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Multiple Equilibria and Interfirm Macro-Externality: An Analysis of Sluggish Real Adjustment

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In an imperfectly competitive economy, a continuum of equilibria at the firm level exists under certain analytical conditions (Ng 1986). Extending the earlier analysis of a representative firm, this paper shows that even if the condition for a continuum of equilibria is not exactly satisfied, the factors of price-adjustment costs, interfirm heterogeneity, and macro-externality can cause the economy to be stuck at the quasi macroequilibria after aggregate demand experiences a contractionary shock. Although adjustment costs are small and gains from adjustment are potentially large, the adjustment tends to be sluggish due to the existence of interfirm macro-externality.

Key Words: Imperfect competition; Externality; Adjustment cost; Aggregate demand.
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1. INTRODUCTION

Macroeconomists are currently dichotomized, to a large extent, between those who believe that Keynesian economics is irrelevant and those who want to resurrect or at least to reconstruct it. In endeavors to unite Keynesian economics with monetarism and the new classical macroeconomics, Ng (1980, 1982, 1992) shows in a micro-macro analysis of the representative non-perfectly competitive firm that each of these academic camps as

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a special case is possibly applicable under certain conditions. The analysis focuses on the optimizing decision of a representative firm with interfirm interactions and repercussions via aggregate variables and suggests the possibility of a continuum of real equilibria under non-perfect competition.[1]

Given the existence of multiple or even a continuum of equilibria, according to micro-macroeconomic analysis of the *representative* firm, it may take only very small adjustment costs to cause multiple quasi macroequilibria in the real world that accounts for interfirm differences. An economy is said to be at a quasi macroequilibrium if the economy experiences a shock to aggregate demand but fails, due to the existence of small adjustment costs, to restore its general zero-economic-profit equilibrium after the shock. In this paper, we argue that, even under the conditions where there is a unique real equilibrium according to a disaggregated general equilibrium analysis, the economy may yet possess multiple or even a continuum of real quasi macroeconomic equilibria as a result of adjustment costs facing the representative firm and interfirm macroeconomic externality.

Although adjustment costs are small relative to the gain realizable if the adjustments to the profit-maximizing general equilibrium position are effected, the existence of interfirm macroeconomic externality explains the failure to pay the small adjustment costs to obtain a gain of higher order of magnitude. The expansion towards the higher general equilibrium position involves an increase in the adjusting firm's output and thus the resulting decrease in its price, which raises the demand for other firms' products through an increase in real aggregate demand even before the familiar income multiplier takes effect. In contrast, according to Shleifer and Vishny (1988), an apparently similar study, the macroeconomic externality depends on the income multiplier effect: the distribution of profits back to consumers leads to an increase in aggregate demand and hence the profits of "monopolists" with decreasing average costs.[2] Moreover, our externality result vanishes under perfect competition whereas the Shleifer-Vishny result depends on some uncertainty and only vanishes with perfect information. In addition, although our work also shares the same spirit

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[1] Ng's approach of analyzing the effects of economy-wide changes on aggregate output and the price level is credited as one that "effectively started the modern movement" in providing the imperfect-competition microfoundation of macroeconomics (see Marris 1991, p.215). Following Ng (1977, 1980, and 1982), academic interest in this area has continued later in the work of Benassy (1982), Hart (1982), Snower (1983), Solow (1986), Blanchard & Kiyotaki (1987), Dixon (1987), Mankiw (1988), Startz (1989), Ball and Romer (1990), Ng (1986, 1992), Naish (1993), Romer (1993), Anderson (1994), Dixon and Rankin (1994), and Rankin (1995).

[2] See also Bohn and Gorton (1993) on the role of nominal contracts and monetary policies to overcome the relevant coordination failure. Indeed, Cooper and John (1988) provide a survey of related literature and a general framework in terms of Nash equilibria and strategic complementarity. However, our analysis focuses more specifically on the interactions between representative firms.

with Ball and Romer (1991) in tackling the issues of coordination failure and menu cost, our paper depends upon the cost responsiveness to post-shock changes in output and price rather than conditional upon the size of aggregate demand shock as in their paper.

The paper is organized as follows. Section 2 presents the theoretical model of a continuum of equilibria and interfirm macro-externality for the representative non-perfectly competitive firm. Section 3 provides graphical presentations of the theoretical results. Section 4 presents some real-world evidence based on the cases of the United Kingdom and Japan. Section 5 concludes.

2. MODEL

In the analytical framework of a representative imperfectly-competitive firm, if the proportional changes in marginal cost caused by proportional changes in the firm's output and aggregate output entirely offsets the corresponding proportional change in marginal revenue and if marginal cost is unit elastic with respect to the general price level, a continuum of real equilibria exists whereby there is a multiplicity of possible equilibrium output levels for a given equilibrium price and the equilibrium output level is not uniquely determined.[3] Along this line, we present a two-sector model in which both a unique real equilibrium and a continuum of real equilibria could occur respectively as aggregate demand changes.

Suppose that there are two goods X and Z (their respective quantities are also denoted by the same symbols), and each of them is supplied by a given number of Cournot-Nash imperfect competitors. The utility maximization by a representative consumer with a Cobb-Douglas utility function yields the following demand functions

$$(a)\;\; p^X X = \lambda\alpha \quad ; \quad (b)\;\; p^Z Z = \beta\alpha \tag{1}$$

where p^X and p^Z are the nominal prices of X and Z, λ and β (with $\lambda+\beta = 1$) are the preference parameters associated with X and Z respectively, α is the nominal aggregate demand given by

$$\alpha = \alpha(p^X, p^Z, X, Z, M), \tag{2}$$

satisfying that $0 < \eta^{\alpha px}, \eta^{\alpha pz}, \eta^{\alpha X}, \eta^{\alpha Z}, \eta^{\alpha M} < 1$ (In general, η^{uv} is the elasticity of u with respect to v, defined as $(\partial u/\partial v)(v/u)$, where u and v are any two variables.), and M is the money supply. If we write the price level (Laspeyres price index) $P \equiv \frac{p^X X^\circ + p^Z Z^\circ}{p^{X\circ} X^\circ + p^{Z\circ} Z^\circ} = p^X X^\circ + p^Z Z^c irc$

[3] See Ng's pioneering work of mesoeconomics (1980, 1982, 1986).

(from normalization), we have (from the position $X = X^\circ, Z = Z^\circ$), $\partial P/\partial p^X = X, \partial P/\partial p^Z = Z$. Thus from $\alpha = \alpha(P, Y, M)$ (where Y is the aggregate output or real income in equilibrium), we have $\partial\alpha/\partial p^X = (\partial\alpha/\partial P)(\partial P/\partial p^X)$ and thus $\eta^{\alpha px} = S_X\eta^{\alpha P}$ and $\eta^{\alpha pz} = S_Z\eta^{\alpha P}$ where $S_X \equiv p^X X/\alpha$, $S_Z \equiv p^Z Z/\alpha$ are the shares of X and Z in the total expenditure. Similarly, with respect to $Y \equiv \frac{p^{X^\circ}X + p^{Z^\circ}Z}{p^{X^\circ}X^\circ + p^{Z^\circ}Z^\circ}$ (Laspeyres quantity index), we thus have

$$S_X\eta^{\alpha pZ} = S_Z\eta^{\alpha pX}; \quad S_X\eta^{\alpha Z} = S_Z\eta^{\alpha X} \tag{3}$$

Each firm in the X industry assumes the output of other firms as given and maximizes its profit [noting that $p^X = \lambda\alpha/X$ from Eq.(1(a))],

$$\frac{\lambda\alpha}{x_i + \sum_{j\neq i} x_j} x_i - W x_i^\theta \tag{4}$$

where x_i is the output level for firm i, W is the price of the only composite variable input and θ is a constant related to the slope of the marginal cost curve (θ is greater or less than one according to whether the marginal cost curve is upward or downward sloping). Taking firm i as the representative, we then have $\sum_{j\neq i} x_j = (N_X - 1)x_i$, where N_X is the number of firms in the X industry, which is given in our context so that the demand elasticity for X could be constant at any given level of the price as aggregate demand changes. Assuming that the no-shutdown and second-order conditions are satisfied, the first-order condition is,

$$x_i = \left[\left(\frac{\lambda\alpha}{\theta W}\right)\left(\frac{N_X - 1}{N_X^2}\right)\right]^{\frac{1}{\theta}} \tag{5}$$

Multiplying both sides by N_X produces

$$X = N_X\left[\left(\frac{\lambda\alpha}{\theta W}\right)\left(\frac{N_X - 1}{N_X^2}\right)\right]^{\frac{1}{\theta}} \tag{6}$$

Similarly, for the Z industry, we have

$$Z = N_Z\left[\left(\frac{\beta\alpha}{\phi W}\right)\left(\frac{N_X - 1}{N_X^2}\right)\right]^{\frac{1}{\phi}} \tag{7}$$

where $N_Z =$ number of firms in the Z industry, and ϕ is the counterpart of θ in the Z industry.

If we take the variable input to be labour only and denote the labour employed in the X industry by L_X and the labour in the Z industry by

L_Z, then we have $L_X = X^\theta$ and $L_Z = Z^\phi$, which is consistent with the structure of variable cost Wx_i^θ in (4). Thus, from (6) and (7) the total demand for labour L in the two-sector economy is

$$L = N_X^\theta \left[\left(\frac{\lambda\alpha}{\theta W}\right)\left(\frac{N_X - 1}{N_X^2}\right)\right] + N_Z^\phi \left[\left(\frac{\beta\alpha}{\phi W}\right)\left(\frac{N_Z - 1}{N_Z^2}\right)\right] \tag{8}$$

The expected utility of the average worker, EU, depends on the real wage-rate W/P, the probability of employment ρ, and the utility of unemployment benefit $\overline{u}$ (taken as given by unions). Through their unions, workers choose the real-wage rate, and thus labor supply implicitly, to maximize the expected utility

$$EU = \rho u\left(\frac{W}{P}\right) + (1-\rho)\overline{u} \tag{9}$$

Before the full employment, ρ can be considered as $L/\overline{L}$ where $\overline{L}$ is the total labour force. When ρ is replaced by $L/\overline{L}$ and L is substituted from (8), maximizing (9) yields

$$u'\left(\frac{W}{P}\right)\frac{W}{P} + \overline{u} = u\left(\frac{W}{P}\right) \tag{10}$$

A remarkable feature of (10) is that the real wage (hence the marginal cost curve) is independent of α (before the full employment is reached). As aggregate demand increases or decreases and the demand-for-labour function shifts rightward or leftward, the representative firm's cost curve does not shift accordingly since unions maximize their expected utility by leaving the real wage claim unchanged.[4] With labor being less than fully employed, the demand for labor actually determines the equilibrium employment level at the real wage that is targeted by the unions.

Equation (10) completes the specification of the equilibrium conditions. To derive the comparative statics, we differentiate (10) and the definition of P to have

$$\frac{dW}{W} = \frac{dP}{P} = S_X\frac{dp^X}{p^X} + S_Z\frac{dp^Z}{p^Z} \tag{11}$$

Differentiation of (2) produces

$$\frac{d\alpha}{\alpha} = \eta^{\alpha px}\frac{dp^X}{p^X} + \eta^{\alpha pz}\frac{dp^Z}{p^Z} + \eta^{\alpha X}\frac{dX}{X} + \eta^{\alpha Z}\frac{dZ}{Z} + \eta^{\alpha M}\frac{dM}{M} \tag{12}$$

[4]See McDonald & Solow (1981) and Ng (1986, Ch. 13).

Substituting $d\alpha/\alpha$ and dW/W in the differentiation expressions of (6), (7), (1a) and (1b) produces four equations written in the following matrix-vector form:

$$\begin{bmatrix} 1-\eta^{\alpha X} & -\eta^{\alpha Z} & 1-\eta^{\alpha p} & -\eta^{\alpha q} \\ -\eta^{\alpha X} & 1-\eta^{\alpha Z} & -\eta^{\alpha p} & 1-\eta^{\alpha q} \\ \theta-\eta^{\alpha X} & -\eta^{\alpha Z} & S_X-\eta^{\alpha p} & S_Z-\eta^{\alpha q} \\ \phi-\eta^{\alpha Z} & -\eta^{\alpha X} & S_X-\eta^{\alpha p} & S_Z-\eta^{\alpha q} \end{bmatrix} \begin{bmatrix} dX/X \\ dZ/Z \\ dp^X/p^X \\ dp^Z/p^Z \end{bmatrix} = \begin{bmatrix} \eta^{\alpha M} dM/M \\ \eta^{\alpha M} dM/M \\ \eta^{\alpha M} dM/M \\ \eta^{\alpha M} dM/M \end{bmatrix} \tag{13}$$

Denoting the determinant of the 4×4 coefficient matrix by Δ and solving (13) by the Cramer's rule, we get

$$\Delta \frac{dX}{dM}\frac{M}{X} = \Delta \frac{dZ}{dM}\frac{M}{Z} = 0 \tag{14}$$

Unless Δ equals zero, the equilibrium of the model is unique and money is neutral. However, if we substitute $\theta = \phi = 1$ (the necessary and sufficient condition for a constant and non-shifting marginal cost curve in the X and Z industries) into Δ, we have $\Delta = 0$, making dX/dM and dZ/dM indeterminate. The resulting case represents a continuum of real equilibria.

A natural question about the continuum of real equilibria is: once an economy is stuck at a low-output equilibrium after experiencing a negative demand shock, what explains the failure of coordination among firms in making adjustments toward the full-employment level of output? We address the issue by examining interfirm macroeconomic externality in a more general analytical setting.

Consider a demand function of homogeneity of degree zero for a representative firm's product,

$$q = \frac{\alpha}{P} h\left(\frac{p}{P}\right) \tag{15}$$

where q is the quantity demanded of a representative firm's product, p is its price, P is the average price of all firms' products in the economy, α is the nominal aggregate demand as before, and h is a function notation. Then, the associated first-order condition for profit-maximization becomes

$$p + P\frac{h\left(\frac{p}{P}\right)}{h'\left(\frac{p}{P}\right)} = c(q, P, Y) \tag{16}$$

The real profit of a representative firm i, denoted R_i, is obtained by dividing its nominal profit by the average price P,

$$R_i = \frac{1}{P}\left[p_i \frac{\alpha}{P} h\left(\frac{p_i}{P}\right) - C(q_i, P, Y)\right] \tag{17}$$

where C is the firm's total production costs.

We now examine the effect on the maximal real profit R_i of a representative firm i of an increase in the output of another representative firm j (and thus a resulting reduction in its price.) As shown in the appendix, the effect can be described by

$$\frac{\partial R_i}{\partial q_j} = \frac{1}{N}\left[\frac{1}{\eta}\left(\frac{1-\eta^{\alpha P}}{\eta} + 1 - \eta^{CP} - \eta^{\alpha Y}\right) - \eta^{CY}\right] \tag{18}$$

where N is the number of firms in the economy, η is the firm's price elasticity, η^{CP} and η^{CY} are the cost elasticity with respect to the overall price level and aggregate output, respectively, and other terms are defined as before. The sufficient condition for $\partial R_i/\partial q_j$ to be positive is that $\eta^{CP} = 1$ and $\eta^{CY} \leq 0$, which holds if cost curves respond fully to the price level but do not shift up (or down) as aggregate output increases (or decreases), that is, there are no money illusion and lags. Indeed, though $\partial R_i/\partial q_j$ is then positive, its absolute value is negligible since N is very large. Realizing that $\partial R_i/\partial q_j$ is the effect of an increase in output of one representative firm on the profit of another representative firm, we have to multiply (18) by N to get the effect of one firm's output on all the other firms' profits. Then, we have to multiply the result by another N when all the firms expand together. Therefore, for the economy as a whole, unless the big bracketed term on the RHS of (18) is extremely small, the interfirm externality is certainly not negligible since N is large.

Under non-perfect competition ($\eta > -\infty$), even abstracting from both technological and pecuniary externalities ($\eta^{CY} = 0$) and assuming no money illusion and lags ($\eta^{CP} = 1$), we could still have $\partial R_i/\partial q_j > 0$ as $1 - \eta^{\alpha P} > 0$ and $\eta^{\alpha Y} > 0$.[5] The term $(1 - \eta^{\alpha P})$ accounts for increases in the real aggregate demand when the nominal aggregate demand α increases relative to the average price P; the term $\eta^{\alpha Y}$ (the income-multiplier effect) accounts for the further increase in aggregate demand as real output increases. Since both terms work through the increase in aggregate demand in shifting the demand curve of the representative firm with no effect on its production function, it is certainly not a technological externality and is more akin to the traditional pecuniary externality. Nevertheless, it is not just a pure transfer as suggested by pecuniary externality. The increase

[5] In a perfectly competitive economy, the first term in the big bracketed term on the RHS of (18) is in fact zero since $\eta = -\infty$. Thus, under perfect competition, the RHS of (18) simplifies into $-\eta^{CY}/N$. The value of η^{CY} differs from zero for two reasons. First, there may exist technological external economies or diseconomies, which are recognized in the traditional analysis of efficiency. Secondly, a change in aggregate output may affect the costs of firms through its effect on factor prices, which, as a pecuniary externality, does not affect efficiency since it represents only a transfer (with gains offsetting losses) and is adequately taken account of by the working of a price mechanism, at least as far as efficiency is concerned. If we abstract from technological and pecuniary externalities, then no market failure arises with perfect competition.

in real profits that would otherwise materialize is not at the expense of any other economic actor. Thus the failure to realize the possible gain due to the interfirm macroeconomic externality imposes a real loss on the economy. In fact, had we not abstracted away the additional likely gain to newly employed workers, the opportunity cost of firms' non-adjusting behavior would be even larger.

The interfirm macroeconomic externality works even before the Keynesian income multiplier effect (through $\eta^{\alpha Y}$) is activated or in the absence of it. It may need some explanation about why the externality works through $1-\eta^{\alpha P}$. As a firm wants to increase its output (or to keep its output from falling in the face of decreasing aggregate demand), it will have to lower its price [hence the appearance of η in Equation (18)] except under perfect competition. With aggregate income being held constant, a reduction in P reduces nominal aggregate demand α but by less than proportionately (i.e. $\eta^{\alpha P} < 1$); hence, real aggregate demand increases, thus benefiting other firms.

3. GRAPHICAL ANALYSIS

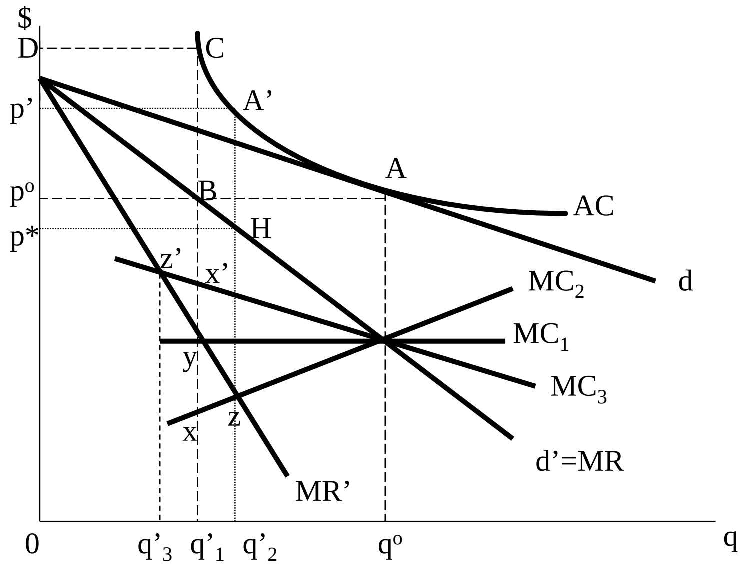
The possibility of a continuum of equilibria and the associated result of monetary non-neutrality appear to contradict some existing literature of imperfect competition suggesting that money is neutral in an imperfectly competitive economy.[6] In fact, the existing literature only shows that, for any given real equilibrium with a given stock of money supply, the equilibrium remains at another level of money supply. But money may no longer be neutral as the change in money may trigger a movement from a real equilibrium to another. The multiple equilibria here actually represent the more general characterization of imperfect competition compatible with monetary non-neutrality.

Now, for simplicity but without losing generality, let us ignore in this paper the possibility of entry and exit and any changes in the demand elasticity (at any given level of the price) as aggregate demand changes.[7] As illustrated in Figure 1, the representative firm is initially in equilibrium at point A where its marginal cost curve (MC_1) intersects its marginal revenue curve (MR). A decrease in nominal aggregate demand (by an exaggerated 50% for geometrical clarity) shifts the demand curve for the product of the representative firm, at an unchanged price level, horizontally leftward by 50% from d to d', with no change in demand elasticity at any given price level. Correspondingly, the MR curve also shifts leftward by 50%. If the

[6]See Benassy 1987, Blanchard and Kiyotaki 1987, Dixon 1987, 1990, Hart 1982, for examples.

[7]For a detailed and rigorous demonstration of the effects of firms' entry/exits and the resulting change in demand elasticity, see Ng (1982, and 1986, Ch. 4).

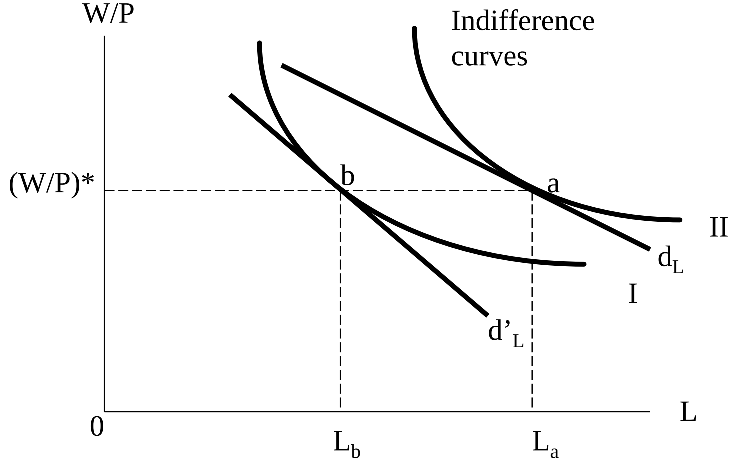
FIG. 1. A continuum of equilibria with iso-elasticity of demand



firm's marginal cost curve is horizontal (like MC_1) and does not shift as aggregate output decreases, it will intersect the new MR curve, MR', at point y dictating an unchanged profit-maximizing price. If prices remain unchanged, the demand curve d' is consistent with the new situation (a lower nominal aggregate demand at unchanged prices means also a lower real aggregate demand) and hence the new profit-maximizing point B is the new equilibrium, making q_1' the new equilibrium output. Since the change in nominal aggregate demand could be caused purely by a change in money supply, money needs not be neutral. Moreover, a whole range of output from q° to q_1' (when considering only MC_1) could be equilibria depending on the magnitude of the change in aggregate demand, its impact on the firm's cost, and the resulting interplay between the endogenous cost changes and demand changes. Here, although the multiplicity or a continuum of equilibria is associated with different levels of nominal aggregate demand, the endogenous co-adjustment of cost and demand factors to the initial demand shock holds the key for the determination of the general equilibrium status.

Factors conducive to the existence of a continuum of quasi-equilibria include union power, interfirm differences in unit costs, adjustment costs, and interfirm macro-externalities. As the output of the representative firm decreases, aggregate output and employment also decrease. Although the wage rate could possibly fall and hence the firm's cost curves shift downward until the unique real equilibrium point q° is restored at the zero-economic-profit level of output, an unchanged wage rate in real terms could well be optimal to union workers when they maximize either their wage bill (Dunlop 1944) or the expected utility with respect to their employment status by setting real-wage claims (employers choose employment levels), as shown in the previous section and illustrated in Figure 2. With the demand-for-labour curve d_L, workers choose the real wage rate $(W/P)^*$ to reach the highest indifference curve II. When the demand-for-labour curve shifts leftward proportionately to d'_L, the utility-maximizing real wage rate remains unchanged in real terms.

FIG. 2. Maximization of union workers' expected utility



The existence of the interfirm differences in cost curves can also explain economy's sluggish adjustment in response to a negative demand shock. The quasi macroequilibria occur as a result of the interplay of small adjustment costs and the equilibria's vicinity to the original zero-economic-profit equilibrium. In our model (see section 2), even if either θ or ϕ or both are not exactly equal to unity so that the general equilibrium should be unique according to the representative-firm analysis, the existence of price-adjustment costs could then still cause a continuum of equilibria as long as the parameters are sufficiently close to unity. Returning to Figure 1, even if marginal cost is horizontal for the representative firm, it is still likely that some firms have horizontal MC curves, some have upward-sloping MC curves (e.g. MC_2), and some have downward-sloping curves (e.g. MC_3). Then, ignoring possible differential shifts in the demand curves of different firms and considering the new demand curve d' with a lower aggregate demand at an unchanged price level, firms with MC_1 will reduce output to q_1' and leave prices unchanged, firms with MC_2 will increase output only to q_2' and reduce prices somewhat, and firms with MC_3 will reduce output to q_3' and increase prices. Although the average price level remains approximately unchanged, the structure of relative prices has changed. This, in general, will have some effects on the demand curve faced by each firm, leading to further readjustments. Under the circumstances, even if the general zero-economic-profit equilibrium of the system is unique (since $\theta \neq 1$ or $\phi \neq 1$), it is highly likely that the adjustment back to the general equilibrium position q°, as in Figure 1, is very slow since a change in the structure of prices with no change in the average price level has offsetting effects (although a change in the price level has a direct and one-sided effect on the demand curve of the representative firm). Thus, in the presence of interfirm differences in costs, the economy may be stuck at a low-level equilibrium even though the rigorous analytical conditions for a continuum of equilibria may not be satisfied.

Furthermore, as aggregate demand decreases, the potential profit forgone for not adjusting perceived by each firm is likely to be small and hence could be offset by the presence of small costs of adjustment;[8] thus, non-adjusting may lead to a multiplicity or continuum of quasi macroequilibria in an economy which would otherwise possess a unique equilibrium. This point is also illustrated in Figure 1. Consider a firm with MC_2. With the new demand curve d', the new profit-maximizing output level is q_2' and the new profit-maximizing price p^* is somewhat lower than the original price p°. However, if the firm does not change its price to the new profit-maximizing level and hence produce and sell only q_1' instead of q_2', the amount of profit forgone is the area surrounded by MR' and MC_2 between q_1' and q_2', i.e., the small triangle Δxyz. Similarly, the amount of profit forgone for a firm with MC_3 is the small triangle, $\Delta x'yz'$. For cases where the representative firm is a good representation of the whole economy, the MC curves of most firms are not very different from that of the representative firm, that is, MC_1. Thus, the triangular (or curvilinear-triangular) areas of perceived profit forgone are small. Moreover, these areas may be several orders of magnitude smaller than the gain realizable if adjustments to the original general zero-economic-profit equilibrium position are effected. As illustrated in Figure 1, at the original high equilibrium position q°, economic profit is zero. After the fall in aggregate demand, if firms fail to adjust due to some adjustment costs and hence are operating at the low quasi-equilibrium position B, the amount of economic loss is the area $CDp^\circ B$. Thus, this area measures the gain to the representative firm if all the other

[8]Carlton (1986) and Price (1992) find the significant effect of adjustment costs on high degree of persistence in price setting. Ball and Mankiw (1994) argue that a contraction in aggregate demand reduces output substantially due to downward rigidity of prices while an expansion in demand has a smaller effect on output.

firms adjust back to q°. For the case illustrated in Figure 1, this area is about twenty times larger than the triangular area of profit forgone that each non-adjusting firm perceives. If the adjustment cost is, say, twice as large as the triangular area, it does not pay for any single firm to adjust while all the other firms do not (cf. Cooper and John, 1988).

The presence of relatively small costs of price adjustment makes the economy stuck at a low equilibrium, therefore forgoing huge gains (even before accounting for the potential multiple gain that would stem from higher output and employment). Although the perceived small losses of not adjusting are in sharp contrast to the potential big gains from a coordinated adjustment, the representative firm has no incentive to incur adjustment cost and initiate the adjustment to benefit other firms with higher demand for their products. The graphical result above echoes the formal analysis of interfirm macroeconomic externality in the previous section.

4. EVIDENCE FOR SLUGGISH REAL ADJUSTMENT

This section provides some real world evidence for the theory of low-equilibrium trap (or a continuum of real equilibria) and interfirm macroeconomic externality. Specifically, it focuses on the cases of the United Kingdom economy before and during the Thatcher administration, i.e., from the mid-1970s to mid-1980s, and Japan's economy since the late 1980s when its financial bubbles burst.

Beginning from the mid-1970s, especially during the Thatcher government, the U.K. economy underwent a retreat from its full-employment level of output. The unemployment rate registered double-digit figures in the 1980s. Indeed, there is a high proportion of the labor force that is unionised in the U.K. The union's power was also reflected in the continued increase in the mark-up of union wages during the 1980s. As a result of the unions' bargaining strategy, the nominal wage level kept up with the overall price level in such a way that the real wage of workers was targeted at the desired level. The U.K. experience seems to suggest that the union's power in maintaining the targeted real wage resulted in a quantity adjustment in the employment level as a response to a decline of aggregate demand, which caused much of the rise in unemployment during the late 1970s and early 1980s. Its further implication, however, is that classical unemployment due to excessive wages in fact exacerbates Keynesian unemployment caused by insufficient aggregate demand. Therefore, the union power presents a scenario in which an economy could be stuck at a low-equilibrium for a long time and there is a full range of such possible real equilibria.

The case of Japan's economy provides another example for sluggish adjustment. Since its bubble burst at the late 1980s and early 1990s, what the last decade has seen in Japan was a trend of deflation associated with the liquidity trap: the key nominal interest rates have been stuck at the near-zero level since the mid 1995 but the real interest rates have been positive and relatively high due to deflation or zero inflation.[9] Why is Japan stuck in its stagnation for so long? If an imperfectly competitive economy may be characterized by the existence of a continuum of quasi-equilibria with sluggish adjustments, this may at least partly explain the Japan's situation. Of course, the real world is more complicated than our simplified model. Thus, the following brief account of the Japanese stagnation incorporates factors related to as well separate from the analysis above.

Apart from its policy mistakes, structural rigidity to a great extent accounts for Japan's sluggish readjustment toward its capacity after being hit by adverse shocks. Corporate governance in Japan is characterized by the mixture of the "main bank" and *keiretsu* systems: the "main bank" system involves close and long-standing relationships between a bank and its principal corporate clients, while the *keiretsu* system is typified by close relationships between corporations and their principal suppliers and distributors. The dual system is further cemented by pervasive cross shareholdings among banking and non-banking businesses. Such a structure of corporate governance, combined with the low cost of capital in Japan, has reduced the role of non-corporate shareholders and thus tended to weaken the pressure for the corporate sector to produce high rates of return. Substantial capital gains earned on shares during the asset-bubble period further considerably eroded the incentives of banks to discipline the corporate sector in the areas such as profitability and dividend payout. In addition, as Japan's demographic trends exhibit an increasingly aging society, the "lifetime employment system" and associated seniority-based compensation mechanism in Japan has impeded the ability of the business sector to respond flexibly to shocks such as the burst of asset bubbles, technological changes, and the pressures from globalization.

As a result of the cross-ownership, Japan's large firms commonly have around 75% of their stock locked up in the hands of the firms they do business with, and the *keiretsu* system of cross-shareholdings prevents shareholders from pushing for painful cut of the number of employees, as they, as corporate buddies, are afraid of getting the same treatment some day. Another reason why it is hard for Japan's business firms to prune staff is based on its share-ownership by banks. As large shareholders, banks fear that redundancy costs might force firms into the red and thus exacerbate the banks' bad-debt problems. The slow processes of deindustrialization and emerging knowledge-based industries in Japan witness the further evidence for sluggish adjustments. Unlike most other industrial countries, Japan has clearly lagged behind in its readjustment to the globalization of

[9] See IFS (2001).

markets through reduction of the share of manufacturing employment in favor of service-sector employment.

The cases of the U.K. economy and Japan's economy also provide insights into the role of self-fulfilling expectations in the persistence of real rigidity, the issue tackled in Ng (1992). For example, after more than a decade since the burst of its asset bubbles, Japan today remains to be trapped in its predicament, suggesting a self-fulfilling collapse in confidence. Low consumer confidence based on the observation of *de facto* continuing deflation can be self-reinforcing so that today's Japan is stuck in such a deflationary spiral. With the persistent deflationary expectations, any effort to stimulate the economy on the part of Japan's monetary authority would tend to be in vain since households and firms respond to monetary expansions by simply holding speculative balances rather than spending them.

5. CONCLUDING REMARKS

We have shown that, even when an economy would otherwise have only a unique equilibrium point, it may yet possess a continuum of quasi-macroeconomic equilibria in the presence of real-world frictions such as adjustment costs and inter-firm differences in the cost structure. This is likely to be the case if the economy has a continuum of equilibria according to an analysis of a representative firm with inter-firm differences being ignored. At a low quasi-equilibrium point, each firm sees the gain from effecting the adjustments as either non-existent (for firms which are representative) or very small (for most other firms) and thus may well not be worth incurring the adjustment costs involved. However, the presence of interfirm macroeconomic externality under imperfect competition may make the actual losses of being stuck at a low equilibrium position very large for the economy as a whole. The existence of a continuum of equilibria also sheds light on the non-neutrality of money and the relevance of changes in business and consumer confidence, since a change in either the money supply or in business confidence can trigger a change from an equilibrium point to another. Despite the unique equilibrium that would otherwise obtains, the existence of a continuum of quasi macroequilibria with adjustment costs explains why the economy can be stuck at a low quasi-equilibrium and why the adjustment back to the high equilibrium tends to be sluggish.

Economists who see the possibility of a low-level equilibrium for both short and long runs due to inadequate aggregate demand naturally have sympathy for Keynesian economics, while those who exclusively treasure the ability of the market mechanism of self-adjustment may think differently. In this long-standing debate, rather than holding a single view on an economy's ability to adjust and the resulting issue of monetary neutrality, our analysis has produced some insightful outcome that may favor one camp under some circumstances and thwart the camp under other circumstances.

APPENDIX: DERIVATION OF THE INTERFIRM MACRO-EXTERNALITY

For profit-maximization, the first-order condition (16) must apply before and after the change. Thus, totally differentiating (16), after rearranging terms and dividing through by (16), yields

$$\begin{aligned}&\left[\frac{p}{c}\left\{2-\frac{hh"}{(h')^2}\right\}-\eta\eta^{cq}\right]\frac{dp}{p}\\ &=\ \eta^{cq}\frac{d\alpha}{\alpha}+\eta^{cY}\frac{dY}{Y}-\left\{1-\eta^{cP}+\eta\eta^{cq}+\frac{p}{c}\frac{hh"}{(h')^2}\right\}\frac{dP}{P}\end{aligned}\tag{A.1}$$

From (A.1), we have,

$$\frac{q_j}{p}\frac{\partial p}{\partial q_j}=\frac{\eta^{cq}\frac{q_j}{\alpha}\frac{\partial\alpha}{\partial q_j}+\eta^{cY}\frac{q_j}{Y}\frac{\partial Y}{\partial q_j}-\left\{1-\eta^{cP}+\eta\eta^{cq}+\frac{p}{c}\frac{hh"}{(h')^2}\right\}\frac{q_j}{P}\frac{\partial P}{\partial q_j}}{\frac{p}{c}\left\{2-\frac{hh"}{(h')^2}\right\}-\eta\eta^{cq}},\tag{A.2}$$

where the subscript i associated with p, c, q, etc. has been dropped. Differentiating R_i in (17) with respect to q_j obtains,

$$\begin{aligned}\frac{\partial R}{\partial q_j}\ &=\ \frac{p-c}{P}\left(\frac{h}{P}\frac{\partial\alpha}{\partial q_j}-\frac{\alpha h}{P^2}\frac{\partial P}{\partial q_j}+\frac{\alpha h'}{P^2}\frac{\partial p}{\partial q_j}-\frac{p\alpha h'}{P^3}\frac{\partial P}{\partial q_j}\right)\\ &+\ \frac{q}{P}\frac{\partial p}{\partial q_j}-\frac{1}{P}\frac{\partial C}{\partial P}\frac{\partial P}{\partial q_j}-\frac{1}{P}\frac{\partial C}{\partial Y}\frac{\partial Y}{\partial q_j}-\frac{pq-C}{P^2}\frac{\partial P}{\partial q_j},\end{aligned}\tag{A.3}$$

where, again, all the subscripts i in the relevent variables have been dropped on the RHS.

From (15), $h=qP/\alpha$, $h'=(\partial q/\partial p)P^2/\alpha$, $h''=(\partial^2 q/\partial p^2)P^3/\alpha$, and (16) may be written as $p(1+1/h)=c$. Since Y is the aggregate output, $\partial Y/\partial q_j=1$ and since P is the average price for all the N firms, $\partial P/\partial q_j=(\partial p_j/\partial q_j)/N$, as firm j is a representative firm. Also, since both firm i and firm j are representative, p_i (or p)$=p_j=P$, and q_i (or q)$=q_j=Y/N$. Substituting all these relations and $\partial p/\partial q_j$ from (A.2) into (A.3), we have, after simplification and rearrangement,

$$\frac{\partial R}{\partial q_j}=\frac{1}{N}\left[\frac{1}{\eta}\left\{\frac{\left(1-\eta^{\alpha P}\right)}{\eta}+\frac{C}{pq}\left(1-\eta^{CP}\right)-\eta^{\alpha Y}\right\}-\frac{C}{pq}\eta^{CY}\right].\tag{A.4}$$

If we start from a position of long-run equilibrium with zero profit, $pq = C$, and (A.4) simplifies into (18) of the text; however, the use of (A.4) instead of (18) does not affect the argument in the text.

REFERENCES

Anderson, T. M., 1994, *Price Rigidity: Causes and Macroeconomic Implications.* Oxford University Press, Oxford and New York.

Ball, L. and D. Romer, 1990, Real rigidities and the non-neutrality of money. *Review of Economic Studies* **57**: 183-203.

Ball, L. and D. Romer, 1991, Sticky prices as coordination failure. *American Economic Review* **81**, 539-552.

Ball, L. and N. G. Mankiw, 1994, Asymmetric price adjustment and economic fluctuations. *Economic Journal* **104**, 247-261.

Benassy, J. P., 1982, Developments in non-Walrasian economics and in the microfoundations of macroeconomics. In *Advances in Economic Theory.* Edited by W. Hildenbrand, Cambridge University Press, Cambridge.

Benassy, J. P., 1987, Imperfect competition, unemployment, and policy. *European Economic Review* **31**, 417-426.

Blanchard, O. J., and N. Kiyotaki, 1987, Monopolistic competition and the effects of aggregate demand. *American Economic Review* **77**, 647-666.

Bohn, H. and G. Gorton, 1993, Coordination failure, multiple equilibria, and economic institutions. *Economica* **60**, 257-280.

Carlton, D. W., 1986, The rigidity of prices. *American Economic Review* **76**, 637-658.

Cooper, R., and John, A., 1988, Coordinating coordination failures in Keynesian models. *Quarterly Journal of Economics* **103**, 441-463.

Dixon, H., 1987, A simple model of imperfect competition with Walrasian features. *Oxford Economic Papers* **39**, 134-160.

Dixon, H., 1990, Imperfect competition, unemployment benefits, and non-neutrality of money: An example. *Oxford Economic Papers* **42**, 402-413.

Dixon, H. and N. Rankin, 1994, Imperfect competition and macroeconomics: A survey. *Oxford Economic Papers* **46**, 171-199.

Dunlop, J. T., 1944, *Wage Determination under Trade Unions.* Macmillan, London.

IFS (*International Financial Statistics*), 2001, International Monetary Funds, Washington, D.C.

Hart, O. D., 1982. A model of imperfect competition with Keynesian features. *Quarterly Journal of Economics* **97**, 109-38.

Mankiw, N. G., 1988, Imperfect competition and the Keynesian cross. *Economics Letters* **26**, 7-13.

Marris, R., 1991, *Reconstructing Keynesian Economics with Imperfect Competition.* Edward Elgar in association with the United Nations University, World Institute for Development Economics Research, Helsinki, Finland.

McDonald, I. M. and R. M. Solow, 1981, Wage bargaining and employment. *American Economic Review* **71**, 896-908.

Naish, H. F., 1993, Imperfect competition as a micro foundation for Keynesian macroeconomics: A graphical analysis. *Journal of Macroeconomics* **15**, 273-99.

Ng, Y. K., 1977, Aggregate demand, business expectation, and economic recovery without aggravating inflation. *Australian Economic Papers* **16**: 130-140.

Ng, Y. K., 1980, Macroeconomics with non-perfect competition. *Economic Journal* **90**, 598-610.

Ng, Y. K., 1982, A micro-macroeconomic analysis based on a representative firm. *Economica* **49**, 121-40.

Ng, Y. K., 1986, *Mesoeconomics*. Wheatsheaf, London.

Ng, Y. K., 1992, Business confidence and depression prevention: A mesoeconomic perspective. *American Economic Review* **82**, 365-371.

Price, S., 1992, Forward looking price setting in UK manufacturing. *Economic Journal* **102**: 497-505.

Rankin, N., 1995, Money in Hart's model of imperfect competition. *European Journal of Political Economy* **11**, 557-575.

Romer, D., 1993, The new Keynesian synthesis. *Journal of Economic Perspectives* **7**, 5-22.

Shleifer, A. and R. W. Vishny, 1988, The efficiency of investment in the presence of aggregate demand spillovers. *Journal of Political Economy* **96**, 1221-1231.

Snower, D., 1983, Imperfect competition, underemployment, and crowding out. *Oxford Economic Papers* **35**, 245-270.

Solow, R. M., 1986, Monopolistic competition and the multiplier. In: *Essays in Honor of Kenneth J. Arrow*, Vol. 2, Edited by W. Heller, Cambridge University Press, Cambridge.

Startz, R., 1989, Monopolistic competition as a foundation for Keynesian macroeconomic models. *Quarterly Journal of Economics* **104**, 737-752.