpha+\delta)y + \beta s]\,\chi(1,\theta,\sigma)}{\beta(1+\theta+\sigma)},$$

so if we add total output in the CM and the DM each period, we obtain, using (17),

$$Y = Y^{DM} + Y^{CM} = \frac{[(\alpha+\delta+\beta)y + \beta s]\,\chi(1,\theta,\sigma)}{\beta(1+\theta+\sigma)}.$$

What is an optimal policy in the dynamic model? First, note that a social planner who could choose θ and σ would pick these quantities to maximize the number of matches in the DM, i.e. this planner would solve

$$\max_{\theta,\sigma} \frac{\chi(1,\theta,\sigma)}{1+\theta+\sigma}.$$

Therefore, letting θ^* and σ^* denote the optimal quantities of labor market tightness and goods market tightness, the optimum is the solution to

$$\chi_2(1,\theta^*,\sigma^*) - \chi_1(1,\theta^*,\sigma^*) = 0 \tag{18}$$

$$\chi_3(1,\theta^*,\sigma^*) - \chi_1(1,\theta^*,\sigma^*) = 0 \tag{19}$$

Then, using (14) and (15), we can solve for the optimal monetary and fiscal policy:

$$\mu^* = \frac{\beta(1-\alpha\sigma^*)}{\alpha+\delta}$$

$$s^* = \frac{y(\theta^*\alpha - \delta)}{\beta}$$

Here, we require that $\mu^* \geq \beta$, or

$$\sigma^* \leq \frac{1-\alpha-\delta}{\alpha} \tag{20}$$

Then, if (20) does not hold, $\mu^* = \beta$ (Friedman rule), and from (**??**),

$$\sigma = \frac{1-\alpha-\delta}{\alpha},$$

and s^* solves

$$s^* = \arg\max_s \left[\frac{\chi(\alpha y, \delta y + \beta s, (1-\alpha-\delta)y)}{\beta s + y}\right]$$

In this version of the model, the only role of policy is to correct bargaining inefficiencies. In some cases the optimal monetary policy is not a Friedman rule, i.e. $\mu^* > \beta$, and then monetary and fiscal policy provide the two instruments necessary to correct the two bargaining inefficiencies. If the optimal monetary policy is a Friedman rule, then monetary policy is essentially constrained by the zero lower bound on the nominal interest rate. Then, there is only one effective instrument at the margin, and policy cannot correct both bargaining inefficiencies. However, in that case another fiscal instrument would do the trick, just as is the case in New Keynesian models in which the zero lower bound is problematic (see Correia, Farhi, Nicolini, and Teles 2011).

3.2 Indeterminacy

Following a similar approach to what we did with the static model, suppose now that the surplus in a match is not split according to any particular bargaining rule. Market-clearing (money demand equals money supply in the CM) gives

$$\frac{(m_t + s_t)\,\chi(1, \theta_t, \sigma_t)}{(1 + \theta_t + \sigma_t)} = \phi_{t+1} M_t \tag{21}$$

Then, substituting for prices in (8) using (21), we obtain

$$\beta \sigma_t w_t = y - \frac{M_t(1 + \theta_t + \sigma_t)\chi(1, \theta_{t-1}, \sigma_{t-1})\,(m_{t-1} + s_{t-1})\,m_t}{M_{t-1}(1 + \theta_{t-1} + \sigma_{t-1})\chi(1, \theta_t, \sigma_t)(m_t + s_t)} \tag{22}$$

Then, we can describe an equilibrium as a sequence $\{w_t, m_t, \theta_t, \sigma_t\}_{t=0}^{\infty}$ solving (7) and (22) with

$$m_t > 0,\ w_t > 0,\ \theta_t > 0,\ \sigma_t > 0,$$

and

$$\frac{M_t(1 + \theta_t + \sigma_t)\chi(1, \theta_{t-1}, \sigma_{t-1})\,(m_{t-1} + s_{t-1})\,m_t}{M_{t-1}(1 + \theta_{t-1} + \sigma_{t-1})\chi(1, \theta_t, \sigma_t)\,(m_t + s_t)} \geq \beta, \tag{23}$$

where the latter condition states that the implicit nominal interest rate must be nonnegative in equilibrium.

To illustrate the nature of the indeterminacy, and to compare this with the conventional solution, suppose that the money growth factor is a constant, μ, and restrict attention to stationary equilibria where real quantities are constant, i.e. $w_t = w$, $m_t = m$, $\theta_t = \theta$, $\sigma_t = \sigma$, for all t. Then, from (7) and (22), we get

$$\theta = \frac{m - w + s}{w}, \tag{24}$$

$$\sigma = \frac{y - \mu(m + s)}{\beta w}. \tag{25}$$

In (24) and (25) there is a two-dimensional indeterminacy, as we have two equations that must solve for the four unknowns m, w, θ, and σ. Note that equilibria with higher w are associated with lower θ and lower σ, i.e. if more surplus goes to workers, then the labor and goods markets are less tight. Equilibria with higher m are associated with higher θ and lower σ so that, if more surplus goes to workers and producers, vis-a-vis consumers, then the labor market is tighter and the goods market is less tight. Further, given m and w, an increase in the money growth factor μ (and thus in the inflation rate) has no effect on labor market tightness, but reduces goods market tightness. As well, given m and w, an increase in the subsidy s increases labor market tightness and has no effect on goods market tightness.

3.2.1 New Keynesian Sticky Wages and Prices

Suppose that we think about this model in terms that a New Keynesian might recognize. In particular, assume that prices and wages are set in nominal terms. Since there is no role for dynamic price-setting or wage-setting here, simply assume that the sequence of money prices that consumers pay for y goods in the DM is $\{P_t\}_{t=0}^{\infty}$, which is exogenous, and the nominal wage received by workers is given by $\{W_t\}_{t=0}^{\infty}$. Then, replace (7) and (8) by

$$\theta_t W_t \phi_{t+1} = P_t \phi_{t+1} - W_t \phi_{t+1} + s_t, \tag{26}$$

$$\sigma_t \beta W_t \phi_{t+1} = y - P_t \phi_t, \tag{27}$$

and (21) by

$$\frac{\left(\phi_{t+1} P_t + s_t\right) \chi(1, \theta_t, \sigma_t)}{(1 + \theta_t + \sigma_t)} = \phi_{t+1} M_t \tag{28}$$

From (18) and (19), θ^* and σ^* are optimal labor market tightness and goods market tightness respectively. We can find a policy rule that supports $\theta_t = \theta^*$ and $\sigma_t = \sigma^*$ in equilibrium for all t. Such a rule is given by

$$M_t = \frac{\chi(1, \theta^*, \sigma^*)\,(1 + \theta^*)\,W_t}{(1 + \theta^* + \sigma^*)}, \; t = 0, 1, 2, ..., \tag{29}$$

$$s_0 = \frac{(y - P_0 \phi_0)\,[(1 + \theta^*) W_0 - P_0]}{\sigma^* \beta W_0}, \tag{30}$$

$$s_t = \frac{y\,[(1 + \theta^*)\,W_t - P_t]\,[(1 + \theta^*)\,W_{t-1} - P_{t-1}] - P_t s_{t-1}}{\sigma^* \beta W_t\,[(1 + \theta^*)\,W_{t-1} - P_{t-1}]}, \; t = 1, 2, ... \tag{31}$$

Note that the policy rule includes an endogenous variable, ϕ_0 (the price of money at the first date in the CM), in equation (30), but otherwise monetary policy $\{M_t\}_{t=0}^{\infty}$ and fiscal policy $\{s_t\}_{t=0}^{\infty}$ are functions of exogenous variables. In (29), the optimal money stock is proportional to the nominal wage in the DM, which seems consistent with traditional Keynesian notions of monetary policy accommodating changes in nominal wages. However, the rule governing fiscal policy, from (30) and (31) is quite complicated, and does not appear to resemble any prescriptions that come from conventional Keynesian economics.

3.2.2 Sophisticated Policy Rules

Another way to think about the indeterminacy, and policies that will solve the indeterminacy problem, is to use ideas from Atkeson, Chari, and Kehoe (2008), who study "sophisticated monetary policies," which are policies that, in the context of potential multiplicity of equilibria can yield determinacy. In this model, it is possible to back out an optimal sophisticated policy rule directly from (7) and (22). Such a policy is:

$$M_0 = \frac{(y - \sigma^* \beta w_0) w_0 (1 + \theta_0) \chi(1, \theta_0, \sigma_0)}{m_0 \phi_0 (1 + \theta_0 + \sigma_0)} \tag{32}$$

$$\frac{M_t}{M_{t-1}} = \frac{(y - \beta \sigma^* w_t)(1 + \theta_{t-1} + \sigma_{t-1}) \chi(1, \theta_t, \sigma_t)}{(1 + \theta_t + \sigma_t) \chi(1, \theta_{t-1}, \sigma_{t-1}) m_{t-1}} \tag{33}$$

$$s_t = (\theta^* + 1) w_t - m_t \tag{34}$$

Monetary policy is specified by (32) and (33), which gives the path for the nominal money stock contingent on wages, prices, labor market tightness, and goods market tightness, including out-of-equilibrium values. Equation (34) specifies the sophisticated fiscal policy rule. Under the policy rules given by (32)-(34), $\{w_t, m_t\}_{t=0}^{\infty}$ is indeterminate, but policy responds to contracts in such a way that the ex ante surpluses received by workers, producers, and consumers is in fact determinate, and yields a division of agents among activities that maximizes aggregate output, and therefore maximizes welfare.

Here, note that the sophisticated monetary policy is quite different from the optimal policy under fixed nominal wages and prices discussed in the previous subsection, in spite of the fact that the underlying Keynesian model is identical Thus, the stand we take on the form of the Keynesian indeterminacy can make a big difference for the sorts of policies we should be recommending.

4 Discussion

This seems to be a model that captures the essence of Keynesian economics. In the usual Keynesian narrative, the private sector, left to its own devices, has difficulty in determining the terms of exchange in private contracts. This can lead to suboptimal outcomes. However, according to the narrative, the government is sufficiently well-informed that it can intervene in ways that mitigate the suboptimality or do away with it altogether.

In this model, producers, workers, and consumers can agree on a suboptimal division of the surplus from trade, and this implies that there is a misallocation of economic agents among productive activities. To correct the suboptimality, two policy instruments are necessary. The two policy instruments considered here were monetary and fiscal policy.

How seriously should we take the implications of this model? In a "chicken model," the private sector cannot make chickens, the government can, and the conclusion is that the government should make chickens. The model analyzed here is indeed a kind of chicken model. Private sector agents in our model are incapable of deciding among themselves on terms of exchange that yield socially optimal outcomes - these private sector agents cannot make chickens. However, the government is well-informed, and has sufficient policy tools that it can effectively manipulate the terms of exchange to bring about efficient outcomes - the government can make chickens. One can imagine extensions of this model that include more heterogeneity among economic agents and/or technologies, but with the same types of indeterminacies. In worlds like that, the government needs more information and more policy tools in order to manipulate match surpluses appropriately so as to attain efficiency. Ultimately, the information requirements and required richness in the set of policy tools begins to seem far-fetched.

This is the basic defect in Keynesian economics. There is a pricing problem that private sector agents are somehow unable to solve on their own. But a benevolent, smart, and well-informed government is able to step in and solve that problem. I think that Keynesians understand the nature of this problem, which they typically try to cover up with "aggregate demand" language. It seems very straightforward to think about solving a problem of "deficient aggregate demand." Solving a pricing problem for the whole economy is much more onerous.

5 References

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