Disequilibrium and New Keynesian Economics

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Abstract

This paper examines the relationship between two separate attempts to provide microeconomic foundations for Keynesian results: the 'Disequilibrium' literature of Barro and Grossman (1971, 1976) and others and the 'New Keynesian Economics' literature. Both literatures provide identical comparative static results to changes in exogenous policy variables. The New Keynesian literature adds to the results of the Disequilibrium literature by endogenizing price rigidity and explaining why certain cases studied in that literature are unlikely to occur in practice. However, New Keynesian models ignore certain general equilibrium effects emphasized in Disequilibrium models.

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1 Introduction

There has recently been renewed interest in providing microeconomic foundations to both aggregate demand and aggregate supply in models with nominal rigidities.[1] These attempts have built on the imperfectly competitive framework of the 'New Keynesian Economics' literature, which has endogenized price rigidity, and explored the dynamic implications of price and wage rigidity.

This new literature has neglected previous attempts [2] to provide microeconomic foundations for Keynesian results. These older models imposed fixed nominal prices and wages onto competitive static general equilibrium models. Since these prices and wages were not necessarily at market-clearing levels, goods and labor markets were in conditions of excess demand or supply. The comparative statics of the model depended on which markets were in excess supply and demand and what rules were specified to determine how transactions were carried out. One set of comparative statics implied unemployment, real effects of nominal money, and a multiplier effect for taxes and government purchases. This literature was termed 'Disequilibrium Economics' by Barro and Grossman (1971).

This paper examines the relationship between 'Disequilibrium' models and 'New Keynesian' models. I show that both models can provide identical comparative static responses to changes in policy variables. New Keynesian models explain why certain cases highlighted in the Disequilibrium literature, such as the case of nominal prices being below the level which clears the goods market, are unlikely to occur in practice. However, New Keynesian models also ignore general equilibrium interactions across markets which are present in the Disequilibrium literature.

After this introduction, the paper proceeds as follows: Section 2 demonstrates the equivalence of comparative static results between Disequilibrium and New Keynesian models by solving a variant of the Blanchard and Kiyotaki model under different assumptions. Section 3 discusses some general equilibrium effects in Disequilibrium models usually ignored by New Keynesian models. Section 5 concludes.

[1] See McCallum and Nelson (1997) and Kimball (1995) for some examples.

[2] Barro and Grossman (1971,1976), Malinvaud(1977), Benassy (1986). See Benassy (1993) for a recent survey.

2 A Small General Equilibrium Model

The Disequilibrium literature typically set up small perfectly competitive general equilibrium models, and then imposed fixed nominal wages and prices. The New Keynesian literature usually assumes that firms are imperfectly competitive. Fixed nominal wages are still imposed (e.g. in contracting models), but nominal prices are made endogenously sticky by assuming costs of changing prices. This section shows that one can get identical comparative static results from a New Keynesian model and a simplified version of the Disequilibrium model in which prices or wages are fixed, but not both.

The following model is a simplified variant of Blanchard and Kiyotaki (1987), with an extension to include government spending. The economy consists of a single representative consumer and the government. There are N goods, indexed by i, produced by N separate industries. The degree of competition assumed in these industries will be specified below. To purchase these goods, the consumer needs to use money. The consumer supplies labor to each of the industries in a competitive fashion. [3] Letting M' denote initial nominal money holdings and L_i labor supply, the following is the consumer's utility function:

$$U = (N^{\frac{1}{1-\theta}}C)^{\gamma}(\frac{M'}{P})^{1-\gamma} - L^{\beta} \tag{1}$$

where $C = (\sum_{i=1}^{N} C_i^{\frac{\theta-1}{\theta}})^{\frac{\theta}{\theta-1}}$, the price index $P = (\frac{1}{N}\sum_{i=1}^{N} P_i^{1-\theta})^{\frac{1}{1-\theta}}$ and $L = \sum_{i=1}^{N} L_i$. Assume that $O < \gamma < 1$, $\beta > 1$ and $\theta > 1$.

The government spends an equal (real) amount g in each industry, where the aggregate amount spent is denoted by $G = Ng$. The government levies a lump-sum tax on the consumer in the amount T and issues money in the nominal amount M.[4]

The production function for each industry is:

$$Y_i = L_i^{\frac{1}{\alpha}}, \tag{2}$$

[3] The following results are qualitatively unchanged if one relaxes this assumption, as is done in the original Blanchard and Kiyotaki (1987) model. Doing so here would only complicate the algebra. See also footnote 7.

[4] One could also impose a 'no debt' constraint by requiring that $\frac{M-M'}{P} + T = G$, or seignorage+taxes=spending. None of the results would change, although one could write aggregate demand more cleanly.

where $\alpha > 1$.

Nominal profits are therefore:

$$\Pi_i = P_i Y_i - W L_i. \tag{3}$$

Profits are distributed to the industry owner, the consumer.

Given the above definitions, the consumer's budget constraint is:

$$\sum_{i=1}^{N} P_i C_i + M = WL + M' + \sum_{i=1}^{N} \Pi_i - T, \tag{4}$$

where M' denotes initial nominal money holdings. Let I denote disposable income, the right-hand-side of equation (4). It will be convenient later to note that disposable income

$$I = WL + M + \sum_{i=1}^{N} P_i Y_i - WL - T = \sum_{i=1}^{N} P_i Y_i - T. \tag{5}$$

Finally, the standard national income accounting identity implies:

$$Y = \sum_{i=1}^{N} \frac{P_i}{P} Y_i = \sum_{i=1}^{N} \frac{P_i}{P} (C_i + g). \tag{6}$$

The following four subsections solve this models under differing assumptions about the rigidity of nominal prices and the nature of competition in the goods market. They also report comparative static results for changes in government spending, taxes and nominal money.[5]

2.1 Perfectly Competitive Solution

Utility maximization of (1) subject to (4), taking the nominal wage and prices as given, implies the following for consumption and money demand:

$$C_i = \left(\frac{P_i}{P}\right)^{-\theta} \gamma \frac{I}{NP} \tag{7}$$

$$M' = (1 - \gamma) \frac{I}{NP} \tag{8}$$

[5]Benassy(1993) does a very similar exercise. He does not consider the combination of imperfection competition and nominal rigidity, however.

Combining equations (6) and (7), using the definition for P, and exploiting the fact that in equilibrium, $P_i = P$, one can show that:

$$Y^D = \gamma \frac{I}{P} + G \tag{9}$$

Using the expression for I from equation 5, and the definition of Y, this expression simplifies to:

$$Y^D = \frac{\gamma}{1-\gamma}\Big(\frac{M}{P} - T\Big) + \frac{1}{1-\gamma}G \tag{10}$$

which is a standard expression for aggregate demand, complete with Keynesian multiplier.

Inserting (7) and (8) into the utility function and solving for labor supply, we obtain:

$$L^S = \Big(\frac{\mu}{\beta}\frac{W}{P}\Big)^{\frac{1}{\beta-1}} \tag{11}$$

where $\mu \equiv \gamma^\gamma(1-\gamma)^{1-\gamma}$. Labor demand comes from maximizing (3) subject to (2), taking prices and the wage as given, which implies:

$$L_i^D = \Big(\alpha\frac{W}{P_i}\Big)^{\frac{\alpha}{1-\alpha}} \tag{12}$$

In symmetric equilibrium, $P_i = P\,\forall i$. Thus,

$$L^D = N\Big(\alpha\frac{W}{P}\Big)^{\frac{\alpha}{1-\alpha}}. \tag{13}$$

From equations (12) and (13), one can work out that aggregate supply is:

$$Y^S = \Big(N^{\beta(\alpha-1)}\frac{\mu}{\alpha\beta}\Big)^{\frac{1}{\alpha\beta-1}}, \tag{14}$$

a constant, which completes the solution.

Money is neutral, given flexible prices. Since taxes are lump-sum, they are nondistortionary, and changes in them do not affect output. Changes in government spending also have no real affects. All movements in aggregate demand are neutral.

2.2 Perfect Competition with Exogenously Fixed Prices

Now assume that the price level is fixed at some level $\hat{P}$. For simplicity, continue to assume that nominal wages are flexible. Let P^* denote the price level which satisfies the condition that aggregate demand equal aggregate supply, above. We must now distinguish between two cases:

2.2.1 $\hat{P} > P^*$

At this price level, the supply of goods derived above exceeds the demand for goods. Assume as is usual in this literature that the minimum of supply or demand is satisfied, in this case demand. Thus, goods suppliers, or firms, are rationed, and output is demand determined.

A key result from the disequilibrium literature is that rationing in one market may affect behavior in another market. In this case, the fact that firms are rationed in the goods market will affect their demand for labor in the labor market. Let $Y^D(\hat{P})$ denote the level of aggregate demand consistent with $P = \hat{P}$. Firms will never be willing to hire more labor than is required to produce $Y^D(\hat{P})$. Thus the true (or 'notional') labor demand curve is a vertical line at that level of labor, $(Y^D(\hat{P}))^\alpha$, and coincides with the competitive (or 'effective') labor demand curve for sufficiently high real wage. All other equations remain the same as in the previous case.

Since output is demand determined, fiscal and monetary policy now have real effects. We can determine the comparative static results by using (11): namely, $\frac{dY}{dM} = \frac{dY}{dT} = \frac{\gamma}{1-\gamma}$ and $\frac{dY}{dG} = \frac{1}{1-\gamma}$.

2.2.2 $\hat{P} < P^*$

At this price level, the competitive demand for goods exceeds the supply of goods. The actual quantity of goods supplied will be determined by (14).

Since the consumer is now rationed in the goods market, this in principle may alter the labor supply decision. To determine this, we remaximize (1), inserting (5), (7) and (8) and the condition that the aggregate supply equation (14) holds. Utility is still linear in I and thus in wage income, so in fact labor supply is unchanged. This is a consequence of the separability of consumption and labor supply, and is not generally true; Driscoll (1998) discusses this in greater detail.

Since output is fixed at the level implied by (14), changes in monetary policy, taxes and government spending have no effect on output. Changes in the latter two do displace consumption one-for-one, assuming that government demand is satisfied before private demand.

2.3 Monopolistic Competition:Flexible Prices

Now alter the assumptions of the model to suppose that all industries are monopolistic competitors. The consumer takes prices and wages as given, as before. Thus, its decisions are not altered by the firms' decisions. Therefore, aggregate demand, (10), remains unchanged, as does labor supply, (11).

The supply of goods and demand for labor will be determined by the firms' maximization problem. Here, the firm chooses both P_i and Y_i to maximize profits, equation (3), again subject to the constraints of the production function, equation (2). Using (7) and (9) and the fact that $Y_i = C_i + g$, one can rewrite the demand for good i as:

$$Y_i = \Big(\frac{P_i}{P}\Big)^{-\theta}\Big(\frac{Y-G}{N}\Big) + g \tag{15}$$

which may be inserted for Y_i in the maximization problem.

Profit maximization implies that, in symmetric equilibrium,:

$$1 - \frac{1}{\theta}\frac{Y_i}{Y_i - g} - \alpha\frac{W}{P}Y_i^{\alpha-1} = 0 \tag{16}$$

Using the production function and the expression for labor supply, one can solve out for the real wage. Hence the first order condition one is left with is:

$$\Big(\frac{Y_i - g}{Y_i}\Big)\Big(1 - \Big(\frac{\alpha\beta}{\mu}N^{\beta-1}\Big)Y_i^{\alpha\beta-1}\Big) = \frac{1}{\theta} \tag{17}$$

This condition, which is simply a version of marginal revenue=marginal cost, implicit defines Y_i as a function of government spending, g and constants. Although one cannot solve explicitly for the level of Y_i, one can see by inspection that changes in nominal money and taxes have no effect on output. One can also show that the level of output is below the equilibrium level. By total differentiation of (17), one can also derive that $\frac{dY}{dG} = \frac{dY_i}{dg} > 1$. This result is standard in models of imperfect competition.[6]

[6]See Mankiw (1988) for a simple demonstration of this.

2.4 Monopolisitic Competition: Endogenously Fixed Prices

Suppose the economy is initially in the equilibrium derived in the previous section. Suppose each firm incurs a cost, z, when it changes its price. Firms will not change prices unless the change in profits exceeds the menu cost. Furthermore, since price exceeded marginal cost in the initial equilibrium, given the fixed prices firms will be willing to satisfy the level of demand. Thus output is again demand-determined. Since the demand curve derived is the same as that in the disequilibrium model, (10), the comparative static results for small changes in policy are also the same as in that model. Namely, $\frac{dY}{dM} = \frac{dY}{dT} = \frac{\gamma}{1-\gamma}$ and $\frac{dY}{dG} = \frac{1}{1-\gamma}$.

If changes in policy are sufficiently large, we revert to the comparative static results of the model without nominal rigidities, since prices are adjusted rather than quantities. However, if z is large, or if the degree of monopoly power $\frac{1}{\theta}$ is small, changes in policy may be able to push demand to the point where price equals marginal cost, where output is back at the competitive level[7]. Subsequent changes in demand due to fiscal or monetary policy will therefore not be accommodated, but will simply lead to reductions in private consumption, as in the perfectly competitive model with low fixed prices. As in that model, this result depends on whether government demand is satisfied before consumer demand. However, a small degree of monopoly power means that the change in profits is likely to be large even for a small change in nominal money. Hence unless menu costs are very large, this case is unlikely ever to be observed.

2.5 Summary

The following table summarizes the comparative static results obtained for each of the models above:

[7]The lack of monopolistic behavior in the labor market is what allows this to happen in this model, but not in the original model of Blanchard and Kiyotaki (1987)

Table I: Comparative Statics

			$\frac{dY}{dM}$	$\frac{dY}{dG}$	$\frac{dY}{dT}$
Perfect Competition	Flexible Prices		0	0	0
	Fixed Prices	$P > P^*$	$\frac{\gamma}{1-\gamma}$	$\frac{1}{1-\gamma}$	$\frac{\gamma}{1-\gamma}$
		$P < P^*$	0	0	0
Monopolistic Competition	Flexible Prices		0	> 1	0
	Menu Costs	z small	$\frac{\gamma}{1-\gamma}$	$\frac{1}{1-\gamma}$	$\frac{\gamma}{1-\gamma}$
		z or θ large	0	0	0

Hence the effects of price rigidity highlighted here do not depend on the causes of price rigidity or on the structure of the goods market.

2.6 Nominal Wage Rigidity

The preceding analysis has focused on price rigidity. In static settings, New Keynesian and Disequilibrium models do not differ in their assumptions about wage rigidity: both are assumed to be exogenous [8] If we assume, as is common, that the nominal wage is fixed at a level such that the implied level of the real wage is greater than the labor-market-clearing level, there is involuntary unemployment (or underemployment) and the amount of labor hired is determined by labor demand. Note that although Disequilibrium models have often been criticized for their reliance on rationing schemes (see for example Blanchard and Fischer (1989), pp. 372-373), this is one case where rationing is also used by New Keynesian models and seems quite natural.

Because of imperfect competition, labor demand will differ between the two sets of models, implying that the slope of the aggregate supply relationship differs across the two models. Aggregate supply in the perfectly competitive case is given by:

$$Y_i^S = \left(\alpha \frac{\bar{W}}{P}\right)^{\frac{1}{1-\alpha}}, \tag{18}$$

[8] The contracting models of Fischer (1977) and Taylor (1979) look at this in a dynamic context.

and in the imperfectly competitive case implicitly by:

$$Y_i^S = \left(\alpha \frac{\bar{W}}{P}\right)^{\frac{1}{1-\alpha}} \left(\frac{1}{1 - \frac{1}{\theta}\frac{Y_i}{Y_i - g}}\right)^{-\frac{1}{1-\alpha}}. \tag{19}$$

In the inflexible price case, the aggregate supply curves are locally horizontal in both the perfectly competitive and imperfectly competitive cases, accounting for the identical nature of the results there.

3 General Equilibrium Effects

The Disequilibrium literature emphasized general equilibrium effects across markets in the presence of nominal rigidities. These effects are often ignores in New Keynesian models, even though they in principle are still present. Thus, when there is involuntary unemployment, in general the fact that consumers are rationed on the labor market may affect their demands for goods and money. One can 'cook' models so that these effects are absent; Driscoll (1998) provides necessary and sufficient conditions.

Disequilibrium models also examined interactions between more than one kind of nominal rigidity. There are four cases to be considered:

- Both the wage and the price level are above the market-clearing level. This has been called the *Keynesian unemployment* case, because it combines the case of unemployment derived above with the case of real effects of aggregated demand disturbances.

- The wage is above, but the price level is below the market-clearing level. Here, consumers are rationed on the goods market. In principle, their rationing implies that effective labor supply is different from notional. In practice, that isn't the case, for the same reason effective and actual goods demand coincided above. This is known as the 'Classical unemployment' case Since labor supply exceeds labor demand, there is unemployment, but changes in aggregate demand are neutral, since firms are not rationed and are on their Walrasian supply curve.

- The wage is below, but the price level is above the market-clearing level. This implies that the firm is constrained in both goods and

labor markets. This cannot happen in a static model, so this case is degenerate.

- Both the wage and the price level are below the market-clearing level. In this case, the consumer is rationed in the goods market, and the producer in the labor market. This is known as the *Repressed Inflation* case, since prices are 'too low'. One can show that in general, increases in aggregate demand, because they increase the degree of rationing faced by the consumer, lead to shifts inward in labor supply as the consumer takes more leisure.

New Keynesian models have not yet considered the case of multiple nominal rigidities, but the effects described above would still be present.

4 Conclusion

Comparative static results from a New Keynesian model in which there is imperfect competition and a Disequilibrium model with perfect competition are identical when prices are fixed. They differ quantitatively but not qualitatively when wages are fixed only due to the presence of imperfect competition. New Keynesian models do imply that output is below the socially optimal level; they also provide a reason why prices are likely to be above and not below, the level which clears the goods market. However, they also ignore general equilibrium effects of nominal rigidities in one market on other markets, and do not consider the case of multiple nominal rigidities.

Perhaps the best outcome for future macroeconomic research is a fusion of the two literatures: Imperfectly competitive models with menu costs which recognize the presence of general equilibrium spillovers across markets and which examine the effects of multiple nominal rigidities.

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